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QUALITY OF WATER COLORADO RIVER BASIN

PROGRESS REPORT NO. 10
JANUARY 1981

UNITED STATES
DEPARTMENT OF THE INTERIOR
Secretary

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QUALITY OF WATER

COLORADO RIVER BASIN

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DEPARTMENT OF THE INTERIOR
Cecil D. Andrus , Secretary

CONTENTS

		Page
SUMMARY		1
PART I	INTRODUCTION	5
	A. Authorization for Report	5
	B. Previous Reports	6
	C. Cooperation	6
PART II	DESCRIPTION OF BASIN	7
	A. Geology	7
	B. Soils	8
	C. Climate	8
	D. Vegetation	9
	E. Hydrology	9
PART III	HISTORY OF WATER RESOURCE DEVELOPMENT	12
	A. Irrigation Development	12
	B. Streamflow Depletions	12
	C. Legal Aspects, Water Quantity	13
	1. Colorado River Compact	13
	2. Mexican Treaty of 1944	14
	3. Upper Colorado River Basin Compact	14
	4. Arizona vs. California Suit in the Supreme Court	15
	5. Colorado River Basin Project Act	15
	D. Legal Aspects, Water Quality	16
	1. Water Ouality Act of 1965 and Related Developments	16
	2. The Federal Water Pollution Control Act Amendments of 1972	17
	3. Clean Water Act of 1977	22
	4. Relations with Mexico	24
	5. Colorado River Basin Salinity Control Act	27
PART IV	CAUSES OF SALINITY	28
	A. Increased Concentration from Salt Additions	28
	1. Natural Sources of Salinity	28
	Upper Basin	28
	Lower Basin	28
	2. Agricultural Sources of Salinity	30
	3. Municipal and Industrial Sources of Salinity	32
	B. Increased Concentration from Water Depletions	32
	1. In-basin Depletions	33
	2. Transbasin Depletions	33
PART V	EFFECTS OF SALINITY ON WATER USE	34
	A. In-stream Use	34
	B. Irrigation Use	34
	C. Industrial Use	35
	D. Domestic Use	35
	E. Economic Impacts	36
PART VI	EVALUATIONS OF EXISTING SALINITY CONDITIONS	37
	A. Quality of Water Stations	37
	1. Key Stations with Complete Records	37

CONTENTS (continued)

		Page
PART VI	EVALUATIONS OF EXISTING SALINITY CONDITIONS (continued)	
	A. Quality of Water Stations (continued)	
	2. Key Stations with Partial Records	37
	Green River near Green River, Wyoming	37
	Green River near Greendale, Utah	39
	Yampa River near Maybell, Colorado	39
	Duchesne River near Randlett, Utah	39
	White River near Watson, Utah	39
	San Rafael River near Green River, Utah	39
	Colorado River near Glenwood Springs, Colorado	39
	Dolores River near Cisco, Utah	39
	San Juan River near Archuleta, New Mexico	40
	San Juan River near Bluff, Utah	40
	Colorado River at Lees Ferry, Arizona	40
	Colorado River near Grand Canyon, Arizona	40
	Virgin River at Littlefield, Arizona	40
	Colorado River below Hoover Dam, Arizona-Nevada	40
	Colorado River below Parker Dam, Arizona-California	41
	Colorado River at Imperial Dam, Arizona-California	41
	3. Other Quality of Water Stations	41
	B. Method of Chemical Analyses	42
	C. Historic Conditions	42
	1. Total Dissolved-Solids Concentration	42
	D. Present Modified Conditions	43
PART VII	ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS	47
	A. Description of Projects	47
	1. Above Green River near Green River, Wyoming	47
	Seedskadee Project and others	47
	2. Between Green River near Green River, Wyoming and Green River near Greendale, Utah	48
	Lyman Project	48
	Utah Power & Light Co.	48
	3. Above Yampa River near Maybell, Colorado	48
	Hayden and Craig Steam Powerplants	48
	Juniper-Cross Mountain Project, Colorado	49
	4. Above Duchesne River near Randlett, Utah	49
	Central Utah Project (Bonneville Unit)	49
	Central Utah Project (Upalco Unit)	49
	Central Utah Project (Uintah Unit)	49
	Deferred Indian Lands	49
	5. Above the White River near Watson, Utah	49
	Oil Shale Prototype Development	49
	6. Between Green River near Greendale, Yampa River near Maybell, Duchesne River near Randlett, White River near Watson, and Green River at Green River, Utah	50
	Cheyenne-Laramie, Wyoming	50
	Central Utah Project (Jensen Unit)	50

CONTENTS (continued)

		Page
PART VII	ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS (continued)	
	A. Description of Projects (continued)	
	7. Above San Rafael River near Green River, Utah	50
	Utah Power & Light, Huntington, Emery County	50
	8. Above Colorado River near Glenwood Springs, Colorado	50
	Denver, Englewood, Colorado Springs, and Pueblo, Colorado	50
	Homestake Expansion Project, Colorado	50
	Windy Gap Project, Colorado	50
	9. Between Colorado River near Glenwood Springs and Colorado River near Cameo, Colorado	51
	Independence Pass	51
	Fryingpan-Arkansas Project	51
	Ruedi Reservoir, Colorado	51
	West Divide Project, Colorado	51
	10. Above Gunnison River near Grand Junction, Colorado	51
	Dallas Creek Project, Colorado	51
	11. Above the Dolores River near Cisco, Utah	51
	Dolores Project, Colorado	51
	San Miguel Project, Colorado	52
	12. Above San Juan River near Archuleta, New Mexico	52
	San Juan-Chama Project	52
	Navajo Indian Irrigation Project	52
	Jicarilla Apache	52
	13. Between San Juan River near Archuleta, New Mexico and San Juan River near Bluff, Utah	53
	Farmington Municipal and Industrial	53
	Animas-La Plata Project, Colorado-New Mexico	53
	Hogback Expansion	53
	Four Corners Powerplant	53
	Navajo M&I Contracts	53
	Return flow Dolores and Navajo Indian Irrigation Projects	53
	14. Between Green River at Green River, Utah, San Rafael River near Green River, Utah, Colorado River near Cisco, Utah, San Juan River near Bluff, Utah, and Colorado River at Lees Ferry, Arizona	54
	Navajo Powerplant	54
	Other Municipal Users in Arizona	54
	Mill Creek Project, Utah	54
	15. Above the Virgin River at Littlefield, Arizona	54
	Dixie Project, Utah	54
	Warner Valley, Utah	54

CONTENTS (continued)

Page

PART VII ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS (continued)
A. Description of Projects (continued)
16. Between the Colorado River at Lees Ferry, Arizona, Virgin River at Littlefield, Arizona, and Colorado River below Hoover Dam, Arizona-Nevada. 55
Southern Nevada Water Project. 55
Harry Allen Powerplant 56
Other Nevada projects. 56
17. Between Colorado River below Hoover Dam, Arizona-Nevada, and Colorado River at Imperial Dam, Arizona-California 57
Mohave Steamplant. 57
Fort Mohave Indian Reservation 57
Chemehuevi Indian Reservation. 58
Central Arizona Project. 58
Contracts - Boulder Canyon Project 59
Colorado River Indian Reservation 59
Lower Colorado River Channelization Project, Arizona-California. 60
18. Augmentation 60
PART VIII COLORADO RIVER SALINITY CONTROL PROGRAM 64
A. Projects Authorized for Construction 64
1. Paradox Valley Unit 64
2. Grand Valley Unit 67
3. Crystal Geyser Unit 68
4. Las Vegas Wash Unit 69
B. Projects Authorized for Planning 71
1. Irrigation Source Control Projects. 71
Lower Gunnison Basin Unit. 72
Uinta Basin Unit 74
Colorado River Indian Reservation Unit . . . 76
Palo Verde Irrigation District Unit. 76
McElmo Creek Unit. 78
2. Point Source Control Projects 79
LaVerkin Springs Unit. 80
Lower Virgin River Unit. 80
Glenwood-Dotsero Springs Unit. 80
3. Diffuse Source Control Projects 82
Big Sandy River Unit 82
Price-San Rafael Rivers Unit 83
Dirty Devil Unit 84
Meeker Dome Unit 85
C. Projection of Salinity Levels Assuming Actual Operation of Congressionally Authorized Salinity Control Units. 86

CONTENTS (continued)

		Page
PART IX	OTHER WATER QUALITY ASPECTS	89
	A. Pollution Sources Other Than Salinity	89
	1. Municipal Wastes	89
	2. Industrial Wastes	89
	3. Agricultural Wastes	89
	4. Mine Drainage	90
	B. Water Quality Parameters Other Than Salinity	90
	1. Dissolved Oxygen	90
	2. Temperature	91
	3. pH	92
	4. Heavy Metals	92
	5. Pesticides	92
	6. Nutrients	93
	7. Bacteria	94
	8. Radioactivity	95
	9. Mercury	95
	10. Sediment	96
PART X	SPECIAL STUDIES	99
	A. Flaming Gorge Reservoir	99
	B. Lake Powell	99
	C. Lake Mead	99
	D. Upper Colorado River Salinity Investigations	101
	E. Lower Colorado River Salinity Investigations	102
	F. Irrigated Areas	103
	1. Prediction of Mineral Quality of Irrigation Return Flow	103
	2. Florida Project Area Study	104
	3. Grand Valley Agricultural Research Service	104
	4. Montezuma Valley	104
	5. Other studies	104
	G. Environmental Protection Agency Report	105
	H. Model Studies	105
	1. Colorado River Storage Project Model	105
	2. Interim Water Quality Simulation Model for the Colorado River	105
	3. Colorado River Simulation System (CRSS)	106
	4. Two-Dimensional Reservoir Modeling	116
	I. Geologic Factors that Affect Salinity in the Upper Colorado River Basin	116
	J. Salt Pickup and Transport in Surface Runoff from Rangelands and Ground Water	116
	K. Saline Water Use and Disposal Opportunities Study	122
Metric Conversions		123
Definitions of Terms		125
References Cited		128

FIGURES

Number		Page
1	Quality of Water Map, Colorado River Basin	Frontispiece
2	Flow and Quality of Water Records, 1941-78	38
3	Weighted Average Dissolved-Solids Concentration, Colorado River Above and Below Lees Ferry, Arizona	44
4	Investigation and Construction Schedule, Colorado River Water Quality Improvement Program	65
5	Colorado River at Lees Ferry - Sediment and Waterflow. . . .	97
6	Combined Sediment and Waterflow, Colorado River near Cisco, Green River at Green River, Utah, and San Juan River near Bluff	98
7	Salinity Changes in Lake Powell at Wahweap Site	100
8	Block Diagram of Reach Configuration (CRSS).	109
9	Salinity Projections at Imperial Dam (CRSS).	112
10	Salinity Projections at Imperial Dam with Water Quality Improvement Projects (CRSS).	113

TABLES

		Page
A	Saline Springs and Wells, Upper Colorado River Basin	29
B	Contribution from Major Springs and Tributaries Between Glen Canyon and Hoover Dams	31
C	Projects Depleting Colorado River Water Incremental Changes in Flow and Salt Load 1978 to 2010	61
D	Summary of Historical, Present Modified and Estimated Future Water Conditions at 21 Stations, Colorado River Basin	63
E	Salinity Control Units Effects	88
F	Colorado River Simulation System Predictions Without Water Quality Improvement Projects	114
G	Colorado River Simulation System Predictions With Water Quality Improvement Projects	115
H	Estimated Values for Salt Load Contributed by Natural and Irrigation Returnflow Ground Water	119
Number		
1	Flow and Quality of Water Data, Green River Near Green River, Wyoming	131
2	Flow and Quality of Water Data, Green River Near Greendale, Utah	134
3	Flow and Quality of Water Data, Yampa River Near Maybell, Colorado	137
4	Flow and Quality of Water Data, Duchesne River Near Randlett, Utah	140
5	Flow and Quality of Water Data, White River Near Watson, Utah	143
6	Flow and Quality of Water Data, Green River at Green River, Utah	146
7	Flow and Quality of Water Data, San Rafael River Near Green River, Utah	149
8	Flow and Quality of Water Data, Colorado River Near Glenwood Springs, Colorado	152
9	Flow and Quality of Water Data, Colorado River Near Cameo, Colorado	155
10	Flow and Quality of Water Data, Gunnison River Near Grand Junction, Colorado	158
11	Flow and Quality of Water Data, Dolores River Near Cisco, Utah	161
12	Flow and Quality of Water Data, Colorado River Near Cisco, Utah	164
13	Flow and Quality of Water Data, San Juan River Near Archuleta, New Mexico	167
14	Flow and Quality of Water Data, San Juan River Near Bluff, Utah	170
15	Flow and Quality of Water Data, Colorado River at Lees Ferry, Arizona	173
16	Flow and Quality of Water Data, Colorado River Near Grand Canyon, Arizona	176
17	Flow and Quality of Water Data, Virgin River at Littlefield, Arizona	179
18	Flow and Quality of Water Data, Colorado River Below Hoover Dam, Arizona-Nevada	182
19	Flow and Quality of Water Data, Colorado River Below Parker Dam, Arizona-California	185
20	Flow and Quality of Water Data, Colorado River at Imperial Dam, Arizona-California	188

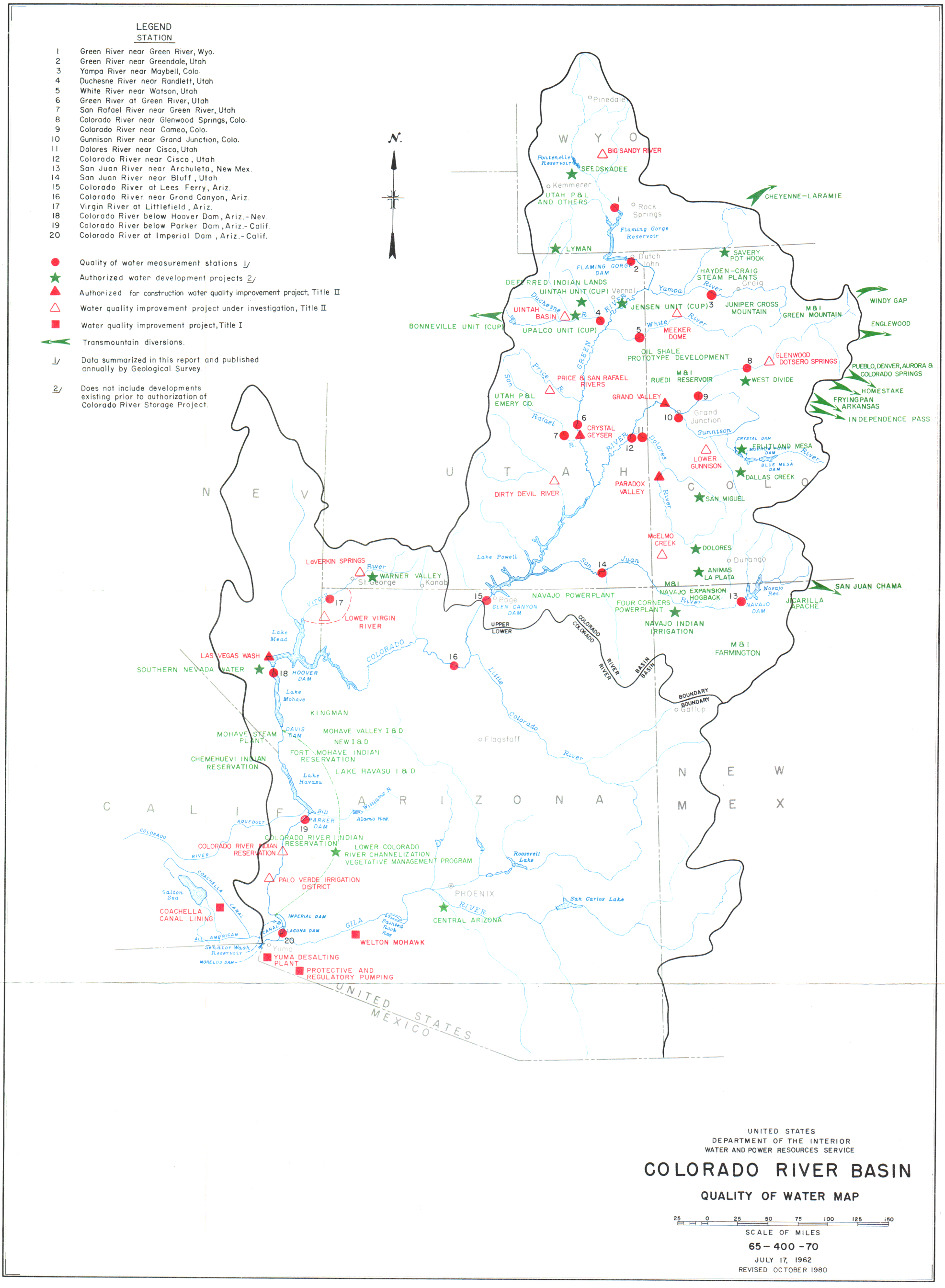

LEGEND
STATION
1 Green River near Green River, Wyo.
2 Green River near Greendale, Utah
3 Yampa River near Maybell, Colo.
4 Duchesne River near Randlett, Utah
5 White River near Watson, Utah
6 Green River at Green River, Utah
7 San Rafael River near Green River, Utah
8 Colorado River near Glenwood Springs, Colo.
9 Colorado River near Cameo, Colo.
10 Gunnison River near Grand Junction, Colo.
11 Dolores River near Cisco, Utah
12 Colorado River near Cisco, Utah
13 San Juan River near Archuleta, New Mex.
14 San Juan River near Bluff, Utah
15 Colorado River at Lees Ferry, Ariz.
16 Colorado River near Grand Canyon, Ariz.
17 Virgin River at Littlefield, Ariz.
18 Colorado River below Hoover Dam, Ariz.-Nev.
19 Colorado River below Parker Dam, Ariz.-Calif.
20 Colorado River at Imperial Dam, Ariz.-Calif.
Quality of water measurement stations 1/
Authorized water development projects 2/
Authorized for construction water quality improvement project, Title II
Water quality improvement project under investigation, Title II
Water quality improvement project, Title I
Transmountain diversions.
1/ Data summarized in this report and published annually by Geological Survey.
2/ Does not include developments existing prior to authorization of Colorado River Storage Project.
N.
W Y O
U T A H
C O L O
N E V
C A L I F
A R I Z O N A
N E W M E X
UNITED STATES
MEXICO
Pinedale
BIG SANDY RIVER
Fontenelle Reservoir
SEEDSKADEE
Kemmerer
UTAH P&L AND OTHERS
Rock Springs
Flaming Gorge Reservoir
CHEYENNE-LARAMIE
LYMAN
Dutch John
FLAMING GORGE DAM
SAVERY POT HOOK
HAYDEN-CRAIG STEAM PLANTS
Craig
DEFERRED INDIAN LANDS
UINTAH UNIT (CUP)
Vernal
Yampa River
JENSEN UNIT (CUP)
JUNIPER CROSS MOUNTAIN
M&I GREEN MOUNTAIN
WINDY GAP
ENGLEWOOD
UINTAH BASIN
Duchesne R.
BONNEVILLE UNIT (CUP)
UPALCO UNIT (CUP)
White River
MEEKER DOME
OIL SHALE PROTOTYPE DEVELOPMENT
GLENWOOD DOTSERO SPRINGS
PUEBLO, DENVER, AURORA & COLORADO SPRINGS
PRICE & SAN RAFAEL RIVERS
Price R.
San Rafael R.
M&I RUEDI RESERVOIR
WEST DIVIDE
HOMESTAKE
FRYINGPAN ARKANSAS
INDEPENDENCE PASS
UTAH P&L EMERY CO.
GRAND VALLEY
Grand Junction
Gunnison
CRYSTAL GEYSER
CRYSTAL DAM
FRUITLAND MESA
MORROW POINT DAM
BLUE MESA DAM
LOWER GUNNISON
DALLAS CREEK
DIRTY DEVIL RIVER
PARADOX VALLEY
Dolores River
SAN MIGUEL
McELMO CREEK
DOLORES
Durango
Lake Powell
San Juan
ANIMAS LA PLATA
LaVERKIN SPRINGS
WARNER VALLEY
St. George
Kanab
M&I NAVAJO EXPANSION HOGBACK
Navajo Res.
SAN JUAN CHAMA
Page
GLEN CANYON DAM
NAVAJO POWERPLANT
FOUR CORNERS POWERPLANT
NAVAJO DAM
JICARILLA APACHE
LOWER VIRGIN RIVER
UPPER
LOWER
COLORADO RIVER BASIN
NAVAJO INDIAN IRRIGATION
M&I FARMINGTON
Lake Mead
LAS VEGAS WASH
SOUTHERN NEVADA WATER
HOOVER DAM
Lake Mohave
KINGMAN
BOUNDARY
Gallup
MOHAVE STEAM PLANT
DAVIS DAM
MOHAVE VALLEY I&D
NEW I&D
Flagstaff
Little Colorado River
CHEMEHUEVI INDIAN RESERVATION
FORT MOHAVE INDIAN RESERVATION
LAKE HAVASU I&D
Lake Havasu
Williams R.
Alamo Res.
Bill
PARKER DAM
AQUEDUCT
COLORADO RIVER INDIAN RESERVATION
LOWER COLORADO RIVER CHANNELIZATION VEGETATIVE MANAGEMENT PROGRAM
Roosevelt Lake
PALO VERDE IRRIGATION DISTRICT
Salton Sea
COACHELLA CANAL
COACHELLA CANAL LINING
PHOENIX
San Carlos Lake
CENTRAL ARIZONA
IMPERIAL DAM
LAGUNA DAM
GILA RIVER
Painted Rock Res.
WELTON MOHAWK
ALL AMERICAN CANAL
Senator Wash Reservoir
MORELOS DAM
Yuma
YUMA DESALTING PLANT
PROTECTIVE AND REGULATORY PUMPING
UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
COLORADO RIVER BASIN
QUALITY OF WATER MAP
25 0 25 50 75 100 125 150
SCALE OF MILES
65-400-70
JULY 17, 1962
REVISED OCTOBER 1980

FIGURE 1

QUALITY OF WATER
COLORADO RIVER BASIN
PROGRESS REPORT

SUMMARY

This report prepared and updated every 2 years presents the various important water quality aspects of the Colorado River. Although several water quality parameters are discussed, the major part of the report is allotted to salinity (total dissolved solids) because it is presently the most serious quality problem on the river system. The historical, present modified, and future salinity conditions of the waters of the Colorado River down to Imperial Dam are presented in this report. The historical is represented by a tabulation of the recorded or estimated past condition at 20 quality of water stations for the 1941-78 period. Although various other studies have included different periods of records such as the 1906 to present period, this report has used the 1941-78 period because most salinity records in the basin do not extend back beyond about 1941. The present (1978) modified condition includes adjustments to the historic condition based on the assumption that all developments existing in 1978 were in operation for the full 1941-78 period. Estimated future conditions are shown for the years 1990, 2000, and 2010. They are estimated projections, including past projects, presently authorized developments, projects proposed for authorization, and other future anticipated projects.

Under historic conditions the flow weighted average concentration of dissolved solids of the Colorado River at Lees Ferry was about 560 mg/L, below Hoover Dam about 692 mg/L, below Parker Dam about 696 mg/L, and at Imperial Dam about 769 mg/L for the 1941-78 period.

Under present modified conditions (that is 1941-78 historical flows modified to reflect present depletions), the concentrations would have been about 621, 760, 788, and 878 mg/L, respectively, at the three stations.

For the data in Table D the projection of future water quality conditions was based on 1941-78 averages rather than a year-by-year study. These data were developed using the present modified method as in the past.

The Colorado River Simulation System (CRSS) was also used for future water quality projections. A description of the model is given in Part X, Special Studies, along with the projections. We feel that the model will produce better water quality forecasts due to its ability to more accurately describe the river basin and its greater degree of flexibility. We anticipate that all future progress reports will show only the CRSS results.

The CRSS flow and salinity projections in Table F and Table G, Part X, Special Studies section are considered preliminary for several reasons. The hydrologic data base for the computer model was not completed beyond 1974. It was intended to use a data base from 1906 to 1978. Also, time did not allow thorough checking of the projections against the input data to insure proper operation of the model. The projections found in Table D based on annual averages remain our best estimate at this time.

Projections made using CRSS will differ from those previously made in three significant ways:

1. The model dynamically routes water and salt through the system using a monthly time step, more accurately reflecting the time lags, changes in reservoir storage, and related buffering of salinity as it travels through the system. Previous techniques applied projected annual changes in depletion and salt loading to a water and salt load accounting which assumed that the system was at a steady state of average conditions for that point in time.

2. The data base used in CRSS utilizes the period beginning in 1906, while previous analyses of future salinity have been based upon the period beginning in 1941. This change places the analyses of salinity in the same context as water supply analyses conducted by the Department of the Interior.

Traditionally, there has been some disagreement regarding the use of water supply records from the first quarter of this century to determine firm water supply. During hearings on the Colorado River Basin Project Act (Public Law 90-537) in the middle 1960's, experts testified that, although the river has exhibited a long-term annual flow of 15 million acre-feet, the safe usable volume needs to be based upon a lesser runoff to reflect the impact of drought periods. Therefore, the water supply studies prepared by the Department of the Interior;

a. utilize a combination of stream flow and reservoir storage releases which reflect the most adverse period of record which occurred in the 1928 to 1964 time frame to determine firm water supply for consumptive use purposes and

b. utilize the long-term hydrologic record beginning in 1906 to determine power production and in the future to analyze salinity impacts.

3. Rather than a single projection of mean salinity at future points in time, the results of a set of historical hydrologic events provide an idea of the range of salinity that can be expected if the extremes of history are reflected in the future. The resulting probability projections of expected salinity levels identify the most probable future salinity levels and provide a view of the impacts of drought and flood events on the salinity of the Colorado River.

Of the three analytic differences described above, the change in the assumptions regarding the period of record used for analyses has the most significant impact because of the larger average virgin flow that results. The average Lee Ferry virgin flows during the 1941-1978 and 1906-74 period are about 14 and 15 million acre-feet, respectively. Although the salt loading also increases marginally, the resulting additional diluting water results in significantly lower future salinity projections when the longer term hydrology is used. However, by using the longer period of record,

extremes as well as average conditions are reflected in the resulting probabilities of occurrence, thereby providing a more complete view of future salinity conditions.

It has been assumed for purposes of this study that the average annual rate of pickup of dissolved solids from newly irrigated lands would be in the range of zero to 2 tons per acre (zero to 4.5 t/ha) per year. This assumption is based upon previous detailed studies. Where comprehensive studies showed a different rate, the different figure was used. The effect of salt contributed from new lands is thus evaluated by computations of salinity concentrations using these rates. It was also assumed no increase in the rate of pickup of dissolved solids would occur for lands already under irrigation. Large industries such as powerplants were considered to have no return of salts or water, and salt load changes due to municipal and minor industries were assumed negligible.

The estimated concentrations in milligrams per liter projected for 1990, 2000, and 2010 conditions, without salinity control measures, are as follows:

	1990			2000			2010		
	Zero T/A	Two T/A	CRSS	Zero T/A	Two T/A	CRSS	Zero T/A	Two T/A	CRSS
Lees Ferry	670	690	592	703	730	656	709	736	680
Hoover Dam	831	853	697	883	913	766	898	928	805
Parker Dam	853	878	730	912	946	808	928	963	851
Imperial Dam	1021	1055	859	1093	1141	969	1112	1161	1019

Since the above figures from Table D and Table E were computed by using average values, they show only average conditions. Actual conditions will produce years of higher flow, producing better quality water, or years of lower flow producing, poorer quality water.

The depletions used in this report are for the projects, both authorized and proposed for authorization together with present developments and other proposals for developments as presently planned.

This report includes discussions of the effect of salinity on water uses and potential salinity control measures. Investigations of the potential for water quality improvement on the Colorado River were initiated by the Water and Power Resources Service (formerly the Bureau of Reclamation) in fiscal year 1972. A report, "Colorado River Water Quality Improvement Program," dated February 1972, describes potential projects for controlling the salinity of the Colorado River. A second report, "Colorado River Water Quality Improvement Program, Status Report," was published by the Water and Power Resources Service in January 1974. This report, with appropriate updating by current investigations, is the basis for the discussion of the Colorado River Salinity Control program presented in Part VIII. This evaluation of the program is made in accordance with requirements of the Colorado River Salinity Control Act, Public Law 93-320. The Final Environmental Impact Statement for the Colorado River Water Quality Improvement

Program was completed in May 1977. The final Environmental Impact Statement for the Paradox Valley Unit was filed with the Environmental Protection Agency (EPA) on March 20, 1979.

Other phases of water quality, including sources of pollution, and parameters such as dissolved oxygen, temperature, pH, heavy metals, toxic materials, nutrients, bacteria, radioactivity, mercury, and sediment, are discussed.

PART I. INTRODUCTION

A. Authorization for Report

This is the tenth progress report on Quality of Water in the Colorado River Basin. The directive for preparing this and the nine previous reports is contained in four separate public laws. Section 15 of the authorizing legislation for the Colorado River Storage Project (CRSP) and participating projects, Public Law 485, 84th Congress, Second Session, April 11, 1956, states, "The Secretary of the Interior is directed to continue studies and make a report to the Congress and to the States of the Colorado River Basin on the quality of water of the Colorado River."

A progress report to comply with Public Law 84-485 was in preparation when the authorizing legislation for the San Juan-Chama Project and the Navajo Indian Irrigation Project, Public Law 87-483 became effective on June 13, 1962. Section 15 of this act states, "The Secretary of the Interior is directed to continue his studies of the quality of water of the Colorado River system, to appraise its suitability for municipal, domestic, and industrial use and for irrigation in the various areas in the United States in which it is used or proposed to be used, to estimate the effect of additional developments involving its storage and use (whether heretofore authorized or contemplated for authorization) on the remaining water available for use in the United States, to study all possible means of improving the quality of such water and of alleviating the ill effects of water of poor quality, and to report the results of his studies and estimates to the Eighty-Seventh Congress and every 2 years thereafter."

A few weeks later Public Law 87-590, which authorized the Fryingpan-Arkansas Project, was passed with a similar section pertaining to quality of water reports. This public law, however, stipulated that January 3, 1963, would be the submission date for the initial report and that the reports should be submitted every 2 years thereafter.

Section 206 of Title II, Public Law 93-320, Colorado River Basin Salinity Control Act directs the Secretary of the Interior to submit every 2 years to the President, the Congress, and the Advisory Council, a progress report on the Colorado River salinity control program and specifies that it may be included in the Quality of Water, Colorado River Basin Biennial Report.

Nothing in this report is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Water Treaty of 1944 with the United Mexican States (Treaty Series 994; 59 Stat. 1219), the decree entered by the Supreme Court of the United States in Arizona vs. California, et al. (376 U.S. 340), the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), the CRSP Act, (70 Stat. 105; 43 U.S.C. 620), or the Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501).

B. Previous Reports

A series of nine reports starting with the 1963 edition have been prepared prior to this report. Each succeeding report updated the previous report and added changes which occurred within the 2-year interval.

In addition to including 2 more years of record, the major changes in this report from the January 1979 report are as follows: (1) transferring that part of the future estimated depletions that actually occurred during the 2 years to present depletions; (2) updating Part VIII "Colorado River Salinity Control Program" in order to report on the progress of investigations, planning, and construction of salinity control units as required under Title II Section 206 of the Colorado River Basin Salinity Control Act, Public Law 93-320; (3) updating the depletion schedule for future conditions, such as removing the Resources, Inc. - Kaiparowits Project and adding the Mill Creek Project. Fruitland Mesa and Savery-Pot Hook Projects have not been de-authorized and therefore are left on the map but were not included in the computations due to their inactive status.

C. Cooperation

This report was prepared by the Water and Power Resources Service. The Geological Survey provided most of the basic data. A continuing cooperation program between the Water and Power Resources Service and the Survey for the collection of streamflow quality data and the exchange of information has been in effect for a number of years. This cooperation provides for the collection of data at stations other than basic data stations maintained by the Geological Survey in order to obtain additional data at key points in the basin.

In the Upper Basin, data are obtained at various points along the river and in drains cooperatively with the Geological Survey and other agencies. Along the main stem below Lees Ferry, data are obtained on a regular basis at a network of stations that includes essentially all significant diversions, surface return flows, and major river stations. The Water and Power Resources Service is the lead agency of an ongoing task force for coordinating the collection of other quality data in the Lower Basin. Other members of the task force include representatives from the Geological Survey, International Boundary and Water Commission, and EPA.

PART II. DESCRIPTION OF BASIN

A. Geology

Rocks of all ages from those of the Archean age (the oldest known geological period) to the recent alluvial deposits, including igneous, sedimentary, and metamorphic types, are found in the Colorado River Basin. The high Rocky Mountains which dominate the topography of the upper regions are composed of granites, schists, gneisses, lava, and sharply folded sedimentary rocks of limestone, sandstone, and shale. Many periods of deposition, erosion, and upheaval have played a part in the present structure of these mountains.

In contrast to the folded rocks of the mountains which fringe the basin, the plateau country of southwestern Wyoming, eastern Utah, and northern Arizona is composed principally of horizontal strata of sedimentary rocks. Slow but constant elevation of the land area has allowed the Colorado River and its tributaries to cut narrow, deep canyons into the flat-topped mesas. This type of erosion reaches its culmination in the Grand Canyon where the Colorado River has cut through all of the sedimentary rocks down to the oldest Archean granites.

The Lower Basin is characterized by broad, flat valleys separated by low mountain ranges. These valleys are filled by large accumulations of alluvial deposits.

Sediment removed by constant erosion of the upper areas was deposited in Arizona, California, and Mexico and now forms the great delta of the Colorado River.

Reservoirs constructed above Lee Ferry such as Lake Powell, Flaming Gorge, Fontenelle, Navajo, Wayne N. Aspinall Unit (Blue Mesa, Morrow Point, and Crystal), together with Lake Mead downstream, have caused some major changes in stream regimen: (1) the stream channels inundated by these reservoirs are no longer subject to natural stream erosion; (2) the accumulation of sediment and water within the reservoir slows the growth and flooding of the Colorado River delta; (3) flooding has diminished in many areas; and (4) sections of sediment-laden streams have given way to clear water streams and lakes.

The salt concentration in runoff generally increases from the headwater areas downstream and occurs in relation to the geologic character of the terrain across which the Colorado River and its tributaries flow. The geologic formations that largely contribute to the salinity concentrations in natural runoff are evaporites of Paleozoic age, shale of Cretaceous age, and salt and gypsum of Tertiary age.

B. Soils

The soils of the Colorado River Basin closely resemble the geologic formations of their origin. Only in limited areas at the higher elevations has the precipitation leached the soil mass of its soluble constituents. Over most of the area both residual and transported soils are basic in reaction and supplied with carbonates with normal or mature soils exhibiting a distinct horizon of carbonate accumulation. The impress of soil-forming factors has resulted in a wide range of soil development. Soils formed in areas with low precipitation are classified in the orders Entisols and Aridisols. Those formed in areas with high precipitation are classified in orders Mollisols and Alfisols. Saline and alkali (sodic) soils occur in many parts of the basin.

The residual soils comprise the larger area and are usually shallow in depth over shale and sandstone of various ages. Many of the shales are saline but contain much gypsum as well as other chloride and sulphate salts. Some formations are high in sodium chloride and some have sodium carbonate or bicarbonate strata. Very few residual soil areas are suitable for irrigation development. A large part of the salt pickup occurs in areas where the natural runoff contacts the saline shales before entering the streams.

The alluvial materials are extremely variable and range from alluvial fans and terraces, outwash plains, to lacustrine sediments. Some areas have soils from material transported only short distances and resemble the original materials. Other areas have soils which have been transported and mixed extremely well. Most of the agricultural areas are on these well-mixed alluviums and, therefore, the soils are quite variable.

Extensive areas of Eolian deposits occur in parts of the basin, principally in southwestern Colorado. The uniformly textured soils are reddish brown in color and have no resemblance to either the underlying formations or adjacent areas. These are excellent agricultural soils, but in many areas topography makes agriculture difficult.

C. Climate

The Colorado River Basin has climatic extremes, ranging between year-round snow cover and heavy precipitation on the high peaks of the Rocky Mountains to desert conditions with very little rain in the southern part of the basin. This wide range of climate is caused by differences in altitude, latitude, and by the configuration of the high mountain ranges. The encircling mountain ranges obstruct and deflect the air masses to such an extent that storm patterns are more erratic than in most other parts of the United States. Most of the moisture for precipitation on the Upper Basin is derived from the Pacific Ocean and the Gulf of Mexico. The Pacific source predominates generally from October through April and the Gulf source during the late spring and early summer.

In the northern part of the basin most precipitation falls in the form of winter snows and spring rains. Summer storms are infrequent but are sometimes of cloudburst intensity in localized areas. In the more arid southern portion the principal rainy season is in the winter months with occasional localized cloudbursts in the summer and fall.

Extremes of temperature in the basin range from -50° F (-46° C) to 130° F (54° C). The northern portion of the basin is characterized by short, warm summers and long, cold winters, and many mountain areas are blanketed by deep snow all winter. The southern portion of the basin has long, hot summers, practically continuous sunshine, and almost complete absence of freezing temperatures.

The entire basin is arid except in the extremely high altitudes of the headwaters areas. Rainfall averages as low as 2.5 inches (64 mm) in the southern end of the basin while total precipitation in the mountain tops could reach as high as 40 to 60 inches (1000 to 1500 mm) annually.

D. Vegetation

Areas of higher elevation are covered with forests of pine, fir, spruce, and silver-stemmed aspens, broken by small glades and mountain meadows. Pinon and juniper trees, interspersed with scrub oak, mountain mahogany, rabbit brush, bunch grasses, and similar plants grow in the intermediate elevations of the mesa and plateau regions. Large areas in the Upper Basin are dominated by big sagebrush related vegetation. Many of the streams are bordered by cottonwood, willows, and salt cedar. Scattered cottonwoods and chokecherries grow in the canyons with the cliff rose, the redbud, and blue columbine. A profusion of wildflowers carpets many mountain parks. At lower elevations large areas are almost completely devoid of plant life while other sections are sprinkled with desert shrubs, Joshua trees, other Yucca plants, and saguaro cacti, some of the latter giant plants reaching 40 feet (12 m) in height. Occasionally, cottonwoods or desert willows are found along desert streams with mesquite and creosote bush or catclaw and paloverde. Many river flood plains have been overrun with tamarisk or salt cedar to the extent that a large volume of water is being consumed by such vegetation.

E. Hydrology

The Colorado River begins where peaks rise more than 14,000 feet (4300 m) high in the northwest portion of Colorado's Rocky Mountain National Park, 70 miles (113 km) northwest of Denver. It meanders southwest tor 640 miles (1030 km) through the Upper Basin to Lee Ferry.

The Green River, its major tributary, rises in western Wyoming and discharges into the Colorado River in southeastern Utah - 730 river miles (1170 km) south of its origin and 220 miles (350 km) above Lee Ferry. The Green River drains 70 percent more area than the Colorado River above their junction but produces only about three-fourths as much water. The Gunnison

and the San Juan are the other principal tributaries of the Colorado River in the Upper Basin.

The flows of the San Juan River are now controlled by the Navajo Dam, the Green River by Fontenelle and Flaming Gorge Dams, and the Gunnison River by the Wayne N. Aspinall Unit Dams. Glen Canyon Dam is the only major dam on the main stem of the Colorado above Lee Ferry, but it will permit control of almost all flows leaving the Upper Basin.

The natural drainage area of the Colorado River below Lee Ferry and above Imperial Dam is about 75,100 square miles (195 000 km^2). This section of the river is now largely controlled by a series of storage and diversion dams starting with Hoover Dam and ending at Imperial Dam.

At the present time there is no significant storage on the main river or on the tributaries between Glen Canyon Dam and Lake Mead. The intervening tributary inflow is erratic but amounts to almost enough to offset the evaporation from Lake Mead.

Lake Mead provides most of the storage and regulation in the Lower Colorado River Basin with the water being stored for irrigation, municipal and industrial uses, generation of electrical power, flood control, and other beneficial uses.

Lake Mohave, the reservoir formed by Davis Dam, backs water at high stages about 67 miles (108 km) upstream to the tailrace of Hoover Powerplant. Storage in Lake Mohave is used for some reregulation of releases from Hoover Dam, for meeting treaty requirements with Mexico, and for developing power head for the production of electrical energy at Davis Powerplant.

The river flows through a natural channel for about 10 miles (16 km) below Davis Dam at which point the river enters the broad Mohave Valley 33 miles (53 km) above the upper end of Lake Havasu.

Lake Havasu backs up behind Parker Dam for about 45 miles (72 km) and covers about 25,000 acres (10 100 ha). Lake Havasu serves as a forebay from which the Metropolitan Water District of Southern California pumps water into the Colorado River Aqueduct. Havasu Lake will also serve as forebay for the Central Arizona Project pumping plants and aqueducts. Lake Havasu and Alamo Dam and Reservoir are used to control floods originating below Davis Dam and above Parker Dam.

Headgate Rock Dam, Palo Verde Diversion Dam, and Imperial Dam all serve as diversion structures with practically no storage. Imperial Dam, located some 150 miles (240 km) downstream from Parker Dam, is the major diversion structure to irrigation projects in the Imperial Valley and Yuma areas. It diverts water on the right bank to the All-American Canal which delivers water to the Yuma Project in Arizona and California and Imperial and Coachella Valleys in California. It diverts on the left bank to the Gila Gravity Main Canal.

The Senator Wash Dam, an offstream reservoir also affords regulation in the vicinity of Imperial Dam and assists in the delivery of water to Mexico. This dam and reservoir is used for pump back storage, power generation, and recreation.

The Morelos Dam is the last dam on the Colorado River. This small diversion dam diverts water for the Alamo Canal which delivers water to northern Mexico.

The flow at various points in streams in the Colorado River Basin for the 1941-78 period is given in Tables 1 through 20. The records of flow depict the characteristic wide fluctuations from month-to-month and the considerable variation from year-to-year. The storage reservoirs now level out some of the fluctuations in the reaches below the dam.

PART III. HISTORY OF WATER RESOURCE DEVELOPMENT

A. Irrigation Development

Irrigation development in the Upper Basin took place gradually from the beginning of settlement, about 1860, but was hastened by the purchase of land from the Indians in 1873. About 800,000 acres (320 000 ha) were irrigated by 1905. Between 1905 and 1920 the development of irrigated land continued at a rapid pace, and by 1920 nearly 1.4 million acres (570 000 ha) were irrigated. The development then leveled off and increase since that time has been slow. The average depletion from 1971-75 period was approximately 2.2 million acre-feet (2700 x $10^6 m^3$).

The slow growth in irrigated acreage in the Upper Basin in the last 60 years is ascribed to both physical and economic limitations on the availability of water. By 1920 most of the lower cost and more easily constructed developments were in operation, and, although some new developments have taken place since that time, they have been partially offset by other acreage going out of production.

Irrigation development began in the Lower Basin about the same time as in the Upper Basin. Development was slow because of difficult diversions from the Colorado River with its widely fluctuating flows. Development of the Gila area began in 1875 and the Palo Verde area in 1879. Construction of the Boulder Canyon Project in the 1930's and other downstream projects since that time has provided the means for a continued expansion of the irrigated area. In 1970 an additional 21,800 acres (8800 ha) were irrigated by private pumping either directly from the Colorado River or from wells in the flood plain. In 1974, there were nearly 849,000 acres (344 000 ha) in the United States irrigated from Colorado River diversions below Hoover Dam. About 25,500 acres (10 300 ha) of Lower Basin lands in Utah and 12,000 acres (4900 ha) in Nevada are also now under irrigation.

B. Streamflow Depletions

Development and utilization of the basin's water resources result in depletions of streamflows. Consumptive use of water by irrigated crops and exports to other basins produce the greatest flow depletions. Reservoir evaporation and consumptive use of water for municipal and industrial purposes also produce significant depletions.

The 1978 estimated consumptive use of water by irrigated crops and municipal and industrial users in the Upper Basin was approximately 3.3 million acre-feet (2800 x $10^6 m^3$) in 1978. Depletions related to irrigation such as evaporation from irrigation reservoirs (not CRSP reservoirs) were estimated to be about 120,000 acre-feet (150 x $10^6 m^3$) per year.

Water exported from the Upper Basin during the period 1941-70 averaged about 360,000 acre-feet (440 x $10^6 m^3$) per year. Completion of the large

projects such as the Colorado-Big Thompson, Duchesne Tunnel, Roberts Tunnel, and the more recent projects such as the San Juan-Chama, Fryingpan-Arkansas, Homestake, and partially completed Strawberry Aqueduct resulted in increased exports to about 848,000 acre-feet (1046 x $10^6 m^3$) in 1978.

Reservoir evaporation varies from year to year but the variations have little effect on average streamflow depletions. For the period of record considered, average reservoir evaporation in the Upper Basin was not large until about 1963 when the Colorado River Storage Project reservoirs started to store water. In 1975 about 653,000 acre-feet (805 x $10^6 m^3$) were evaporated from the reservoirs and about 690,000 (851 x $10^6 m^3$) in 1978. Under normal operating conditions, evaporation from the Colorado River Storage Project reservoirs plus Navajo and Fontenelle is expected to average about 568,000 acre-feet (701 x $10^6 m^3$) annually.

In the Lower Basin, water is diverted to municipal and industrial projects and to irrigation districts. These M&I projects include the Southern Nevada Water Project which diverts water from Lake Mead above Hoover Dam, and the Metropolitan Water District which diverts water from above Parker Dam and exports it to the Southern California coastal areas. Below Parker Dam water is diverted for irrigation to the Colorado River Indian Reservation and to the Palo Verde Irrigation District. At Imperial Dam the water is divided into three parts. To the east it irrigates the Gila and Yuma Projects, and on the west it flows to the Imperial and Coachella water districts through the All-American Canal, with the remaining water going to Mexico. Below the Imperial Dam, water is delivered to Mexico as required by the treaty with Mexico. There is essentially no flow below Morelos Diversion Dam except for the bypassed saline flows from the Wellton-Mohawk Drain Extension.

C. Legal Aspects, Water Quantity

1. Colorado River Compact

Water of the Colorado River was divided between the Upper and Lower Colorado River Basins by the Colorado River Compact which was signed in 1922 by a commissioner of each of the seven States of the river basin and by a representative of the United States. All States but Arizona ratified the compact prior to its effective date in 1929. The dividing point on the river between the Upper and Lower Basins is at Lee Ferry which is defined as a point 1 mile (1.2 km) below the mouth of the Paria River. (Lee Ferry is not to be confused with Lees Ferry which is the site of the gaging station just above the Paria River.) The compact apportions from the Colorado River system to each of the Upper and Lower Basins in perpetuity for exclusive beneficial consumptive use, a total of 7.5 million acre-feet (9300 x $10^6 m^3$) annually. In addition to the apportionment of 7.5 million acre-feet (9300 x $10^6 m^3$), the Lower Basin is given the right to increase its beneficial consumptive use of water from the Colorado River system by 1 million acre-feet (1000 x $10^6 m^3$) annually. The compact further provides that the States of the upper division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 million acre-feet (93 000 x $10^6 m^3$) for any period of 10 consecutive years.

One provision in the compact permits exportation of the water out of the basin as long as it is used beneficially in the seven Basin States, and another provision recognizes the obligations of the United States to the Indian Tribes. The compact prescribes the manner in which the water of the Colorado River system may be made available to Mexico under any water rights recognized by the United States.

The compact, in effect, cleared the way for legislation authorizing the construction of major projects such as Boulder Canyon Project, and it also cleared the way for compacts or agreements within the Upper and Lower Basins to further divide the water among the States.

2. Mexican Treaty of 1944

The treaty with Mexico, signed in 1944, provided for the annual guaranteed delivery by the United States of 1.5 million acre-feet (1900 x $10^6 m^3$) of Colorado River water to Mexico. This treaty does not mention water quality, and water from different sources has been used to supply the 1.5 million acre-feet (1900 x $10^6 m^3$) right. Because of this and other reasons, a problem of quality arose which had become of much concern to both countries. The quality aspects of the relationship with Mexico are covered later under "Legal Aspects, Water Quality."

3. Upper Colorado River Basin Compact

With the water allocated to the Upper Basin by the Colorado River Compact and with the 1944 Mexican Treaty signed, the Upper Basin States began negotiations which resulted in the signing of the Upper Colorado River Basin Compact in 1948. Under the terms of the compact, Arizona is permitted to use 50,000 acre-feet (60 x $10^6 m^3$) of water annually from the Upper Colorado River system, and the remaining water is apportioned to the other Upper Basin States in the following percentages.

State of Colorado	51.75 percent
State of New Mexico	11.25 percent
State of Utah	23.00 percent
State of Wyoming	14.00 percent

Congress had previously been unwilling to approve projects without assurance that a water supply would be available, so this division of water among the States permitted development to proceed and resulted primarily in the authorization of most of the Federal projects above Lee Ferry that are mentioned in this report.

Neither of the compacts specifically mentions water quality, but it has been recognized as a factor to be considered in developing projects, and water quality studies have been required by recent legislation authorizing the construction of projects in the Upper Basin.

4. Arizona vs. California Suit in the Supreme Court

The States of the Lower Basin have never agreed to a compact for the division of use of the waters of the Lower Colorado River Basin. The State of Arizona filed suit in the Supreme Court of the United States in October 1952 against the State of California and others for the determination of the rights to use the waters of the Lower Colorado River system. The Supreme Court gave its decision on June 3, 1963, and issued a decree on March 9, 1964, providing for the apportionment of the use of the waters of the main stream of the Colorado River below Lee Ferry among the States of Arizona, California, and Nevada. The States of Arizona and New Mexico were granted the exclusive use of the waters of the Gila River system in the United States. The decree did not affect the rights or priorities to the use of water in any of the other Lower Basin tributaries of the Colorado River.

The decree permitted the States of the Lower Basin to proceed with developments to use their apportionments of Colorado River water. Major new developments include the Southern Nevada Water Project in Nevada, and the Central Arizona Project in Arizona. Development of the Indian lands is expected to use all of the water allocated to them by the decree. These lands include the Colorado River Indian Reservation, Arizona-California; the Fort Mohave Indian Reservation, Arizona-California-Nevada; and the Chemehuevi Indian Reservation, California.

5. Colorado River Basin Project Act (Public Law 90-537, 90th Congress, September 30, 1968)

The major items provided in the law include the following:

a. Construction of the Central Arizona Project consisting of a system of main conduits and canals including a main canal and pumping plants (Granite Reef aqueduct and pumping plants) for diverting and carrying water from Lake Havasu to Orme Dam or suitable alternative.

b. Construction of five multiple-purpose projects in Colorado; the Animas-La Plata, Dolores, Dallas Creek, West Divide, and San Miguel; and one in Utah, the Uintah Unit of the Central Utah Project, upon completion and approval of a feasibility report to Congress.

c. Establishment of a Lower Colorado River Development Fund.

d. Development of criteria for the coordinated long-range operation of the Federal reservoirs, equalizing the storage in Lake Mead and Lake Powell.

e. Direction that the Secretary of the Interior shall conduct full and complete reconnaissance investigations for the purpose of developing a general plan to meet the future water needs of the Western United States, except that for a period of 10 years from the date of

the act, studies shall not be undertaken of any plan for the importation of water into the Colorado River Basin from any other natural river drainage basin lying outside the States of Arizona, California, Colorado, New Mexico, and those portions of Nevada, Utah, and Wyoming which are in the natural drainage basin of the Colorado River.

f. Direction to the Secretary to make reports of annual consumptive use and losses of water from the Colorado River System after each successive 5-year period beginning with the 5-year period starting on October 1, 1970.

D. Legal Aspects, Water Quality

Various water quality legislative acts have been passed by the Congress of the United States and the Legislatures of the Basin States. Discussion of four Federal acts that are of special significance to the Colorado River Basin follows:

1. Water Quality Act of 1965 and Related Developments

The Water Quality Act of 1965, Public Law 89-234, amended the Federal Water Pollution Control Act and established a Federal Water Pollution Control Administration (now the EPA), to provide grants for research and development, to increase grants for construction of sewage treatment works, to require establishment of water quality criteria, and for other purposes. Section 5 of this Act requires States to adopt water quality criteria applicable to interstate waters or portions thereof within their boundaries by June 30, 1967.

Each of the seven Basin States proceeded with actions directed toward establishment of water quality standards for interstate streams. Early in the standards setting process, it became apparent to the States that because of legal and institutional constraints combined with lack of technical knowledge of salinity control and management, it would be very difficult to establish numerical salinity standards on the Colorado River which would be workable, equitable, and enforceable. The seven Basin States subsequently developed water quality standards which did not include salinity standards.

The "Seventh Enforcement Conference in the Matter of Pollution of the Interstate Waters of the Colorado River and Its Tributaries" was held in Las Vegas (February 15-17, 1972) and Denver (April 26-27, 1972).

The conferees, (official representatives of the seven Basin States) and the EPA, unanimously adopted conclusions and recommendations pertaining to the salinity problems of the Colorado River. The conclusions and recommendations were approved by Mr. William D. Ruckelshaus, Administrator of the EPA in June 1972. The more significant conclusions were as follows:

"I. It is recommended that: A salinity policy be adopted for the Colorado River system that would have as its objective the maintenance of salinity concentrations at or below levels presently found in the lower main stem. In implementing the salinity policy objective for the Colorado River System, the salinity problem must be treated as a basinwide problem that needs to be solved to maintain Lower Basin water salinity at or below present levels while the Upper Basin continues to develop its compact-apportioned waters."

"II. The salinity control program as described by the Department of the Interior in their report entitled 'Colorado River Water Quality Improvement Program,' dated February 1972, offers the best prospect for implementing the salinity control objective adopted herein."

The conferees further suggested that the Water and Power Resources Service should have the primary responsibility for investigation, planning, and implementing the Colorado River Basin Salinity Control Program with the assistance of the Office of Saline Water and the EPA at the Federal level.

2. The Federal Water Pollution Control Act Amendments of 1972

The object of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. It declares that the national goals are to eliminate discharge of pollutants into navigable waters by 1985 with an interim goal of attaining by July 1983, water quality which provides for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the Nation's water.

The Act authorizes the EPA, after cooperation with other Federal agencies, State water pollution control agencies, interstate agencies and municipalities and industries involved, to prepare or develop comprehensive programs for preventing, reducing or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters.

Some of the more important aspects of the Act briefly explained are as follows: The Act authorizes the EPA to provide grants for research or demonstration projects and construction of treatment works to Federal agencies, states, or private organizations. It also authorizes the EPA to publish and revise from time to time, water quality criteria and to revise standards to include intrastate as well as interstate streams. The law also provided that by July 1, 1977, the best practical water pollution control technology must have been applied followed by the best available technology economically achievable by July 1, 1983. Section 402 of the Act provides for the Governmental regulation of pollutant discharges through a mandatory permit program, monitoring, inspection, and periodic reporting. Section 404 requires those dischargers of fill or dredge material into a navigable stream to obtain a permit from the Corps of Engineers.

Enactment of Public Law 92-500 introduced a new factor into the salinity problem. The legislation has been interpreted by EPA to require that numerical standards for salinity on the Colorado River be set. Consequently, in November 1973 the EPA submitted to several of the Colorado River Basin States proposed requirements and procedures for salinity control of the Colorado River system and proposed the establishment of an interstate organization to develop a salinity control plan.

The Basin States, in response to EPA's submittal of the proposed requirements, and to discuss several other questions that had been generated relative to certain sections of Public Law 92-500, met on November 8 and 9, 1973, and among other things, formed the Colorado River Basin Salinity Control Forum. A statement of position for use in discussing the proposed requirements and procedures for salinity control was adopted on November 9, 1973, and states in part:

> "The States have established a mechanism for interstate cooperation (Colorado River Basin Salinity Control Forum) and for preparation of semiannual reports on the development of numeric criteria and the adoption of such criteria by October 18, 1975."

The Forum members at the November 8-9, 1973, meeting also agreed to the request of EPA that:

> ". . .The final statement on proposed water quality standards and plan of implementation for salinity control should be consistent for all seven States of the Colorado River Basin; and opportunity should be provided for further direct discussion between representatives of the Environmental Protection Agency and the Forum before the proposed regulations are published in the Federal Register. . ."

Following the formulation of the Colorado River Basin Salinity Control Forum, meetings were held with representatives of the EPA in January, March, and April 1974 to discuss the proposed regulation on Colorado River salinity.

The EPA published a notice of proposed amendments to (40 CFR Part 120) COLORADO RIVER WATER SYSTEM, Salinity Control Policy and Standard Procedures in FR DOC 74-13683 dated June 12, 1974. After hearings in Las Vegas, Nevada, and Denver, Colorado, in August 1974, the final regulation was published on December 18, 1974, in the Federal Register. The regulation states that 40 CFR Part 120 is amended by adding Section 120.5 Colorado River System Implementation Plan, which reads as follows:

> "(a) 'Colorado River System' means that portion of the Colorado River and its tributaries within the United States of America."
>
> "(b) It shall be the policy that the flow weighted average annual salinity in the lower main stem of the Colorado River System be maintained at or below the average value found during 1972. To carry out this policy, water quality standards for

salinity and a plan of implementation for salinity control shall be developed and implemented in accordance with the principles of paragraph (c) of this section below."

"(c) The States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming are required to adopt and submit for approval to the Environmental Protection Agency on or before October 18, 1975:

(1) Adopted water quality standards for salinity including numeric criteria consistent with the policy stated above for appropriate points in the Colorado River System, and

(2) A plan to achieve compliance with these standards as expeditiously as practicable provided that:

(i) The plan shall identify State and Federal regulatory authorities and programs necessary to achieve compliance with the plan.

(ii) The salinity problem shall be treated as a basinwide problem that needs to be solved in order to maintain lower main stem salinity at or below 1972 levels while the Basin States continue to develop their compact-apportioned waters.

(iii) The goal of the plan shall be to achieve compliance with the adopted standards by July 1, 1983. The date of compliance with the adopted standards shall take into account the necessity for Federal salinity control actions set forth in the plan. Abatement measures within the control of the States shall be implemented as soon as practicable.

(iv) Salinity levels in the lower main stem may temporarily increase above the 1972 levels if control measures to offset the increases are included in the control plan. However, compliance with 1972 levels shall be a primary consideration.

(v) The feasibility of establishing an interstate institution for salinity management shall be evaluated."

"(d) The States are required to submit to the respective Environmental Protection Agency Regional Administrator, established procedures for achieving (c)(1) and (c)(2) above within 30 days of the effective date of these regulations and to submit progress reports quarterly thereafter. EPA will on a quarterly basis determine the progress being made in the development of salinity standards and the implementation plan."

The Colorado River Basin Salinity Control Forum prepared a report entitled, Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, in June of 1975. The Forum held public meetings in Las Vegas, Nevada, on August 4, 1975, and Grand Junction, Colorado, on August 7, 1975, and received written comments through August 8, 1975, on the proposal. Based on the comments received, the Forum developed a supplement including modifications to the report. This supplement is dated August 26, 1975.

Based upon the Forum's proposal and supplement thereto, each of the Colorado River Basin States held formal public hearings in accordance with their individual authority and public participation requirements of Public Law 92-500. As a result of the public hearings, the States adopted the Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975, and the Supplement thereto dated August 26, 1975. Together these documents would constitute the water quality standards as required by Section 303 of Public Law 92-500 and by the regulation promulgated in the Federal Register of December 18, 1974.

The EPA published a Notice of Availability for Public Review and Comment for the proposed Standards in the Federal Register of March 31, 1976. A 60-day period following publication was allowed for comments. The State government administrators in all seven states were notified by letter from EPA during the period November 8 to November 23 that the standards had been formally adopted.

The following is a summary of the adopted standards:

Summary

The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, in Section 303 require the adoption of water quality standards applicable to interstate waters. Pursuant to that requirement, the EPA on December 18, 1974, issued a regulation requiring the States of the Colorado River Basin to adopt water quality standards for salinity, consisting of numeric criteria and plan of implementation for salinity control. The standards were to be submitted for approval to the EPA on or before October 18, 1975.

This report, prepared by the seven-State Colorado River Basin Salinity Control Forum, presents in a single document the water quality standards for salinity submitted for adoption by each of the States in the Basin. The standards are to be reviewed at 3-year intervals and modified, if appropriate.

Consistent with the regulation, the recommended flow-weighted average annual numeric salinity criteria for three locations in the lower main stem of the Colorado River System are as follows:

	Salinity in mg/L
Below Hoover Dam	723
Below Parker Dam	747
Imperial Dam	879

The plan of implementation comprises a number of Federal and non-Federal projects and measures to maintain the flow-weighted average annual salinity in the lower main stem at or below the recommended numeric criteria through 1990, as the Basin States continue to develop their compact-apportioned waters. The principal components of the plan are as follows:

1. Prompt construction and operation of the initial four salinity control units authorized by Title II of Public Law 93-320, the Colorado River Basin Salinity Control Act.

2. Construction of the 12 other units listed in Title II of Public Law 93-320 or their equivalent after receipt of favorable planning reports.

3. The placing of effluent limitations, principally under the National Pollutant Discharge Elimination Systems (NPDES) permit program provided for in Section 402 of Public Law 92-500 on industrial discharges.

4. The reformulation of previously authorized, but unconstructed, Federal water projects to reduce the salt loading effect.

5. Use of saline water for industrial purposes whenever practical, programs by water users to cope with the river's high salinity, studies of means to minimize salinity in municipal discharges, and studies of future possible salinity control programs.

The report recognizes that many natural and man-made factors affect the river's salinity. Consequently, the actual salinity will vary above and below the recommended numeric criteria. However, under the assumptions of streamflow equivalent to the long-term average, a "moderate" rate of increase in water depletions, and full implementation of needed salinity control measures, the average salinity can be maintained at or below 1972 levels during the study period of the next 15 years.

The Federal regulations provide for temporary increases above the 1972 levels if control measures are included in the plan. Should water development projects be completed before control measures are identified or

brought on line, temporary increases above the criteria could result and these increases will be in conformance with the regulations. With completion of control projects, those now in the plan or those to be added subsequently, salinity would return to or below the criterial level.

Periodic increases above the criteria as a result of reservoir conditions or periods of below long-time average annual river flow also will be in conformance with the regulation. With satisfactory reservoir conditions and when river flows return to the long-time average annual flow or above, concentrations are expected to be at or below the criteria level.

3. Clean Water Act of 1977

Public Law 95-217, the Federal Water Pollution Control Act Amendments of 1977, (commonly referred to as the Clean Water Act) includes among other things, several significant amendments which will have a bearing upon salinity control activities in the Colorado River Basin. It assures State authority to allocate rights to quantities of water. The Administrator of the EPA, after consultation with the States, is to submit a report to Congress which analyzes the relationship between programs of the Clean Water Act and the programs by which State and Federal agencies allocate quantities of water including recommendations to improve coordination to reduce and eliminate pollution in conjunction with programs for managing water resources. The report was originally to have been submitted on or before July 1, 1978, however an extension was granted. A draft report dated August 1979 entitled "Water Quality/Water Allocation Coordination Study" has been circulated for review and comment.

The Act also includes provisions to require that Section 208 plans consider return flows from irrigated agriculture. Irrigated agriculture return flows are excluded from the "point source" definition and are not subject to National Pollutant Discharge Elimination System permits unless the individual States so desire.

A new program was established under Section 208 to provide technical and financial assistance to landowners and operators in rural areas to implement area-wide management plans. Farmers may contract with the Department of Agriculture for cost sharing assistance to reduce agricultural runoff if the measures proposed are part of the 208 "best management practices." The Federal share could be as high as 50 percent. Federal agencies may also receive funds for implementing approved 208 plans.

Section 404 was modified to exempt normal farming, silviculture, and ranching activities from dredge and fill permit regulations. Federal activities specifically authorized by Congress may be exempted from 404 permit requirements if an environmental impact statement, which has information on the effects of such discharge, is submitted to Congress before the actual discharge of dredged or fill material occurs.

Section 303(c) of the Clean Water Act requires that from time to time, but at least once each 3 years, applicable water quality standards be reviewed and revised as appropriate. Consequently, the Colorado River Basin Salinity Control Forum began reviewing the 1975 standards and plan of implementation in late 1977. Based upon their review a report entitled "1978 Revision - Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control - Colorado River System" was disseminated for public review. Public meetings were conducted in Las Vegas, Nevada, on November 14, 1978, and in Grand Junction, Colorado, on November 16, 1978. Based upon comments received, the Forum developed a supplement to the report. On December 18, 1978, the Forum approved the 1978 revision and supplement and forwarded the report to the Basin States with a recommendation for adoption as the 1978 revision to the Colorado River salinity standards. At this time six of the seven states have adopted the revision.

The 1978 revision recommends no change in the numeric salinity criteria at the three lower main stem stations. The plan of implementation has been modified to reflect developments since the 1975 report and the principal comments are as follows:

1. Prompt construction and operation of three salinity control units authorized by Section 202, Title II, of Public Law 93-320, namely the Paradox Valley, Grand Valley, and Las Vegas Wash Units. Additional planning on Las Vegas Wash will be required before construction will be undertaken.

2. Authorization and construction of the Meeker Dome Unit and 10 of the 12 units listed in Section 203 (a)(1), Title II of Public Law 93-320, or their equivalents after receipt of favorable planning reports.

3. The placing of effluent limitations on industrial and municipal discharges principally under the NPDES permit program provided for in Section 402 of the Clean Water Act of 1977. NPDES permits will be consistent with the Forum-adopted and EPA-approved "Policy for Implementation of the Colorado River Salinity Standards Through the NPDES Permit Program."

4. The reformulation of previously authorized, but unconstructed, Federal water projects to reduce the salt loading effect of return flows. This process is essentially completed.

5. Inclusion of the 208 Water Quality Management Plans. The Basin States are individually developing water quality management plans to conform to the requirements of Section 208 of the Clean Water Act. When the plans have been adopted by the states and approved by EPA, those portions of the plans dealing with salinity control will become part of this implementation plan.

The plan also contemplates the use of saline water for industrial purposes whenever practicable, programs by water users to cope with higher salinity water, improvements in irrigation systems, and management to reduce salt pickup, studies of means to minimize salinity in municipal discharges, and studies of future possible salinity control programs not now included in the plan.

4. Relations with Mexico

The average annual salinity of the water delivered to Mexico at the Northerly International Boundary (NIB) increased in 1961 from about 800 mg/L to nearly 1400 mg/L and to over 1500 mg/L in 1962. The completion of the drainage wells and subsequent pumping of 151,500 acre-feet (186 x $10^6 m^3$) of drainage water in 1961 from the Wellton-Mohawk District added over 1 million tons (900 000 t) of salt to the Colorado River. The district further increased their pumping to 213,000 acre-feet (263 x $10^6 m^3$) in 1962 and added over 1.7 million tons (1.5 x 10^6 t) of salt. If the flow in 1961 leaving Imperial Dam and arriving at the NIB had remained at the same volume as in 1960, the salinity at the NIB would have been less in 1961. Since the flow in 1961 was limited to approximately the treaty obligation, about 800,000 acre-feet (1000 x $10^6 m^3$) less than in 1960, a larger salinity was observed resulting in a water quality of nearly 1400 mg/L at the NIB. The reduced flow was the result of low runoff and the installation of structures in the Colorado River Basin in the United States that allowed retention of large volumes of water for future use. Approximately 75 percent of the rise in the salinity at the NIB was caused by Wellton-Mohawk drainage returns. The remaining 25 percent was caused by the reduction in the excess deliveries to Mexico.

The increase in salinity resulted in negotiations between the United States and Mexico. In March 1965, Minute No. 218 was signed and approved by the two Governments. Beginning on November 16, 1965, Wellton-Mohawk drainage flows were bypassed around Morelos Dam and replaced by water from other United States sources during periods of minimum flow which amounted to about 55,000 acre-feet (68 x $10^6 m^3$)per year. The minimum flow of 900 ft^3/s (25 m^3/s) at the NIB occurs during the winter months for a period not to exceed 180 days. This agreement was in effect until June 30, 1972, and reduced the average annual salinity of waters delivered to Mexico at NIB under the treaty to about 1245 mg/L.

On July 14, 1972, another agreement, Minute No. 241 was entered into. This Minute provided that the United States would increase the bypass of Wellton-Mohawk drainage, without charge against scheduled treaty deliveries to Mexico to the annual rate of 118,000 acre-feet (146 x $10^6 m^3$) and substitute equal volumes of other waters of better quality to be discharged to the Colorado River above Morelos Dam. This reduced the salinity of waters delivered to Mexico at NIB under the treaty by an estimated 100 mg/L. Minute 241, with three extensions, was in effect from July 1, 1972, through December 31, 1972.

Minute No. 242

In keeping with President Nixon's objective to find a permanent, definitive, and just solution to the salinity problem with Mexico, accord was reached on August 30, 1973, with the execution of Minute 242 of the International Boundary and Water Commission. The Minute was developed following an intensive study of the problem by former Attorney General Herbert Brownell and a federal Task Force appointed to assist him. Participation of the Basin States was sought by Mr. Brownell and representatives of the Governors (identified as the Committee of Fourteen), assisted in defining the solution. The key elements of the agreement were:

"1. Referring to the annual volume of the Colorado River waters guaranteed to Mexico under the Treaty of 1944, of 1,500,000 acre-feet (1,850,234,000 cubic meters):

"a. The United States shall adopt measures to assure that not earlier than January 1, 1974, and no later than July 1, 1974, the approximately 1,360,000 acre-feet delivered to Mexico upstream of Morelos Dam, have an annual average salinity of no more than 115 ppm ± 30 ppm United States count (121 ppm ± 30 ppm Mexican count) over the annual average salinity of Colorado River waters which arrive at Imperial Dam, with the understanding that any waters that may be delivered to Mexico under the Treaty of 1944 by means of the All-American Canal shall be considered as having been delivered upstream of Morelos Dam for the purpose of computing this salinity.

"b. The United States will continue to deliver to Mexico on the land boundary at San Luis and in the limitrophe section of the Colorado River downstream from Morelos Dam approximately 140,000 acre-feet annually with a salinity substantially the same as that of the waters customarily delivered there.

"c. Any decrease in deliveries under point 1(b) will be made up by an equal increase in deliveries under point 1(a).

"d. Any other substantial changes in the aforementioned volumes of water at the stated locations must be agreed to by the Commission.

"e. Implementation of the measures referred to in point 1(a) above is subject to the requirement in point 10 of the authorization of the necessary works.

"2. The life of Minute 241 shall be terminated upon approval of the present Minute. From September 1, 1973, until the provisions of point 1(a) become effective, the United States shall

discharge to the Colorado River downstream from Morelos Dam, volumes of drainage waters from the Wellton-Mohawk District at the annual rate of 118,000 acre-feet and substitute thereof an equal volume of other waters to be discharged to the Colorado River above Morelos Dam; and, pursuant to the decision of President Echeverria expressed in the Joint Communique of June 17, 1972, the United States shall discharge to the Colorado River downstream from Morelos Dam the drainage waters of the Wellton-Mohawk District that do not form a part of the volumes of drainage waters referred to above, with the understanding that this remaining volume will not be replaced by substitution waters. The commission shall continue to account for the drainage waters discharged below Morelos Dam as part of Article 10 of the Water Treaty of February 3, 1944.

"3. As a part of the measures referred to in point 1(a), the United States shall extend in its territory the concrete lined Wellton-Mohawk bypass drain from Morelos Dam to the Arizona-Sonora international boundary, and operate and maintain the portions of the Wellton-Mohawk bypass drain located in the United States.

"4. To complete the drain referred to in point 3, Mexico, through the Commission and at the expense of the United States, shall construct, operate and maintain an extension of the concrete-lined bypass drain from the Arizona-Sonora international boundary to the Santa Clara Slough of a capacity of 353 cubic feet per second. Mexico shall permit the United States to discharge through this drain to the Santa Clara Slough all or a portion of the Wellton-Mohawk drainage waters, the volumes of brine from such desalting operations in the United States as are carried out to implement the Resolution of this Minute, and any other volumes of brine which Mexico may agree to accept. It is understood that no radioactive material or nuclear wastes shall be discharged through this drain, and that the United States shall acquire no right to navigation, servitude or easement by reason of the existence of the drain, nor other legal rights, except as expressly provided in this point.

"5. Pending the conclusion by the Governments of the United States and Mexico of a comprehensive agreement on ground water in the border areas, each country shall limit pumping of ground waters in its territory within 5 miles of the Arizona-Sonora boundary near San Luis to 160,000 acre-feet annually.

"6. With the objective of avoiding future problems, the United States and Mexico shall consult with each other prior to undertaking any new development of either the surface or the ground water resources, or undertaking substantial modifications of present developments, in its own territory in the border area that might adversely affect the other country.

"7. The United States will support efforts by Mexico to obtain appropriate financing on favorable terms for the improvement and rehabilitation of Mexicali Valley. The United States will also provide nonreimbursable assistance on a basis mutually acceptable to both countries exclusively for those aspects of the Mexican rehabilitation program of the Mexicali Valley relating to the salinity problem, including tile drainage. In order to comply with the above-mentioned purposes, both countries will undertake negotiations as soon as possible.

"8. The United States and Mexico shall recognize the undertakings and understandings contained in this Resolution as constituting the permanent and definitive solution of the salinity problem referred to in the Joint Communique of President Richard Nixon and President Luis Echeverria dated June 17, 1972.

"9. The measures required to implement this Resolution shall be undertaken and completed at the earliest practical date.

"10. This minute is subject to the express approval of both Governments by exchange of Notes. It shall enter into force upon such approval; Provided, however, That the provisions which are dependent for their implementation on the construction of works or on other measures which require expenditure of funds by the United States, shall become effective upon the notification by the United States to Mexico of the authorization by the United States Congress of said funds, which will be sought promptly."

The passage of the Colorado River Basin Salinity Control Act, Public Law 93-320, on June 24, 1974, authorized construction of the Yuma desalting plant and other works necessary for the United States to comply with the provisions of Minute 242.

5. Colorado River Basin Salinity Control Act

On June 24, 1974, Public Law 93-320 was signed by the President. This Act is cited as the "Colorado River Basin Salinity Control Act." The act is divided into Title I, which includes features to comply with the United States obligations to Mexico under Minute 242 of the International Boundary and Water Commission, and Title II, which authorizes construction and planning of salinity control features and the goal of maintaining lower main stem salinity concentrations at or below 1972 level. Features authorized for construction under Title I include a 100 million gallon a day (4.38 m^3/s) desalting plant, a brine discharge canal, lining of the Coachella Canal, acreage retirement and irrigation efficiency improvement programs in the Wellton-Mohawk Irrigation District, and development of a well field along the international boundary. Title II authorizes construction of the Paradox Valley, Grand Valley, Las Vegas Wash, and Crystal Geyser salinity control units and the expedited planning of 12 other salinity control projects in the basin above Imperial Dam.

PART IV. CAUSES OF SALINITY

A. Increased Concentration from Salt Additions

1. Natural Sources of Salinity

Flow and quality records reveal that along certain reaches of the Colorado River there are large increases in the dissolved-solids load that cannot be attributed to irrigation or other man-related activity. This increase is mainly due to natural diffused sources and saline springs.

Natural diffused sources are those sources of salt contribution which occur gradually over long reaches of the river system. Salt pickup occurs over large areas of surface and underlying soils, from stream channels and banks, and is difficult to identify, measure, or control. This source contributes the largest overall share of the salts to the Colorado River. Natural point sources are mainly saline springs where the contribution of salt and water is easily identified, issuing from single or concentrated sources.

Very little information was obtained prior to irrigation, making it difficult to identify the magnitude of specific natural sources of salinity in the Colorado River Basin.

Upper Basin. Past records indicate a substantial increase in salt load in the Lake Powell area above Lees Ferry and below the Green River, Utah, Cisco, and Bluff stations. Iorns and others (1965, p. 20) presented estimates of dissolved-solids loads in this river reach based on the period 1914-57 adjusted to 1957 conditions of development.(1) Unaccounted inflow of dissolved solids in this reach amounted to about 5 percent of the load at Lees Ferry. Most of this resulted from natural diffused sources with the San Rafael and Dirty Devil areas being fairly heavy contributors.

Other areas in the Upper Basin with large amounts of natural diffused sources of salt are the Grand Valley, Uncompahgre, Lower Gunnison, and McElmo Creek areas in Colorado; Price River and Uinta Basin in Utah; and Big Sandy River and Blacks Fork area in Wyoming. Although a large amount of salt pickup in these areas is due to natural runoff, a large amount can also be attributed to irrigation in some parts of the areas.

Table A summarizes information about the contribution of water and dissolved salts by point sources, including the springs and wells in the Upper Colorado River system. Although wells are man-made and not a natural source, abandoned saline flowing wells are shown with the natural springs. The largest contributors in the Upper Basin are the Dotsero and Glenwood Springs which supply the major part of the salts from point sources.

Lower Basin. The inflow to the reach of the Colorado River between Lees Ferry and Grand Canyon has varied from a low of 18,000 acre-feet ($22 \times 10^6 m^3$) in 1949 to a high of 939,000 acre-feet ($1160 \times 10^6 m^3$) in 1941 with an average annual inflow of water for the 1941-78 period of 310,000

Table A
Saline Springs and Wells
Upper Colorado River Basin[1/]

Spring and location	Flow (cfs)	Flow (m^3/s)	Total dissolved solids concentration (tons/AF)	Total dissolved solids concentration (mg/L)	Total dissolved solids load (tons/year)	Total dissolved solids load (tonnes/year)
Castle Creek Spring near Moab, Utah	0.245	0.0069	6.0	4390	1,060	962
Onion Creek Spring near Moab, Utah	0.122	0.0035	12.4	9120	1,100	998
Cold Kendall Spring near Kendall Ranger Sta., Wyo.	1.400	0.0396	2.8	2100	2,880	2613
Ragen Spring on Muddy Creek west of Ft. Bridger, Wyo.	0.089	0.0025	12.6	9210	800	726
Dotsero Springs 1.5 mi. west of Dotsero, Colo.	17.000	0.4811	14.5	10 700	182,600	165 655
Glenwood Springs area, Glenwood Springs, Colo.	18.000	0.5094	25.5	18 900	355,000	303 912
Steamboat Springs at Steamboat Springs, Colo.	1.400	0.0396	8.4	6140	8,500	7711
Lithia Srings, Steamboat Springs, Colo.	0.022	0.0006	7.8	5770	110	100
Piceance Creek Spring, Meeker, Colo.	0.022	0.0006	6.5	4650	72	65
Trimble Hot Spring, Durango, Colo.	0.066	0.0019	4.4	3250	36	33
Pagosa Hot Spring, Pagosa, Colo.	2.300	0.0651	4.4	3240	7,300	6623
Pinkerton Hot Spring, Durango, Colo.	0.500	0.0141	5.0	3670	1,820	1651
Yellow Creek Spring, Rangely, Colo.	0.089	0.0025	12.7	9370	840	762
Ridgway Hot Spring, Ridgway, Colo.	1.000	0.0283	3.9	2850	2,550	2313
Paradise Hot Spring, Dunton, Colo.	0.111	0.0031	7.5	5490	620	562
Big Sulpher Spring, Meredith, Colo.	0.333	0.0094	3.1	2250	730	662
Arsenic Spring, Crystal Mining Camp	2.000	0.0566	2.8	2030	4,000	3629
Coal Mine Drainage, Oak Creek, Colo.	0.666	0.0188	4.7	3430	2,260	2050
South Drain Ashley Cr. Oil Field, Vernal, Utah	2.200	0.0623	3.6	2670	5,800	5262
Strawberry River Springs	0.100	0.0028	10.9	8000	785	712
Crystal Geyser, Green River, Utah	0.207	0.0059	19.0	14 000	3,000	2722
Flowing Well near Aneth, Utah	0.133	0.0038	6.2	4560	580	526
Drainage, Iles Dome Oil Field near Loyd, Colo.	2.900	0.0821	2.9	2180	6,200	5625

1/ List of springs and wells limited to those with T.D.S. concentrations in excess of 2000 mg/L.

acre-feet (380 x $10^6 m^3$). The total salt inflow in this reach varied from a low of 498,000 tons (452 000 t) in 1962 to a high of 2.022 million tons (1834 x 10^3 t) in 1941 with an average inflow of 1.073 million tons (973 000 t) per year. Springs in the lower portion of the Little Colorado River contribute about half of the measured increase in dissolved-solids discharge in the Colorado River between Lees Ferry and Grand Canyon.

Large amounts of dissolved solids are also added to the Colorado River between Grand Canyon and Hoover Dam. Some of this results from the solution of material in the bed of Lake Mead, but like the reach above Grand Canyon, most is contributed by springs and tributary inflows.

For the whole reach from Glen Canyon Dam to Hoover Dam recent studies have been made by the Geological Survey and the Water and Power Resources Service to provide information about the contribution of springs to the Colorado River.

Major springs and spring-fed tributaries which could be measured were found to contribute about 757,000 tons (687 000 t) of dissolved solids annually to the Colorado River between Glen Canyon Dam and Lake Mead. Storm runoff in small tributaries in this reach of the Colorado River contributes an unknown, but probably much smaller, load to the river. The contribution of dissolved solids by these sources of inflow between Glen Canyon and Lake Mead equals about 10 percent of the average dissolved-solids load of the Colorado River at Lees Ferry.

The average annual dissolved-solids contributions of the measured major springs, streams, and spring-fed tributaries to the Colorado River between Glen Canyon Dam and Lake Mead and to the Virgin River are summarized in Table B.

The total average annual inflow of 1.403 million tons (1270 x 10^3 t) from these sources results in an increase of about 73 mg/L in the Colorado River on the basis of an average annual flow of 10.5 million acre-feet (13 000 x $10^6 m^3$) at Hoover Dam.

2. Agricultural Sources of Salinity

Irrigation in the Colorado River basin has increased the total dissolved solids in the Colorado River. Return flows from the irrigated lands pick up salts from the soils and underlying shales and transport them to the river system. The development of future irrigation projects will further increase the salt load to the river.

Studies prior to irrigation would be helpful to determine contribution from irrigation, but they have not been made in most areas. The amount of salt from this source must therefore be estimated or determined by detailed investigations possibly with the use of simulation models.

Table B
Contribution from Major Springs and Tributaries
Between Glen Canyon and Hoover Dams

Source	Average dissolved-solids inflow in thousands of tons per year	
	Tons	Tonnes
Paria River	30	27
Little Colorado River above Blue Springs	130	118
Springs in Lower Little Colorado River	550	499
Unidentified Inflows and Springs	363	329
Subtotal	1,073	973
Bright Angel Creek	7	6
Tepeats Creek	12	11
Kanab Creek (base flow)	4	4
Havasu Creek (base flow)	24	22
Subtotal	47	43
Total inflow in Colorado River	1,120	1016
LaVerkin Springs (inflow to Virgin River)	109	99
Littlefield Springs (inflow to Virgin River)	174	158
Total inflow to Colorado and Virgin Rivers	1,403	1273

Salt balance conditions exist when the amount of dissolved solids carried off the land is equal to that amount added. Pickup of salt as used in this report represents an unbalanced condition shown by the increase of total dissolved-solids load in the return flow over the total load in the applied water. Salt pickup chargeable to irrigation would be only that additional which occurs as a result of irrigation and should not include the amount resulting from natural sources.

The small amount of data presently available gives indications of much variation in the amount of pickup from land due to irrigation. The estimated salt pickup in this report for projects without specific information is based on values of 0 and 2 tons per acre (0 and 4.5 t/ha) per year from newly irrigated land. Zero or minimum conditions occur generally after initial leaching in areas where soils are loose and contain very little salt and a salt balance of inflow and outflow has been reached. The 2 tons per acre (4.5 t/ha) value was selected as the higher end of the range for the average annual pickup over a project area. It was also assumed in this report no additional pickup would result from supplemental water applied to presently irrigated lands. On projects where detailed information on salt pickup was available through use of models or by special investigations, these more specific figures were used.

3. Municipal and Industrial Sources of Salinity

Salt loads contributed to the Colorado River system by municipal and industrial sources are generally minor, totaling about 1 percent of the basin salt load. Future increases in salt loads from these sources are expected to be small relative to the total basin salt burden and will have only a minor effect on salinity levels.

With the exception of concentrated return flows from the Las Vegas area, most municipal and industrial wastes are relatively low in total salt load in comparison with natural and agricultural sources, and complete elimination of such waste discharges would have little effect on salinity concentrations in the main river system. Since these wastes are point sources of salinity, control could be achieved if salinity levels in the waste being discharged (i.e., industrial brines) warrant such control.

The energy shortage has caused an increase of interest for construction of large energy producing industries within the Colorado River Basin. With emphasis placed on improving the water quality in the basin, these industries have been under pressure by State and Federal agencies to prevent the return of salts to the river by consuming all water diverted for use.

B. Increased Concentration from Water Depletions

Addition of salts to the river system is not the only cause of increased salinity concentrations. The depletion of water of better quality than in downstream reaches produces a concentrating effect on the waters of

the downstream reaches. This concentrating effect occurs to a greater degree when the diverted salts return to the river than when they are depleted along with the water.

1. In-basin Depletions

Consumptive use of water for irrigation within the basin is responsible for the largest depletions while municipal and industrial uses account for a lesser depletion. Evaporation from reservoir and stream surfaces also produces large depletions. Phreatophytes cause significant water losses by evapotranspiration, especially in the Lower Basin below Hoover Dam. In most cases where in-basin depletions occur, the diverted salts return to the river system, adding significantly to the increase in concentration. Only in the case of large industries such as steam powerplants are the salts depleted along with the water.

2. Transbasin Depletions

The major part of the transbasin depletions are made at higher elevations where the salinity concentrations are very low. This removal of high quality water results in the remaining flows downstream becoming more concentrated even though some salts are removed by the water delivered to another basin. Many transbasin diversions have been made for several years and an additional number will divert in the future. The largest future diversions will be by the Bonneville Unit of the Central Utah Project, the Denver-Englewood and Homestake Diversions, the San Juan-Chama Project, and the Fryingpan-Arkansas Project, all of which are presently diverting some water.

PART V. EFFECTS OF SALINITY ON WATER USE

Water quality can be a factor in limiting the use of a water supply. Different water uses require waters of different qualities, and a supply may be acceptable for some uses but unsuitable for others. Most water uses have a range of quality within which a supply may be acceptable for that use. Use of water at the low quality end of this range may impose an economic, social, and/or a political penalty on the water user in comparison to use of the water at a higher quality. The suitability of the quality of a water supply for use is thus a relative matter and must be evaluated with regard to specific uses and the social and economic aspects of such use.

An important objective of salinity investigations is to assess the suitability of Colorado River water for various beneficial uses. The following sections discuss the physical and economic effects of salinity on water uses in the Colorado River Basin.

A. In-stream Use

The major in-stream uses (uses where water is not depleted) of water in the Colorado River Basin include hydroelectric power production, propagation of fish and aquatic life, recreation (including water contact sports), and aesthetics. Within the range of salinity concentrations expected in the foreseeable future, salinity should have no significant effects on these uses.

B. Irrigation Use

The major portion of the basin water supply is consumptively used for irrigation. Any effects of water quality on this use are thus of major importance. Crops grown in the basin differ in sensitivity to a salt concentration in the soil root zone, with some crops tolerating significantly higher concentrations in the root zone than the more sensitive crops. Also, most crops require a lower salinity concentration in the root zone during the germinating and seedling stage than they do later in the growing cycle. Salinity concentrations in the root zone are affected by the salinity concentration of the irrigation water, method of irrigation, irrigation efficiency, depth and concentration of ground water, drainability and texture of the soil, weather patterns, and other factors. If, however, all other factors remain unchanged, the salinity concentration of the root zone will vary with the salinity concentration of the irrigation water. Thus an increase in the salinity concentration of the irrigation water will decrease the productivity of the salt-sensitive crops if its tolerance limit of salinity concentration in the root zone is exceeded. Because of the many factors affecting the salinity concentration in the root zone, an exact irrigation water concentration that will damage a crop cannot be determined. For economic studies to determine Lower Basin damages, a salinity level of 750 mg/L was assumed as the level at which losses begin to occur.

Damage to salt-sensitive crops can be prevented by applying additional irrigation water to flush the salts from the soil. If natural drainage or an existing drainage system is inadequate to remove the additional water, it may be necessary to install additional drains.

In the Upper Basin, salinity concentrations during the irrigation season are relatively low except in local areas. The impact of salinity on irrigation in the Upper Basin is thus minimal and will continue to be in the future.

In the Lower Basin, present peak salinity concentrations are approaching critical levels for some salt-sensitive crops, and, while suitable for irrigation of most crops, are high enough that special irrigation practices are used in some cases. Economic losses will occur as salinity levels increase throughout the basin.

C. Industrial Use

Colorado River water has not yet been widely used for industrial purposes within the basin but extensive use has been made of this water from transmountain diversions outside the basin. Since the quality of the water diverted from the Upper Basin is relatively high, only minimal pretreatment is required for most industrial uses. In the Lower Basin, the higher salinity levels in the diverted flows may require more extensive pretreatment for some types of industrial uses.

The quality of water required for industrial use varies widely and is dependent upon the purposes for which the water is utilized. Within any industrial plant, water may have several functions; however, cooling is the largest single use of industrial water supplied from the Colorado River. Future industrial uses are expected to increase tremendously with the increased requirements for energy.

D. Domestic Use

For domestic water use it is desirable to have a safe, clear, potable, aesthetically pleasing water supply which meets the recommended limits of the National Interim Primary Drinking Water Regulations of December 24, 1975, and any other Federal or State drinking water standards. High salinity levels affect the taste of drinking water and may affect the digestive system in some people. Water hardness, which may increase with increases in salinity concentrations, also requires more soap and laundry additives to achieve acceptable cleaning results. If the water becomes too hard, softening of the supply in large-scale municipal plants or in individual home units may be required. Scaling of water heaters and corrosion of pipes also accelerate with increased salinity or hardness levels.

Water quality in the Upper Basin will generally meet the Public Health Service standards with normal levels of treatment--settling, filtration, and disinfection. In some cases only disinfection is required.

In contrast to the Upper Basin, the quality of the water supply at most points in the Lower Basin does not meet the Public Health Service recommended limits of 500 mg/L for total dissolved solids. Mineralized water supplies with salinity concentrations in the range of those values observed in the Colorado River, however, are commonly accepted in the southwestern United States, with little detriment to the potability of the supply. The use of this mineralized supply imposes an increased treatment cost as hardness levels are high enough that water softening is desirable in addition to normal treatment. Another means of reducing the problem is by mixing better quality water with the saline water. This solution is limited to those areas having other supplies and is an additional cost.

E. Economic Impacts

A consortium of water resources centers in the states of Arizona, California, Colorado, and Utah cooperated in a study funded by the Office of Water Research and Technology and the Water and Power Resources Service to assess the economic damages caused by various salt concentrations to agricultural and municipal water users. This study is documented in a report, "Salinity Management Options for the Colorado River," Water Resources Planning Series Report P-78-003, June 1978.

Based upon the findings of that report, the Water and Power Resources Service has published a summary working document entitled, "Colorado River Salinity - Economic Impacts on Agricultural, Municipal, and Industrial Users." It is estimated that the annual damages to the Lower Basin water users in 1976 dollars are $343,000 for each rise of one mg/L in salinity concentration at Imperial Dam. This damage figure is approximately $450,000 in 1980 dollars. These annual damage costs per mg/L were calculated using the 1972 salinity standard of 879 mg/L (approved by EPA in 1975) and a projected full development salinity level of 1225 mg/L.

In 1976 dollars the $343,000 annual damages are divided as follows: municipal; Metropolitan Water District $187,000, Central Arizona Project $26,300, and Lower Main Stem users $27,200, the total agriculture annual damages are $102,500. Industrial damages are considered relatively small and diffult to identify. Presently industrial costs are included in the municipal.

PART VI. EVALUATIONS OF EXISTING SALINITY CONDITIONS

A. Quality of Water Stations

A primary purpose of this report is to summarize water quality conditions for the Colorado River Basin. This part summarizes chemical quality under both historical and present conditions of water resource development and utilization. Anticipated changes in future chemical quality are discussed in Part VII. Other water quality parameters are discussed in Part IX.

Evaluations of the salinity of the water in the basin are based on quality of water and streamflow records at 20 selected stations. Each station is considered to reflect flow and water quality conditions at its location. Records were generally available at each station for the time period considered by this report, 1941 to 1978. Where records were not available, missing data were estimated by correlation with other stations.

Basic data summarized in this report were primarily obtained from records of the Geological Survey developed by a continuing program for the collection of water data which is supported in part by a transfer of funds from the Water and Power Resources Service.

Locations of the 20 key stations are shown on Figure 1. Available flow and quality records for each station are shown on Figure 2. The source and method of derivation of basic data for each of the stations are briefly discussed in the following sections.

1. Key Stations with Complete Records

Records of flow and water quality are available for all of the 1941-78 period for the Green River at Green River, Utah (Station No. 6); Colorado River near Cameo, Colorado (Station No. 9); Gunnison River near Grand Junction, Colorado (Station No. 10); Colorado River near Cisco, Utah (Station No. 12). Minor extensions only were needed to fill in short periods of record for a few of these stations. The Colorado River near Glenwood Springs gage was moved from above to below the Roaring Fork at the end of the water year 1966. Subsequent records for this station were adjusted by subtracting the Roaring Fork flows. Most records were obtained from the Geological Survey publications. Current Geological Survey data may be obtained from the Geological Survey, Water Resource Division computer data storage banks in Reston, Virginia, or from the Environmental Protection Agency's STORET system. Much of the current data are provisional and subject to change. For this report Geological Survey data for October, November, and December of 1978 was unpublished.

2. Key Stations with Partial Records

Green River near Green River, Wyoming (Station No. 1). Flow records are available at this station from April 1951 and quality records from May

Colorado River Basin
Flow and Quality of Water Records
1941 – 1978

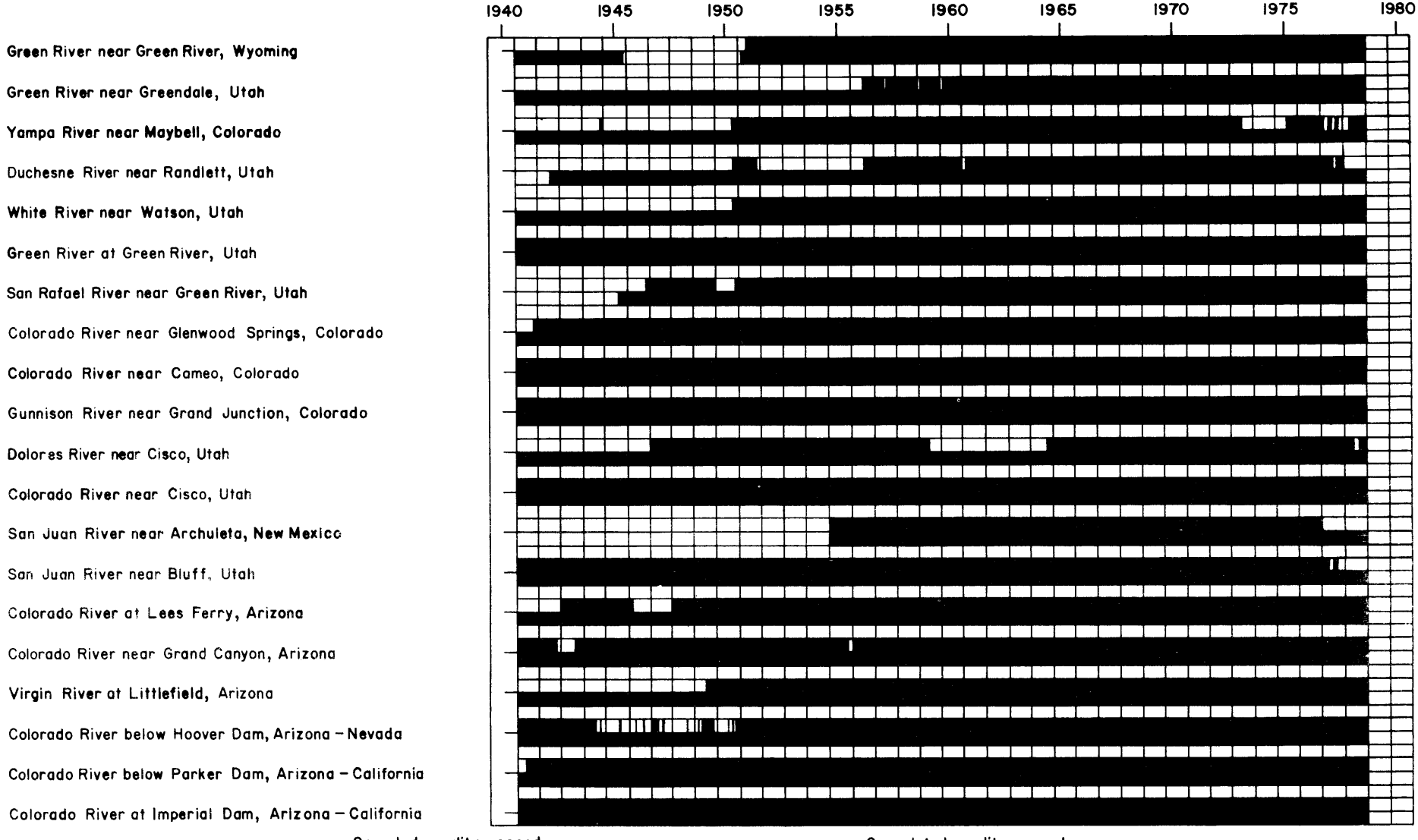


Fig. 2

1951. The records have been extended back to 1941 by correlation with nearby stations.

Green River near Greendale, Utah (Station No. 2). Flow measurements or comparable data are available for this station for the report period, but chemical quality data are available only for the years 1957 through 1978, inclusive. Extensive correlations with other available records on the Green River system were employed to develop estimates for dissolved solids.

Yampa River near Maybell, Colorado (Station No. 3). Flow measurements for this station are recorded for the entire report period, but water quality data are available only from November 1950 through August 1973 and from July 1975 to the current year. The quality data for the missing periods, prior to 1978 were estimated by correlation with flow measurements, in 1978 the missing data were correlated with the quality data from the Yampa River below Craig Colorado Station. For 1978 the quality data were estimated by correlation with quality measurements at the Yampa River below Craig, Colorado.

Duchesne River near Randlett, Utah (Station No. 4). Flow records have been obtained continuously since 1943, and quality data are available for 1951 and 1957 through 1977. Correlations with other stations in the Duchesne River system were employed to estimate the data for the missing period. In 1978 the missing quality data were estimated by correlation with flow measurements.

White River near Watson, Utah (Station No. 5). Flow data are available for the entire report period, and quality data are recorded continuously from December 1950. Correlation with flow measurements were used to extend the quality data back to January 1941.

San Rafael River near Green River, Utah (Station No. 7). Correlations were used to estimate flow at this gage from 1941-45 after which measurements of flow were available. Quality sampling started in 1946 and is complete for the remainder of the study period except for 1950. Extensions of available data provided satisfactory estimates of quality for the missing years.

Colorado River near Glenwood Springs, Colorado (Station No. 8). Correlations were used to estimate the quality data for the 1941 year prior to October 1. Quality records are available after October 1, 1941. Flow records are available for the entire period of study.

Dolores River near Cisco, Utah (Station No. 11). Flow records from January 1951 and quality records from March 1951 are available at this station. Flow records from January 1941 to December 1950 and quality records from October 1947 to February 1951 for the Dolores River at Gateway, Colorado, 21 miles (34 km) upstream, were used without modification

as no perennial stream enters between the gages. The missing periods of quality records were estimated by correlations with flow records.

San Juan River near Archuleta, New Mexico (Station No. 13). For the period 1954-74 flow and quality data presented are a combination of measurements obtained near Archuleta and at Blanco, New Mexico, with a few adjustments and correlations. Correlations were employed to estimate the data for 1941-54. Quality data for 1969 through 1976 were estimated from once-a-month sampling at the Archuleta gaging station. Quality data for 1977 and 1978 were estimated by correlation with the quality data at the Navajo Dam Station. In 1974 electrical conductivity measurements were started on a 3-time per week basis along with occasional chemical analyses. These measurements indicate the quality to be very uniform since the station is close to the outlet works of the Navajo Dam.

San Juan River near Bluff, Utah (Station No. 14). For the period from 1941-76 the records of flow and water quality are complete. For 1977 missing quality data were estimated by correlations with the quality data at the Shiprock, New Mexico Station, and in 1978 by the quality data at the Farmington, New Mexico Station.

Colorado River at Lees Ferry, Arizona (Station No. 15). This station has complete flow records available for the study period but lacks quality of water measurements for 1941, 1942, 1946, and 1947. Quality data for these years were estimated by extensive multiple correlations using data for the Colorado River near Cisco, Utah, and near Grand Canyon, Arizona; the Green River at Green River, Utah; and the San Juan River near Bluff, Utah. Water samples are collected monthly by the Geological Survey for a chemical analysis of major constituents and nutrients analysis. Samples for minor element analyses are collected quarterly. Specific conductance and field water temperature measurements are made daily.

Colorado River near Grand Canyon, Arizona (Station No. 16). Flow records are available for the report period and chemical quality records are also available except for the period December 1942 to August 1943. Quality data for the period of missing records were estimated from records at upstream stations. Water samples are collected and chemical analyses are made monthly by the Geological Survey, with records dating back to 1925.

Virgin River at Littlefield, Arizona (Station No. 17). Flow records are available for the report period, but quality data are available only from July 1949 to the present. Detailed correlations were employed to estimate the data for the missing period. Determinations are made daily by the Geological Survey for specific conductance, and water temperature chemical analyses are made monthly unless significant changes in conductivity occur.

Colorado River below Hoover Dam, Arizona-Nevada (Station No. 18). Discharge and quality records are available from October 1939 until the

present, except for water quality records during the period November 1944 to September 1950. The water quality for this time period is based on specific conductance records and intermittent chemical analyses. The samples used for the chemical analyses are collected monthly by the Geological Survey stream gaging station below the dam.

Colorado River below Parker Dam, Arizona-California (Station No. 19). Flow records at this station are available from October 1934 and have been published or are available from the Geological Survey. The water quality data for the period January 1964 through December 1970 were taken at the Geological Survey station, Colorado River below Parker Dam. The water quality data for the period January 1941 through December 1963 were based on chemical analyses of Colorado River Aqueduct flows made by the Metropolitan Water District. These data have been adjusted based on a correlation of concurrent Metropolitan Water District records with records made by the Geological Survey below Parker Dam for the years 1964-70. The correlated data were then used for the period 1941-63.

Colorado River at Imperial Dam, Arizona-California (Station No. 20). Although Figure 2 indicates flow records are available for the report period, a combination of stations was used to obtain the record. Records from January 1941 through September 1942 are from the station, Colorado River near Picacho, California. Records from October 1942 through September 1960 are based on the combined records of discharge obtained at gaging stations on Colorado River at Yuma, All-American Canal near Imperial Dam, Gila Gravity Main Canal at Imperial Dam, Yuma Main Canal at Laguna Dam, and North Gila Valley Canal at Laguna Dam less that of Gila River near Dome, Arizona. Records after September 1960 are based on the combined daily discharge of Colorado River passing Imperial Dam and at gaging stations on All-American Canal near Imperial Dam and Gila Gravity Main Canal at Imperial Dam and the diversion to Mittry Lake.

Quality data from 1943 through October 1970 were obtained from Geological Survey records and are based on data for the Yuma main canal below the Colorado River Siphon. The water quality data for November and December 1970 and for calendar years 1971-78 were obtained from the Geological Survey records for the water quality station at Imperial Dam. The samples are presently being collected by the Geological Survey and the Water and Power Resources Service above the trashracks at the diversion to the All-American Canal. Salinity analyses are made by the Geological Survey in cooperation with the Water and Power Resources Service. Field analyses and bacteria determinations are made by the Geological Survey in cooperation with EPA.

3. Other Quality of Water Stations

In addition to the key stations discussed above, there are many more points at which water quality data are obtained. Most of these sampling stations are operated by the Geological Survey; however, a number are operated by the Water and Power Resources Service and other Federal, State and private agencies.

The type of data obtained and the purpose of the sampling vary with each station. Many of the stations provide data for the Water Quality Improvement Program in Part VIII and special studies described in Part X.

B. Methods of Chemical Analyses

Published quality of water records consist of a combination of stream discharges with chemical analyses of stream water samples collected at more or less regular intervals. The reliability of the records depends on the accuracy of the streamflow records, the frequency of collection and representativeness of the samples, the stability of the samples during the storage periods prior to making of the analyses, and the completeness and accuracy of the individual analyses.

Most of the chemical analyses of water samples which provided the water quality data were made in the laboratories of the Geological Survey at Washington, DC, Albuquerque, New Mexico, and Salt Lake City, Utah, using standard procedures by chemists specifically trained in water analysis. Geological Survey analyses are now made only at the U.S. Geological Survey National Water Quality Laboratory in Denver, Colorado. During the 38-year period considered there were several changes in laboratory techniques and procedures mostly due to the introduction of new instrumental methods. New procedures were adopted only after careful investigation to insure results consistent with those obtained previously. Some of the quality of water records are based on analysis of samples by Water and Power Resources Service laboratories. Water and Power Resources Service results and methods have been checked by the Geological Survey to insure comparable records. It is probable that errors in the load computations due to errors in chemical analysis are less than those due to changes in the samples upon storage, inaccuracies in sampling, or inaccuracies in the determination of stream discharges.

Prior to about 1970 the Geological Survey analyzed water quality on a composite sample basis and also determined and published the annual total dissolved-solids loads. Since that time the results of the analysis in the Colorado River Basin have been those of individual samples rather than composites and no totals for the year have been computed. At present, individual samples are taken and analyzed about once a month together with daily conductivities. The annual total dissolved-solids loads since this change, have been determined from daily conductivities applied to curves and correlation factors relating conductivities and total dissolved-solids concentrations.

C. Historic Conditions

1. Total Dissolved-Solids Concentrations

Historic streamflows, salinity concentrations, and salt-load data for the 20 key stations for the 1941-78 period of record are presented in

Tables 1 to 20 with each table number corresponding to a station number. The concentrations as shown were determined on a flow-weighted basis.

To simplify tabulation, monthly values of flow and total dissolved-solids loads were rounded to the nearest 1,000 acre-feet and 1,000 tons. This resulted in some differences between the recorded and the computed monthly concentrations when the flows were low, for example, below 1,000 acre-feet in the San Rafael and Duchesne Rivers. Similarly, minor differences from published data in monthly concentrations occur in some instances for other stations.

The water quality at the Lees Ferry and the four other key stations on the main stem of the Lower Colorado River has been affected by abnormal conditions during the 1959-78 period because of low runoff in 1959, 1960, 1961, 1963, 1964, 1966, and 1967 and the storage of water in Lake Powell in 1963-78. Figure 3 shows the historical flow weighted average salinity concentration for these five stations and the combination of the Green River at Green River, Utah; San Rafael near Green River, Utah; Colorado River near Cisco, Utah; and the San Juan River near Bluff, Utah.

The Grand Canyon station has the longest water quality record on the Colorado River, 1926-78. It is of interest that the average salinity concentration for the period 1941-78 is only slightly higher than the average salinity concentration for the period 1926-40, 0.84 to 0.81 tons per acre-foot (618 to 596 mg/L), respectively.

Generally the salinity concentration increases at each succeeding downstream station as a result of depletions by diversions; reservoir and stream evaporation; consumptive use by irrigated crops and phreatophytes; and by salt loading from natural springs, streams, solution of salt from reservoir basins, and by irrigation return flows. The flows of the Bill Williams River often dilute the flow of the Colorado River in Lake Havasu which sometimes results in a decrease in the salinity concentration from the below Hoover Dam station to the below Parker Dam station. Figure 3 shows the concentration changes between the five lower stations and the combined four stations above Lake Powell on the Colorado River. Note also that Lake Mead has a dampening and delaying effect, about 2 years, on the salinity concentrations at the downstream stations. This is especially noticeable for the high salinity concentrations of 1963 at the Lees Ferry and Grand Canyon stations.

D. Present Modified Conditions

The 1941-78 period average present modified flow and quality at any station, as defined in this report, is the average of the flows and quality that would have resulted if the present (1978) level of depletions and salt loading instead of actual depletions and loading had occurred each year of the period. This average present modified flow and quality, therefore, represent an average condition based on the 1941-78 water supply

WEIGHTED AVERAGE DISSOLVED SOLIDS CONCENTRATIONS, COLORADO RIVER ABOVE AND BELOW LEES FERRY, ARIZONA

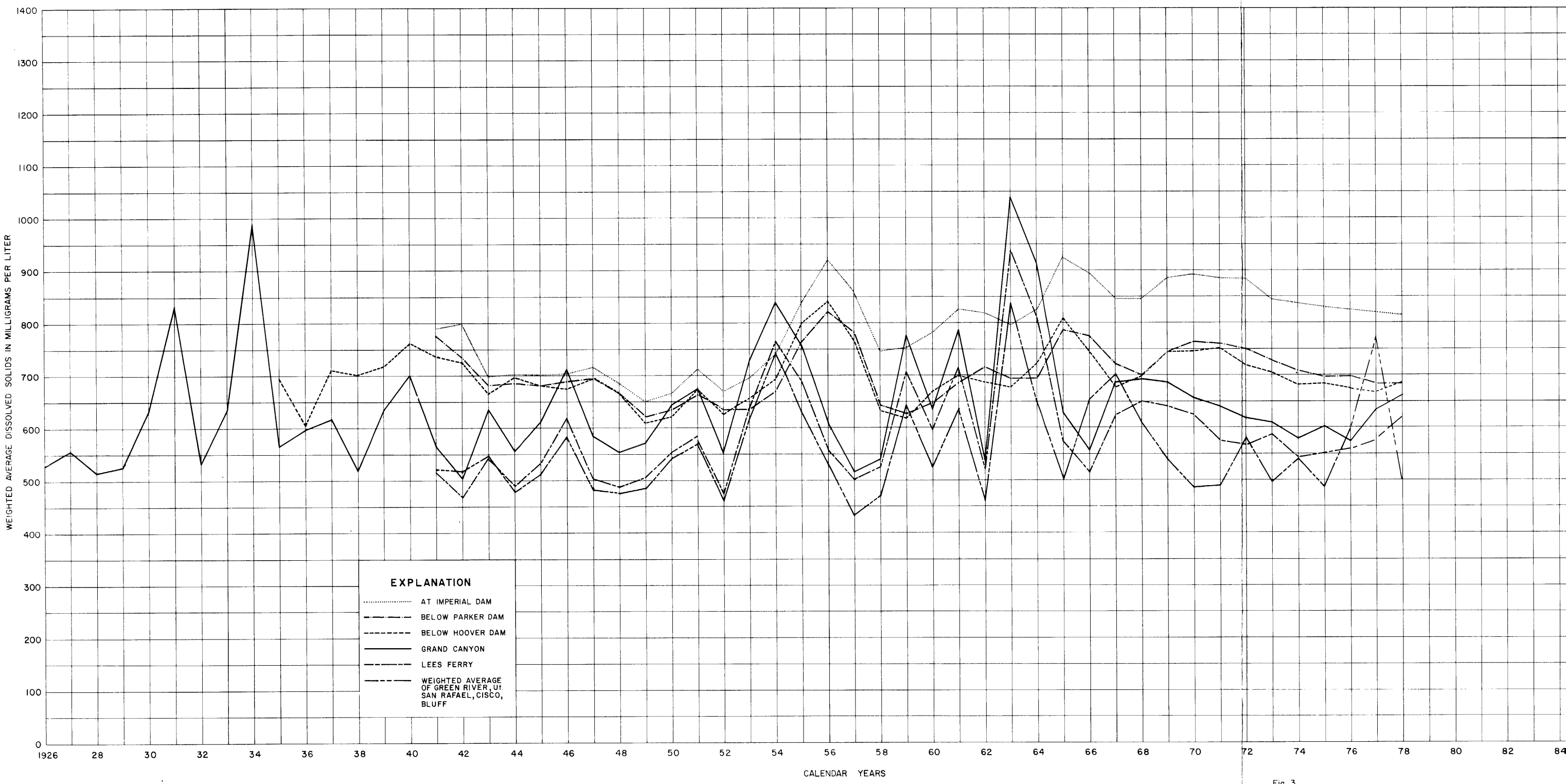


Fig. 3

period occurring at the present (1978) time. This is shown for each station on Table E in Part VII. Adjustments to the historic flow that were made to develop the present modified flow included: (1) adjustments for the increase in depletion in 1978 over that for years prior to 1976; (2) removal of storage effects below large reservoirs by adding the historical storage and subtracting storage releases to obtain unregulated flows at each station; and (3) adjustments for historic evaporation as compared to average present evaporation. The large reservoirs considered in these adjustments were Flaming Gorge, Lake Powell, Wayne N. Aspinall Unit Reservoirs, Navajo, and Fontenelle Reservoirs in the Upper Basin, and Lake Mead, Lake Mohave, and Lake Havasu in the Lower Basin.

Average present evaporation from the CRSP Reservoirs plus Navajo and Fontenelle Reservoirs was estimated to be 568,000 acre-feet (701 x $10^6 m^3$) per year. (Note: This is the latest evaporation estimate pending results from additional investigations being conducted.) This would include evaporation from Lake Powell of 460,000 acre-feet (570 x $10^6 m^3$); Flaming Gorge, 50,000 acre-feet (60 x $10^6 m^3$); Wayne N. Aspinall Unit Reservoirs, 10,000 acre-feet (12 x $10^6 m^3$); Navajo, 26,000 acre-feet (32 x $10^6 m^3$); and Fontenelle Reservoir, 22,000 acre-feet (27 x $10^6 m^3$). These figures were chosen to represent present conditions rather than using the 1978 historical evaporation since a single year record could show an above-or-below normal condition. Present evaporation of the Lower Basin reservoirs was assumed the same as historical since these reservoirs have been operating for a number of years.

Historical flows since 1941 have been affected by the transmountain diversions of the Colorado-Big Thompson Project, Duchesne Tunnel of Provo River Project, Roberts Tunnel of the city of Denver, and a number of small in-basin developments in the Upper Basin. More recently the Independence Pass expansion, Fryingpan-Arkansas, Collbran, Paonia, Smith Fork, Silt, Florida, Hammond, Bostwick Park, San Juan-Chama, Navajo Indian Irrigation, Cheyenne-Laramie, Navajo M&I Contracts Projects, and Vernal Units of Central Utah Project have come into operation. In addition water is used by the Hayden-Craig Steam Powerplant, Four Corners Steam Powerplant, Huntington Powerplant, Navajo Powerplant, San Juan Powerplant, expansion of Hogback Indian lands, and the municipalities and industries in Wyoming. In the Lower Basin, corrections have been made for the Southern Nevada Water Project, the Metropolitan Water District diversion at Lake Havasu, the Colorado River Indian Reservation, and the Palo Verde Irrigation District. The depletions from all of the above projects have been extended back to 1941, from the time they became operational, so that when increased depletions on existing projects or new depletions on new projects occur they can be imposed directly on the present modified condition to show the anticipated effect of all development on the river. In the near future several projects now under construction will become operational. The addition of these new depletions will result in slight increases in dissolved-solids concentrations under present modified conditions.

Quality data for present modified conditions were computed by taking into consideration (1) the flow weighted average of the concentrations of total dissolved solids for the various transmountain diversions, (2) the change in dissolved solids resulting from the existing upper in-basin developments on the basis of an assumed pickup of 2.0 tons of dissolved solids per acre (4.5 t/ha) of irrigated land and a depletion of 1.5 acre-feet of water per irrigated acre (4500 m^3/ha), and (3) in the Lower Basin a consumptive use of 4 acre-feet per acre (12 000 m^3/ha) and a 2.0 tons per acre (4.5 t/ha) pickup for irrigation of the Palo Verde Irrigation District, the Fort Mohave, Chemehuevi, and Colorado River Indian lands. The value of 4 acre-feet per acre (12 000 m^3/ha) is the rate presented in the Colorado River Basin Project hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, House of Representatives.

The present modified conditions are shown on Table D and are used as a base value for developing the anticipated effect of new depletions from new projects and the full development of present partially developed projects in the river basin. The present modified and future conditions should not be anticipated as conditions that might actually occur in any given year. These conditions should be considered as period averages only.

PART VII. ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

In order to estimate the probable effect of the authorized, partially completed, or contemplated developments on the quality of water at certain points along the Colorado River, the developments have been generally listed in downstream order. By following the flow and salts down the river the estimated effects of the development can be shown at the pertinent stations for the years 1990, 2000, and 2010. These results are tabulated in Table E for the new period of record used in this report. The table was computed on the basis of the 1941-78 average annual flow and total dissolved solids. An additional station, "Colorado River above Parker Dam," was included in the table for purposes of clarification and maintaining continuity in computations. It should be noted that future concentrations were estimated without consideration to possible future control measures. Salinity control measures are discussed separately in Part VIII.

The anticipated future conditions evaluated in Table E would result from the construction of both Federal and non-Federal developments. Pickup of dissolved solids from newly irrigated lands where comprehensive studies have not yet been made has been computed for two assumed conditions, 0 and 2 tons per acre (0 and 4.5 t/ha). The future increase in evaporation over average present evaporation, by the Colorado River Storage Reservoirs, was considered negligible and therefore not included in future depletions. Present evaporations are reflected in present modified conditions.

Following is a discussion of the various projects including a brief description of the physical conditions for each development authorized or contemplated for authorization. It should be recognized that the acreages and depletions as listed could change with change of plans on some of the contemplated projects. The figures presented below and in Table D are those which were current at the time of writing this report. In addition to the developments listed, a number of smaller private industrial developments either under construction or contemplated will result in certain depletions and will have some effect on water quality.

The effects of all upstream developments are carried on down to and including Imperial Dam.

A. Description of Projects

1. Above Green River near Green River, Wyoming

Seedskadee Project. This multipurpose project is located adjacent to the Green River in southwestern Wyoming.

Water uses of the Seedskadee Project are not definite, but it now appears that most of the water will be used for industrial purposes. A

total of 150,000 acre-feet (185 x $10^6 m^3$) depletion exclusive of Fontenelle evaporation is anticipated. Of this, an estimated 6,000 acre-feet (7 x $10^6 m^3$) is planned for wildlife purposes while the remaining 144,000 acre-feet (178 x $10^6 m^3$) of depletions was assumed to be for industrial purposes. Irrigation, however, may not yet be completely out of the picture. Industrial users include Pacific Power & Light Co., Sun Oil, and possibly other industries. It is assumed the 6,000 acre-feet (7 x $10^6 m^3$) of water for refuge purposes would neither pick up nor lose salts, but the remaining water for industrial purposes would deplete the salts as well as the water. The salinity concentration in the future at the Green River, Wyoming, gage would remain almost the same as at present because diversions to industries are anticipated to be located not too far above the gage.

Private Industrial Rights. These rights are expected to be utilized for mineral development, particularly for trona mining and processing. Total future depletions are expected to reach 57,000 acre-feet (70 x $10^6 m^3$) by the year 2010.

2. Between Green River at Green River, Wyoming, and Green River near Greendale, Utah

Lyman Project. This is a multipurpose project located in southwestern Wyoming. Project facilities consist of two dams and reservoirs. One is located at the Meeks Cabin site on the Blacks Fork in Wyoming and provides 33,000 acre-feet (41 x $10^6 m^3$) of storage capacity. The other has been constructed at the Stateline site of the East Fork of Smith Fork in Utah and will provide 14,000 acre-feet (17 x $10^6 m^3$) of storage capacity. The project when completed will have the primary purpose of providing supplemental water to 36,000 acres (15 000 ha) of existing farmland along with fish and wildlife and recreation benefits. This project will present an opportunity to study the water quality effects of adding supplemental water to lands already irrigated. Of the 10,000 acre-feet (12 x $10^6 m^3$) total depletions, only 4,000 acre-feet (5 x $10^6 m^3$) remain since 6,000 acre-feet (7 x $10^6 m^3$) from Meeks Cabin Reservoir is now depleted.

Utah Power & Light Co. This steam powerplant (Viva Naughton) is located at Kemmerer, Wyoming, with present depletions of about 6,000 acre-feet (7 x $10^6 m^3$). Total future depletions of this plant are expected to increase to 14,000 acre-feet (17 x $10^6 m^3$ by the year 2000.

3. Above Yampa River near Maybell, Colorado

Hayden and Craig Steam Powerplants. The addition of new units will require an estimated 20,000 acre-feet (25 x $10^6 m^3$) of water by 1990. Present depletions amount to 10,000 acre-feet (12 x $10^6 m^3$). It is assumed the plants will return no salt or water.

Juniper-Cross Mountain Project. This hydroelectric development will utilize two reservoirs to be located on the Yampa River west of Craig, Colorado. Most of the consumptive use is expected to be reservoir evaporation. The State of Colorado estimates that depletions could reach 50,000 acre-feet (62 x $10^6 m^3$) by 1990 and 75,000 acre-feet (93 x $10^6 m^3$) by 2000 for hydroelectric development. Water and Power Resources Service estimates 30,000 acre-feet (37 x $10^6 m^3$) depletions by 2000.

4. Above Duchesne River near Randlett, Utah

Central Utah Project (Bonneville Unit). The Bonneville Unit will include a transmountain diversion of water from the headwaters of the Duchesne River in the Uinta Basin portion of the Colorado River Basin to the Bonneville Basin. The project will develop water for irrigation, municipal and industrial use, and power production. It will also provide benefits to recreation, fish and wildlife, flood control, water quality control, and area redevelopment.

The total depletion to the Green River will be 166,000 acre-feet (205 x $10^6 m^3$) with about 31,000 acre-feet (38 x $10^6 m^3$) being depleted in 1978.

Central Utah Project (Upalco Unit). The Upalco Unit will be located in Duchesne County near Roosevelt, Utah. The plan of development is primarily to provide supplemental irrigation water to Indian and non-Indian lands along Lake Fork River and to enhance recreation and fish and wildlife, while maintaining flood control. The mean annual stream depletion is estimated to be about 12,000 acre-feet (15 x $10^6 m^3$).

Central Utah Project (Uintah Unit). The Uintah Unit of the Central Utah Project will provide a full supply to irrigate 7,800 acres (3 200 ha) of new lands and supplemental water to other lands on the south slope of the Uinta Mountains in the Uinta and Whiterocks Rivers drainage areas. The new annual depletion will be about 28,000 acre-feet (35 x $10^6 m^3$).

Deferred Indian Lands. It is estimated that depletion of 50,000 acre-feet (62 x $10^6 m^3$) of water for these lands will begin between the year 1980 and 2000. Approximately 29,100 acres (11 800 ha) of new land including the 7,800 acres (3200 ha) in the Uintah Unit will receive irrigation. This will result in a net 21,300 acres (8600 ha) exclusive of the Uintah Unit.

5. Above the White River near Watson, Utah

Oil Shale Development. It is estimated that oil shale development would require 78,000 acre-feet (96 x $10^6 m^3$) in Colorado by 1990 and 50,000 acre-feet (62 x $10^6 m^3$) in Utah by 2000. It was also estimated that the heavy use of water would not occur until about the mid-1980's, and by 2000 the 128,000 acre-feet (158 x $10^6 m^3$) would be required.

6. Between Green River near Greendale, Yampa River near Maybell, Duchesne River near Randlett, White River near Watson, and Green River at Green River, Utah

Cheyenne-Laramie, Wyoming. The city of Cheyenne diverts water from the Little Snake River to a tributary of the North Platte in exchange for water diverted from Douglas Creek for municipal use by the city of Cheyenne. This transmountain diversion is now using about 8,000 acre-feet (10 x $10^6 m^3$) and it is estimated that this city and the Laramie area will ultimately deplete the Colorado River by an additional 42,000 acre-feet (52 x $10^6 m^3$) beyond the year 2010.

Central Utah Project (Jensen Unit). This unit is located in Uintah County along the Green River east of Vernal. Storage of water in Red Fleet (Tyzack) Reservoir on Brush Creek together with pumping from the Green River will supply 440 acres (180 ha) of new land and 3,640 acres (1470 ha) of presently irrigated lands. Approximately 15,000 acre-feet (19 x $10^6 m^3$) of water is anticipated to be depleted by this project.

7. Above San Rafael River near Green River, Utah

Utah Power & Light, Huntington, Emery County. The anticipated future effects on the San Rafael River would be steam-electric plants depleting about 15,000 acre-feet (19 x $10^6 m^3$) of water and replacing an estimated 5,000 acres (2000 ha) of presently irrigated lands with industries. The salt was assumed to be depleted with the water. The Huntington Powerplant started one unit in 1975, and another in 1977. The Emery County powerplant started units in 1978, and 1980, and have others scheduled for 1984 and 1987.

8. Above Colorado River near Glenwood Springs, Colorado

Denver Expansion, Englewood, Colorado Springs Expansion, and Pueblo, Colorado. Expansion of municipal supplies for these four cities will eventually deplete the Colorado River by 234,000 acre-feet (290 x $10^6 m^3$) above present uses. These are transmountain diversions from the Blue, Fraser, and Eagle Rivers in the headwaters of the Colorado River. The diversions would vary according to runoff each year.

Homestake Expansion Project, Colorado. The Homestake Project in Colorado, constructed by the cities of Aurora and Colorado Springs, will ultimately divert an additional average annual amount of 31,000 acre-feet (38 x $10^6 m^3$) to the eastern slope from the headwaters of the Colorado River although the diversions will vary from year to year. Present diversions amount to about 25,000 acre-feet (31 x $10^6 m^3$).

Windy Gap Project, Colorado. This transmountain diversion will use the facilities of the Colorado-Big Thompson Project to divert up to 54,000 acre-feet (67 x $10^6 m^3$) annually for domestic use by the cities of Longmont, Loveland, Estes Park, and Greeley, Colorado, and the Platte River

Power Authority. The State of Colorado estimates that 30,000 acre-feet (37 x 10^6m^3) will be diverted annually by 1990 and 54,000 acre-feet (67 x 10^6m^3) by the year 2000.

9. Between Colorado River near Glenwood Springs and Colorado River near Cameo, Colorado

Independence Pass. This water is diverted from the upper Roaring Fork to the east slopes of the Rocky Mountains. The present depletions will ultimately be increased by an additional 7,000 acre-feet (9 x 10^6m^3).

Fryingpan-Arkansas Project. This transmountain diversion project delivers water from the headwaters of the Colorado to the Arkansas River. It is a multipurpose development to supply supplemental irrigation water, municipal water, and water for power production. In addition the project will also control floods originating above Pueblo, retain sediment, preserve fish and wildlife, and provide recreation opportunities. Diversions initiated in 1973 increased to about 50,000 acre-feet (62 x 10^6m^3) in 1978. Additional diversions beyond 1978 of 19,000 acre-feet (23 x 10^6m^3) are anticipated, making a future total of about 69,000 acre-feet (85 x 10^6m^3). A depletion of about 1,000 acre-feet (1 x 10^6m^3) by evaporation from Ruedi Reservoir is also occurring.

Ruedi Reservoir, Colorado. No consumptive uses are presently made except reservoir evaporation. Industrial uses are estimated to begin by 1990 and to reach 48,000 acre-feet (59 x 10^6m^3) annually by the year 2010.

West Divide Project, Colorado. It is presently estimated the West Divide Project will consumptively use about 38,200 acre-feet (47 x 10^6m^3) of water by 2000 for irrigation and municipal and industrial uses. The irrigation water will ultimately supply about 10,450 acres (4230 ha) of new land and 14,720 acres (5960 ha) of land presently irrigated.

Project water will be obtained from a series of Colorado River tributaries south of the river in west-central Colorado. The above uses could be altered in the definite plan report due to changing conditions and plans.

10. Above Gunnison River near Grand Junction, Colorado

Dallas Creek Project, Colorado. The Dallas Creek Project as now planned will develop water of the Uncompahgre River and tributaries for irrigation and municipal and industrial use. The project will provide supplemental water to lands presently irrigated. Depletion of the Colorado River will amount to about 17,000 acre-feet (21 x 10^6m^3) annually. Salt loading effects were based on a detailed special study for this project.

11. Above the Dolores River near Cisco, Utah

Dolores Project, Colorado. The Dolores Project will divert water from the Dolores River Basin to the San Juan drainage for the irrigation

of new and presently irrigated lands. Some 35,000 acres (14 000 ha) will be new land. This project will divert 105,000 acre-feet (130 x $10^6 m^3$) of water from the Dolores River of which 81,000 acre-feet (100 x 10^6 m^3) will be depleted and the balance returned to the San Juan River. Salt loading was determined by a special study for this project.

Return flows from lands in the Montezuma Valley are presently used for irrigation of land in McElmo Canyon outside the project area. Analyses show these flows have relatively high concentrations of soluble salts but are successfully used for irrigation, because of the internal drainage characteristics of the soils.

San Miguel Project, Colorado. The San Miguel Project will regulate flows of the San Miguel River for irrigation, municipal and industrial use, recreation, flood control, and fish and wildlife conservation. The project will supply water to 7,060 acres (2860 ha) of new land and 12,700 acres (5140 ha) of land now receiving a partial supply. Estimated depletion of Colorado River water will be about 31,000 acre-feet (38 x $10^6 m^3$). Salt loading was determined by a special study.

12. Above San Juan River Near Archuleta, New Mexico

San Juan-Chama Project. Construction has been completed on this transmountain diversion project. Delivery of water to the Rio Grande Basin was initiated in 1971. Average depletions from 1971 to 1978 have been about 85,000 acre-feet (105 x $10^6 m^3$). The project will eventually divert an average of 110,000 acre-feet (136 x $10^6 m^3$) annually from the headwaters of the San Juan River across the Continental Divide to the Rio Grande Basin. The effect of this depletion to the San Juan and Colorado Rivers will be to increase the salinity at all downstream stations. The water will be used in New Mexico for municipal and industrial developments and for irrigation.

Navajo Indian Irrigation Project. Construction activities are continuing on this project with some water having been delivered in 1976-77. Studies completed for the project for the all-sprinkler irrigation system indicate an agricultural consumptive use of 226,000 acre-feet (279 x $10^6 m^3$). A Department of the Interior Solicitor's opinion indicates probable depletion by the Navajo Indians totaling 254,000 acre-feet (313 x $10^6 m^3$) as originally authorized. It was decided for this analysis to use the 508,000 acre-feet (63 x $10^6 m^3$) diversion and 254,000 acre-feet (313 x $10^6 m^3$) depletion. The water would be diverted above the Archuleta gage with return flow to the San Juan River below the gage. The 110,000 acres (44 500 ha) of new land as authorized is still considered the project area to be irrigated.

Jicarilla Apache. The water to supply 3,000 acre-feet (4 x $10^6 m^3$) depletion was assumed to be used for municipal and industrial purposes in the Dulce, New Mexico, area.

The effect of the San Juan-Chama and Navajo Indian Irrigation Projects and depletions by the Jicarilla Apache Tribe on the quality of water at

the Archuleta station would be small since the water is presently of very good quality and the station is located only a short distance below the Navajo Dam where there would be no return flows.

13. Between San Juan River near Archuleta, New Mexico, and San Juan River near Bluff, Utah

Farmington Municipal and Industrial. This future depletion to Farmington, New Mexico, is for 5,000 acre-feet (6 x $10^6 m^3$) out of the San Juan River. It was estimated that this would begin by year 1990.

Animas-La Plata Project, Colorado-New Mexico. The Animas-La Plata Project will develop flows of the Animas and La Plata River systems for irrigation, municipal and industrial use, recreation, and fish and wildlife conservation. The project will supply water to about 48,600 acres (19 700 ha) of new land and 21,500 acres (8700 ha) of presently irrigated land. The new lands will include some Indian lands. The total new depletion will amount to 155,000 acre-feet (191 x $10^6 m^3$). Project features include two storage dams, lengthy canals, and several diversion dams. Salt loading was determined by a special study.

Hogback Expansion. This direct diversion to Indian land adjacent to the San Juan River will result in a new depletion of about 8,000 acre-feet (10 x $10^6 m^3$) over present depletions. These lands, in the vicinity of Shiprock, New Mexico, have been developed in small blocks by the Bureau of Indian Affairs over a period of years with further expansion planned for the future. The return flows directly seep into the San Juan River, but the quality of these flows has not been determined.

Four Corners Powerplant. This large steam electric powerplant, in northwestern New Mexico, is now using about 20,000 acre-feet (25 x $10^6 m^3$) of water. A total of 39,000 acre-feet (48 x $10^6 m^3$) use is expected under future expansion. This will supply water for full operation of the five units totaling 2154 MW. The water and salts used in future expansion of the plant will not be returned to the river.

Navajo M&I Contracts. Several energy related industries and possibly municipalities near the Four Corners area of New Mexico have either purchased or are considering the purchase of Navajo Reservoir water on a temporary basis. Under present authorities, the annual delivery of water under these contracts may not exceed 100,000 acre-feet (123 x $10^6 m^3$). The contracts are scheduled to be terminated in the year 2005 and the water returned to the river system. These users include the San Juan Powerplant, Utah International Inc., El Paso (coal gasification), and others including possibly the city of Gallup.

Return Flow Dolores and Navajo Indian Irrigation Projects. The return flows from the Dolores Project and the Navajo Indian Irrigation Project were identified and treated specially because they do not return

back to the system in the same reach where they are diverted. The diverted water for the Dolores Project will not return to the Dolores River from which it will be diverted. Rather the return flows will flow into the San Juan River above the gage at Bluff, Utah. Flows diverted from the San Juan River above Archuleta for the Navajo Indian Irrigation Project do not return to the river above the the gage at Archuleta, but return to the river above the gage at Bluff, Utah. The additional salts brought in with these return flows would be those picked up from the new lands that are irrigated plus the salts originally in the water diverted.

14. Between Green River at Green River, Utah, San Rafael River near Green River, Utah, Colorado River near Cisco, Utah, San Juan River near Bluff, Utah, and Colorado River at Lees Ferry, Arizona

Navajo Powerplant. About 34,000 acre-feet (42 x $10^6 m^3$) will be used in that portion of Arizona within the Upper Basin by 1990 and would be diverted above Lees Ferry. It is expected that the salt will be depleted with the water. No additional water depletions are expected beyond 1990 but due to increased concentrations, additional salts will be depleted.

Other Municipal Uses in Arizona. Of the Upper Colorado River Compact's allocated 50,000 acre-feet (62 x $10^6 m^3$) to Arizona from the Upper Colorado River system, about 13,000 acre-feet (16 x $10^6 m^3$) is presently being used. Besides the 34,000 acre-feet (42 x $10^6 m^3$) to the Navajo Powerplant, additional municipal uses are expected to consume the remaining 3,000 acre-feet (4 x $10^6 m^3$).

Mill Creek Project, Utah. About 1,000 acre-feet (1.2 x $10^6 m^3$) of water will be depleted for municipal and industrial purposes and about 1,500 acre-feet (1.9 x $10^6 m^3$) for irrigation. The project is expected to be completed during 1981.

15. Above the Virgin River at Littlefield, Arizona

Dixie Project, Utah. The authorized Dixie Project was under contract negotiations between the Washington County Water Conservancy District and the Water and Power Resources Service during 1973. At a meeting on February 8, 1973, it was announced by the District that they desired to cease negotiations and not continue with the project.

Warner Valley, Utah. The Washington County Water Conservancy District and the city of St. George have engaged in studies to construct a smaller dam and reservoir at Warner Valley, a former Dixie Project damsite. There are plans for the construction of a reservoir with a capacity of 55,000 acre-feet (68 x $10^6 m^3$) for the storage of 10,000 acre-feet (12 x $10^6 m^3$) of water to be used for cooling purposes for a 500 megawatt coal fired powerplant and 45,000 acre-feet (56 x $10^6 m^3$) for future municipal and industrial demand and supplemental irrigation water. Nevada Power would utilize 375 megawatts and the city of St. George would utilize 125 megawatts at some time in the future. The powerplants would receive coal

by slurry pipeline from Alton, Utah, and would burn approximately 6,000 tons (5400 t) of coal a day. The project was scheduled for completion by 1979 but has been delayed because of environmental issues. The project has been assumed to be on line in 1990.

16. Between the Colorado River at Lees Ferry, Arizona, Virgin River at Littlefield, Arizona, and Colorado River below Hoover Dam, Arizona-Nevada

Southern Nevada Water Project, Nevada. The first stage of the Southern Nevada Water Project was completed by the Water and Power Resources Service and was accepted by the Colorado River Commission on November 1, 1971. The project is operated by the Las Vegas Valley Water District to provide supplemental municipal and industrial water to the cities of Las Vegas, North Las Vegas, Henderson, and Boulder City, and to Nellis Air Force Base. It will also provide water to the potential Eldorado Valley Development. The second stage is under construction and is expected to be completed in 1982.

The total annual diversion and depletion anticipated by the year 2010 for the Southern Nevada Water Project and the other existing systems in southern Nevada are shown in the following tabulation.

	Maximum Diversion		Net Depletion	
	(Acre-feet)	($10^6 m^3$)	(Acre-feet)	($10^6 m^3$)
Southern Nevada Water Project	299,000	369	209,300	258
Basic Management Incorporated Pipeline	41,277	51	41,277	51
Boulder City Pipeline	5,890	7	5,890	7
National Park Sevice Pipelines	2,000	2	2,000	2
Total	348,167	429	258,467	318

Prior to 1975, no creditable return flow from these diversions has been listed in the "Compilation of Records in Accordance with Article V of the Decree of the Supreme Court of the United States in Arizona v. California." Starting in calendar year 1975 a method for determination of a credit for surface return flows was made to Nevada for Colorado River diversions into Las Vegas Valley. The resulting values for 1977 and 1978 were as follows:

	1977		1978	
	(Acre-feet)	($10^6 m^3$)	(Acre-feet)	($10^6 m^3$)
Ground Water Pumped	69,107	85	69,051	85
Basic Management Incorporated[1/]	12,567	16	13,311	17
Southern Nevada Water Project[2/]	72,980	90	78,840	97
Total	154,654	191	161,202	199
Percent Groundwater	44.7		42.8	
Percent Surface Water	55.3		57.2	
Las Vegas Wash near Boulder City[3/]	57,904	71	61,535	76
Computed Surface Return Flows	32,021	39	35,198	43

1/ Less Lake Mead Recreation Area and Nevada State Department of Fish and Game.

2/ Less Boulder City.

3/ Less surface floodflows.

The expected depletions for the Southern Nevada Water Project would be an additional depletion of 4,000 acre-feet (5 x $10^6 m^3$) by 1980. The projected depletion for the 1980-90 time period would be an additional 45,000 acre-feet (56 x $10^6 m^3$). The projected annual depletion for the period 1990-2000 would be an additional 39,900 acre-feet (49 x $10^6 m^3$) for a total 153,000 acre-feet (189 x $10^6 m^3$) by the year 2000. The above depletions are based on the assumption that the Southern Nevada Water Project will pump from Lake Mead 102,000 acre-feet (126 x $10^6 m^3$) in 1980, 171,000 acre-feet (211 x $10^6 m^3$) in 1990, 236,000 acre-feet (291 x $10^6 m^3$) in year 2000 and 313,000 acre-feet (386 x $10^6 m^3$) in year 2010. The 299,900 acre-feet (369 x $10^6 m^3$) of pumpage is projected to occur in 2019, according to the Nevada Division of Colorado River Resources.

Harry Allen Powerplant. The Harry Allen Powerplant, a segment of the Allen-Warner Valley Energy System, is a 2000 megawatt steam powerplant that will be located at Dry Lake northeast of Las Vegas, Nevada. Initially Nevada Power would receive 285 megawatts of power from the plant with the remainder transported to the southern California area. The plant will require about 27,500 acre-feet (33.9 x $10^6 m^3$) of cooling water per year which it will obtain from the advanced wastewater treatment plant. The coal fired powerplant will burn approximately 24,000 tons (21 800 t) per day. The construction of the powerplant is scheduled for completion by 1990.

Other Nevada Projects. The Southern Nevada Water Project, Harry Allen Powerplant and other systems estimated net annual depletion would be 286,500 acre-feet (353 x $10^6 m^3$) of the 300,000 acre-feet (370 x $10^6 m^3$)

depletion alloted to Nevada from the Colorado River. Of the 13,500 acre-feet (17 x 10^6m^3) of uncommitted allotment, it is expected that 7,000 acre-feet (9 x 10^6m^3) will be used by the Fort Mohave Indian Reservation while the remaining 6,500 acre-feet (8 x 10^6m^3) has not been allocated. It was projected for this report that this water would be utilized at the rate of 2,500 acre-feet (3 x 10^6m^3) by 1980, an additional 2,000 acre-feet (2 x 10^6m^3) by 1990, and an additional 5,000 acre-feet (6 x 10^6m^3) by the year 2000. These other projects could include fish and wildlife uses, additional energy requirements, and municipal and industrial projects.

17. Between Colorado River below Hoover Dam, Arizona-Nevada, and Colorado River at Imperial Dam, Arizona-California

Mohave Steamplant. A portion of the Southern Nevada Water Project allotment has been obtained via contractual arrangements by the Southern California Edison Company for diverting up to 23,000 acre-feet (28 x 10^6m^3) annually from the Colorado River for thermal power production purposes at a site about 3 miles (5 km) downstream from Davis Dam. Use of water until July 1, 2006, by the Southern California Edison Company is in accordance with two contracts - one with the State of Nevada and the Southern California Edison Company and one with the Water and Power Resources Service and the State of Nevada. The depletions for the Mohave Steamplant in 1978 were 9,100 acre-feet (11 x 10^6m^3). The anticipated total depletion for the years 1980, 1990, and 2000 would be 12,000, 18,000, and 23,000 acre-feet (15 x 10^6m^3, 22 x 10^6m^3, and 28 x 10^6m^3), respectively. No diversion is anticipated after 2006. The diversion is not shown under the Southern Nevada Water Project since the point of diversion is below Hoover Dam.

Fort Mohave Indian Reservation. The Fort Mohave Indian Reservation, located below Davis Dam, is allocated water by the Supreme Court Decree to irrigate 18,974 acres (7689 ha) of land - 14,916 acres (6037 ha) in Arizona, 2,119 acres (858 ha) in California, and 1,939 acres (785 ha) in Nevada with a maximum annual diversion from the Colorado River of 122,648 acre-feet (151 x 10^6m^3). The consumptive use required for irrigation of these lands is estimated to be 4 acre-feet per acre (12 000 m^3/ha) which would result in main-stream depletion of about 75,900 acre-feet (94 x 10^6m^3) annually. None of the reservation lands were developed as of 1974. In 1978, 8,200 acres (3300 ha) of reservation lands in Arizona and California had been developed, according to the Bureau of Indian Affairs. The following table shows the depletion credited to the reservation from 1974 to 1978 and the dramatic development of use of their water rights. The development of land is not expected to continue at the current rate.

Year	Diversion[1/] Acre-feet	10^6m^3
1974	0	0
1975	3,300	4
1976	20,801	26
1977	30,049	37
1978	32,794	40

1/ No surface return flows.

No lands were developed from 1978 to 1979. An arbitarary uniform land development rate of 980 acres (397 ha) per year was assumed for the rest of Fort Mohave Indian Reservation. By 1980 there would be a total additional development of 980 acres (397 ha) for a depletion of 3,920 acre-feet (5 x 10^6m^3) above the depletion in 1978. From 1980 to 1990 the remaining 9,799 acres (3964 ha) of land on the reservation would be developed for a total additional depletion of 39,184 acre-feet (48 x 10^6m^3).

The consumptive use of 4 acre-feet per acre (12 000 m^3/ha) for irrigation of the Fort Mohave, Chemehuevi, and Colorado River Indian lands is based on the rate presented in Colorado River Basin Project hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, House of Representatives. This value is under study and may be subject to change in future reports.

Chemehuevi Indian Reservation. The Chemehuevi Indian Reservation, located above Parker Dam, is allocated water by the Supreme Court Decree to irrigate 1,900 acres (770 ha) of land in California with a maximum annual diversion from the mainstream of the Colorado River of 11,340 acre-feet (14 x 10^6m^3). The consumptive use required for irrigation of these lands is estimated to be 4 acre-feet per acre (12 000 m^3/ha), which would result in a main-stream depletion of about 7,000 acre-feet (8 x 10^6m^3) annually. The lands that are irrigable are above the river and not feasible for farming at this time. It is anticipated that the reservation will develop 7,000 acre-feet (8 x 10^6m^3) of consumptive use for municipal and industrial and/or irrigation purposes by the year 2000.

Central Arizona Project. The Colorado River Basin Project Act authorizes the Central Arizona Project for the purpose of furnishing irrigation and municipal water supplies to the water-deficient areas of Arizona and western New Mexico through direct diversion or exchange of water. This project is now under construction with water deliveries expected in 1985 to Phoenix and 1987 to Tucson. This project will provide water to Indian lands and a supplemental water supply to lands now being irrigated. Water made available to non-Indian lands can be used only on lands having a recent irrigation history. The Central Arizona Project must stand shortages up to its full allocation if there is insufficient mainstream water to satisfy an annual consumptive use of 7.5 million acre-feet (9300 x 10^6m^3) allocated under the Supreme Court Decree of March 1964 to the States of Nevada, Arizona, and California. When shortages occur,

diversions to the Central Arizona Project will be limited to assure prior water users of their entitled diversions from the Colorado River mainstream water. A maximum of 2.2 million acre-feet (2700 x $10^6 m^3$) of Colorado River water is all that could be diverted with a canal capacity of 3,000 ft^3/s (85 m^3/s).

Contracts - Boulder Canyon Project. Separate contracts have been signed with the city of Kingman, Arizona, the Lake Havasu Irrigation and Drainage District, and the Mohave Valley Irrigation and Drainage District for diversion, respectively, of 18,500 acre-feet, 14,500 acre-feet and 51,000 acre-feet (23 x $10^6 m^3$, 18 x $10^6 m^3$, and 63 x $10^6 m^3$) annually. As a result of terms in the Mohave Valley Irrigation and Drainage Districts contract, they will lose 10,000 acre feet (12 x $10^6 m^3$) of their diversion. The 10,000 acre-feet (12 x $10^6 m^3$) will be used for municipal and industrial and irrigation purposes on lands not part of Mohave Valley Irrigation and Drainage District.

At the present time the city of Kingman does not divert Colorado River water nor are there plans to divert Colorado River water in the near future. It has been anticipated that there will be no use of their contract water until 1990. From 1990 to 2000 it was assumed they will develop 9,250 acre-feet (11 000 x $10^6 m^3$) of their contract water.

The Lake Havasu Irrigation and Drainage District used 7,771 acre-feet (10 x $10^6 m^3$) of water in 1976 according to the Arizona v. California Decree accounting of the waters of the Colorado River. It is anticipated that 14,500 acre-feet (18 x $10^6 m^3$) of water use will be developed by the District by 1990, which will mean an additional depletion of 1,600 acre-feet (2 x $10^6 m^3$) by 1980 and 5,100 acre-feet (6 x $10^6 m^3$) by 1990.

In 1976 the decree accounting shows that Mohave Valley Irrigation and Drainage District used 14,598 acre-feet (18 x $10^6 m^3$). The 1976 decree accounting, however, does not show the total use of water within the District. The 1978 decree accounting of approximately 19,100 acre-feet (24 x $10^6 m^3$) for the District reflects the total use of water while there was little change in irrigated acreage from 1976. It is anticipated that half of the remaining 21,900 acre-feet (27 x $10^6 m^3$) or 10,950 acre-feet (14 x $10^6 m^3$) of use will be developed by 1990 and an additional 10,950 acre-feet (14 x $10^6 m^3$) of use will be developed by the year 2020. Of the 10,000 acre-feet (12 x $10^6 m^3$) of water formerly under contract to the District, it is anticipated there will be a use of 2,200 (3 x $10^6 m^3$) by 1980 with full development of the use of the 10,000 acre-feet (12 x $10^6 m^3$) by 2020.

Colorado River Indian Reservation. The Colorado River Indian Reservation is located along the Colorado River just below Parker Dam, Arizona, with most of the land in Arizona and the remainder in California. The Supreme Court Decree allocated 717,148 acre-feet (885 x $10^6 m^3$) of diversons to the Colorado River Indian Reservation for irrigation of 107,588 acres (43 500 ha) of land. There are 99,375 acres (40 217 ha) of land in Arizona, of which 72,377 acres (29 291 ha) have been developed and 8,213

acres (3324 ha) of land in California are to be developed. The consumptive use requirement for irrigation of these lands is estimated to be 4 acre-feet per acre (12 000 m^3/ha) which would result in an annual mainstream depletion of 430,352 acre-feet (531 x $10^6 m^3$). The estimated consumptive use in 1978 from irrigation of 75,405 acres (30 500 ha) is 289,500 acre-feet (372 x $10^6 m^3$). This leaves an additional depletion of about 128,732 acre-feet (159 x $10^6 m^3$) per year for future development of irrigated lands.

The Bureau of Indian Affairs has reported a general 2,000 acres (800 ha) per year land development rate on the reservation in the past. The land development rate of 2,000 acres (800 ha) per year was assumed for the future even though the Bureau of Indian Affairs feels the land development rate may slow down in the near future. Therefore, by 1980, there will be an additional 4,000 acres (1629 ha) and 16,000 acre-feet (20 x $10^6 m^3$) of use, by 1990, 20,000 acres (80 000 ha) and 80,000 acre-feet (99 x $10^6 m^3$) of use and by 2000, 8,183 acres (3300 ha) and 32,732 acre-feet (40 x $10^6 m^3$) of additional use.

Lower Colorado River Channelization Project, Arizona-California. Between Davis Dam and Parker Dam channelization work in the Mohave Valley Diversion was begun in 1949 and completed in 1960 to salvage 65,000 acre-feet (80 x $10^6 m^3$) of water per year.

Below Parker Dam 24,200 acre-feet (30 x $10^6 m^3$) of water salvage by channelization was planned for the two sections of the Parker Division. This was started in 1966 and section one of the division was completed in 1967. It has been estimated that half of the salvage work associated with the division has been completed. Work began in 1962 and was completed in 1966 to salvage 10,000 acre-feet (12 x $10^6 m^3$) in the Palo Verde Division. In 1964 work to salvage 36,000 acre-feet (44 x $10^6 m^3$) began in the Cibola Division and was complete in 1970.

No future salvage of water has been anticipated. Salvage of water by replacing phreatophytes with vegetation that uses less water and is environmentally more beneficial is being considered.

18. Augmentation

Public Law 90-537 (dated September 30, 1968) states that augmentation of the Colorado River will be a national obligation in order to supply the Mexican Treaty requirements. Although temporary periods of subnormal water supply can be satisfied from storage releases, permanent deficiencies caused by full utilization of the waters allocated to the States would require augmentation.

Table C
Projects Depleting Colorado River Water
Incremental Change in Flow and Salt Load 1978 to 2010

	Increase 1978 to 1990				Increase 1990 to 2000				Increase 2000 to 2010			
	Depletion (1,000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)	Depletion (1000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)	Depletion (1,000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)
Above the gage Green River near Green River, Wyoming												
Seedskadee, Wyoming including Jim Bridger powerplant and others	74	-29	-29	1/	57	-26	-26	1/	50	-17	-17	1/
Between the above gage and the gage Green River near Greendale, Utah												
Lyman, Wyoming	4	0	0	2/	0	0	0	0	0	0	0	0
Utah Power and Light and others, Wyoming	0	0	0	0	8	-4	-4	1/	0	0	0	1/
Above the gage Yampa River near Maybell, Colorado												
Hayden, Craig powerplants, Colorado	13	-3	-3	1/	0	0	0	0	0	0	0	0
Juniper-Cross Mountain, Colorado	0	0	0	0	30	0	0	0	0	0	0	0
Above the gage Duchesne River near Randlett, Utah												
Central Utah Project, Utah												
Bonneville Unit	105	-21	-21	3/	30	-6	-6	3/	0	0	0	0
Upalco Unit	12	0	0	2/	0	0	0	2/	0	0	0	0
Uintah Unit	3	0	2	1,000	25	0	14	6,800	0	0	0	0
Deferred Indian Lands, Utah	40	0	34	17,000	10	0	9	4,300	0	0	0	0
Above the gage White River near Watson, Utah												
Oil shale prototype development, Colorado, Utah	110	-67	-67	1/	18	-11	-11	1/	0	0	0	0
Between the gages Green River near Greendale, Utah: Yampa River near Maybell, Colorado; Duchesne River near Randlett, Utah; White River near Watson, Utah; and Green River at Green River, Utah												
Cheyenne-Laramie, Wyoming	7	-1	-1	3/	5	0	0	3/	30	-3	-3	3/
Central Utah Project, Utah												
Jensen Unit	15	0	1	440	0	0	0	0	0	0	0	0
Above the gage San Rafael River near Green River, Utah												
Utah Power and Light-Huntington, Emery Co., Utah	9	-2	-2	1/	0	0	0	0	0	0	0	0
Above the gage Colorado River near Glenwood Springs, Colorado												
Denver, Englewood, Colorado Springs, Pueblo; Colorado	129	-13	-13	3/	50	-5	-5	3/	56	-6	-6	3/
Homestake, Colorado	15	-1	-1	3/	16	-1	-1	3/	0	0	0	0
Windy Gap, Colorado	30	-2	-2	3/	24	-2	-2	3/	0	0	0	3/
Between the above gage and gage Colorado River near Cameo, Colorado												
Independence Pass, Colorado	7	0	0	3/	0	0	0	0	0	0	0	0
Fryingpan-Arkansas, Colorado	16	-1	-1	3/	17	-1	-1	3/	0	0	0	0
Ruedi M&I, Colorado	15	-9	-9	1/	33	-20	-20	1/	0	0	0	0
West Divide, Colorado	1	0	0	0	37	0	9	4/10,450	0	0	0	0
Above the gage Gunnison River near Grand Junction, Colorado												
Dallas Creek, Colorado	12	7	7	2/ 4/	5	3	3	2/ 4/	0	0	0	0
Above the gage Dolores River near Cisco, Utah												
Dolores, Colorado	102	-16	-16	5/34,000	5/2	-1	-1	5/1,360	1	0	0	0
San Miguel, Colorado	8	0	4	3,500	23	0	10	4/3,560	0	0	0	0
Between the gages Colorado River near Cameo, Colorado; Gunnison River near Grand Junction, Colorado; Dolores River near Cisco, Utah and the gage Colorado River near Cisco, Utah	0	0	0	0	0	0	0	0	0	0	0	0
Above the gage San Juan River near Archuleta, New Mexico												
San Juan-Chama, New Mexico	10	-2	-2	3/	0	0	0	0	0	0	0	0
Navajo Indian Irrigation, New Mexico	458	-105	-105	6/101,000	0	0	0	0	0	0	0	0
Jicarilla Apache	3	0	0	0	0	0	0	1/	0	0	0	0
Between the above gages and the gage San Juan River near Bluff, Utah												
Farmington M&I	5	0	0	0	0	0	0	1/	0	0	0	0
Animas-LaPlata, Colorado, New Mexico	15	0	0	0	131	-17	-6	4/43,700	8	0	0	0
Expansion Hogback, New Mexico	8	0	5	2,500	0	0	0	0	0	0	0	0
Four Corners Powerplant, New Mexico	18	-11	-11	1/	0	0	0	1/	0	0	0	1/
Navajo M&I contracts	90	-55	-55	1/	0	0	0	0	-100	55	55	0
Return flow - Dolores and Navajo Indian Irrigation, Colorado-New Mexico	-252	17	224	5/ 6/	-1	1	2	5/ 6/	0	0	0	5/ 6/
Between the gages Green River at Green River, Utah; San Rafael River near Green River, Utah; Colorado River near Cisco, Utah; and San Juan River near Bluff, Utah; and the gage Colorado River at Lee's Ferry, Arizona												
Navajo Powerplant, Arizona	12	-13	-13	1/	0	-2	-2	1/ 7/	0	0	0	0
Other municipal, Arizona	3	-3	-3	1/	0	0	0	0	0	0	0	0
Mill Creek, Utah	3	0	1	565	0	0	0	0	0	0	0	0
Subtotal Upper Basin	1,100	-325	-71	160,005	520	-92	-38	70,170	45	29	29	0

1/ In basin depletion for municipal and industrial use.
2/ Supplemental irrigation only.
3/ Trans-Colorado River Basin diversion.
4/ Salt pickup determined by special study.
5/ In-basin transfer from Dolores River drainage to the San Juan River drainage - estimated 24,000 acre-foot return flow to the San Juan River.
6/ Diversion at Navajo Reservoir, estimated 254,000 acre-foot return flow to the San Juan River below the gage near Archuleta, New Mexico.
7/ Additional salt removed because of future increased concentration with no increase in water depletion.

Table D

Summary of Historical, Present Modified and Estimated Future Average Annual Water Conditions at Twenty-one Stations
Colorado River Basin[1/] [2/]

(Units: 1,000 except concentrations)

	Average Historical Condition (1941-78)				Present Modified Condition 1978				1990 Condition							2000 Condition							2010 Condition						
									Zero Pickup				T.D.S. Pickup at 2T/A			Zero Pickup				T.D.S. Pickup at 2T/A			Zero Pickup				T.D.S. Pickup at 2T/A		
	Flow (AF)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	Flow (AF)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	Flow (AF)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	Flow (AF)	T.D.S (T)	Concentration (T/AF)	Concentration (mg/L)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	Flow (AF)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/L)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Green River near Green River, Wyoming	1,301	550	0.42	311	1,253	552	0.44	324	1,179	523	0.44	326	523	0.44	326	1,122	497	0.44	326	497	0.44	326	1,072	480	0.45	329	480	0.45	329
Green River near Greendale, Utah	1,581	937	0.59	436	1,563	989	0.63	465	1,485	960	0.65	475	960	0.65	475	1,420	930	0.65	482	930	0.65	482	1,370	930	0.68	499	930	0.68	499
Yampa River near Maybell, Colorado	1,060	228	0.22	158	1,055	227	0.22	158	1,042	224	0.21	158	224	0.21	158	1,012	224	0.22	163	224	0.22	163	1,012	224	0.22	163	224	0.22	163
Duchesne River near Randlett, Utah	417	388	0.93	684	375	385	1.03	755	215	364	1.69	1245	400	1.86	1368	150	358	2.39	1755	417	2.78	2044	150	358	2.39	1755	417	2.78	2044
White River near Watson, Utah	484	291	0.60	442	484	291	0.60	442	374	224	0.60	440	224	0.60	440	356	213	0.60	440	213	0.60	440	356	213	0.60	440	213	0.60	440
Green River at Green River, Utah	4,151	2,580	0.62	457	4,064	2,638	0.65	477	3,681	2,517	0.68	503	2,554	0.69	510	3,498	2,470	0.71	519	2,530	0.72	532	3,418	2,450	0.72	527	2,510	0.73	540
San Rafael River near Green River, Utah	86	202	2.35	1727	69	201	2.91	2142	60	199	3.32	2439	199	3.32	2439	60	199	3.32	2439	199	3.32	2439	60	199	3.32	2439	199	3.32	2439
Colorado River near Glenwood Springs, Colorado	1,606	586	0.36	268	1,451	588	0.41	298	1,277	572	0.45	329	572	0.45	329	1,187	564	0.48	349	564	0.48	349	1,131	558	0.49	363	558	0.49	363
Colorado River near Cameo, Colorado	2,745	1,513	0.55	405	2,525	1,505	0.60	438	2,312	1,479	0.64	470	1,479	0.64	470	2,135	1,450	0.68	499	1,459	0.68	502	2,079	1,444	0.69	511	1,453	0.70	514
Gunnison River near Grand Junction, Colorado	1,684	1,427	0.85	623	1,669	1,442	0.86	635	1,657	1,449	0.87	643	1,449	0.87	643	1,652	1,452	0.88	646	1,452	0.88	646	1,652	1,452	0.88	646	1,452	0.88	646
Dolores River near Cisco, Utah	585	472	0.81	593	585	472	0.81	593	475	456	0.96	706	460	0.97	712	450	455	1.01	743	469	1.04	766	449	455	1.01	745	469	1.04	768
Colorado River near Cisco, Utah	4,836	4,022	0.83	612	4,553	4,053	0.89	655	4,218	4,018	0.95	700	4,022	0.95	701	4,011	3,991	1.00	732	4,014	1.00	736	3,954	3,985	1.01	741	4,008	1.01	745
San Juan River near Archuleta, New Mexico	876	194	0.22	163	767	176	0.23	169	296	69	0.23	171	69	0.23	171	296	69	0.23	171	69	0.23	171	296	69	0.23	171	69	0.23	171
San Juan River near Bluff, Utah	1,563	963	0.62	453	1,432	988	0.69	507	1,077	837	0.78	571	1,049	0.97	716	947	821	0.87	637	1,045	1.10	811	1,039	876	0.84	620	1,100	1.06	778
Colorado River at Lees Ferry, Arizona	10,171	7,747	0.76	560	10,030	8,456	0.84	620	8,930	8,131	0.91	670	8,385	0.94	690	8,410	8,039	0.96	703	8,347	0.99	730	8,365	8,068	0.96	709	8,376	1.00	736
Colorado River near Grand Canyon, Arizona	10,480	8,799	0.84	617	10,339	9,508	0.92	676	9,239	9,183	0.99	731	9,437	1.02	751	8,719	9,091	1.04	767	9,399	1.08	793	8,674	9,120	1.05	773	9,428	1.09	799
Virgin River at Littlefield, Arizona	154	344	2.23	1642	154	344	2.23	1642	133	311	2.34	1719	311	2.34	1719	114	288	2.53	1858	304	2.67	1961	114	288	2.53	1858	304	2.67	1961
Colorado River below Hoover Dam, Ariz.-Nev.	9,999	9,406	0.94	691	9,760	10,084	1.03	760	8,560	9,679	1.13	831	9,934	1.16	853	7,975	9,573	1.20	883	9,899	1.24	913	7,853	9,588	1.22	898	9,914	1.26	928
Colorado River above Parker Dam, Ariz.- Calif.	9,639	9,151	0.95	698	9,388	9,844	1.05	771	8,129	9,430	1.16	853	9,710	1.19	878	7,509	9,310	1.24	912	9,665	1.29	946	7,399	9,339	1.26	928	9,694	1.31	963
Colorado River below Parker Dam, Ariz.-Calif.	8,982	8,500	0.95	696	8,678	9,184	1.06	778	6,630	7,691	1.16	853	7,919	1.19	878	6,627	8,216	1.24	912	8,530	1.29	946	6,636	8,376	1.26	928	8,694	1.31	963
Colorado River at Imperial Dam, Ariz.-Calif.	8,259	8,645	1.05	769	7,815	9,321	1.19	875	5,632	7,820	1.39	1021	8,084	1.44	1055	5,613	8,345	1.49	1093	8,711	1.55	1141	5,622	8,505	1.51	1112	8,875	1.58	1161

1/ Without water quality improvement program.

2/ Several factors influencing the salinity levels portrayed herein warrant caution in using this table. First, projections in the table of future salinity conditions do not represent forecasts of anticipated future salinity levels that might actually occur in any given year in the future. The underlying basis for projections in the table is the long-term average (1941-1978) salinity condition, as modified, for example, by projected year 1990, 2000, and 2010 level water depletions attributable to projects now planned for operation prior to each of these 3 specific years. The average salinity conditions during the period 1941-1978 in the segmented 10-year projections have been modified to reflect what the salinity condition would have been during said period if the planned after-built projects and depletions had been in existence throughout the period 1941-1978. It would only be coincidental if the base average salinity condition for any given year in the past, or the future, were the same as the annual salinity level that did in fact occur. Moreover, there can be no guarantee that any or most of the planned future water projects, and the consequent projected water depletions incorporated into the figures in this table, will be completed, or be in operation at the time now forecast. There is a second reason for caution in using this table. Recent studies indicate a significant deviation in the runoff-salt load relationship for the past several years. Preliminary findings indicate a statistically significant reduction in salt load entering Lake Powell. We have undertaken a detailed examination of the hydrologic data to ascertain the underlying reasons for this reduction and its implications as to salinity control. It is possible that the cause of this reduction is such that it could lead to reductions in salt-loading now projected for future years. Thirdly, since this table is based on 1941-1978 averages, recent downward trends in salinity levels are recognized only to the extent that they influence the long-term average.

Table C (continued)
Projects Depleting Colorado River Water
Incremental Change in Flow and Salt Load 1978 to 2010

	Increase 1978 to 1990				Increase 1990 to 2000				Increase 2000 to 2010			
	Depletion (1,000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)	Depletion (1000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)	Depletion (1,000 ac.-ft.)	T.D.S. Load (1,000 tons) OT/A	2T/A	New Irrigation Lands (acres)
Between the gage Colorado River at Lee's Ferry and the gage Colorado River near Grand Canyon Arizona	0	0	0	0	0	0	0	0	0	0	0	0
Above the gage Virgin River at Littlefield, Arizona												
Warner Valley	21	-33	-33	9/	19	-23	-7	2,000	0	0	0	0
Between the gages Colorado River near Grand Canyon, Arizona, and Virgin River at Littlefield, Arizona, and the gage Colorado River below Hoover Dam, Arizona-Nevada												
Southern Nevada Water Project, Nevada	45	8	8	0	42	8	8	0	50	9	9	9/
Harry Allen Powerplant	28	-56	-56	9/	0	0	0	0	0	0	0	0
Other Nevada Projects.	6	1	2	9/	4	1	2	9/	27	-23	-23	10/
Between the above gage and the gage Colorado River below Parker Dam, Arizona-California												
Mohave Steam Plant	9	-9	-9	0	5	-5	-5	0	-23	23	23	10/
Fort Mohave Indians, Arizona, California	43	0	21	10,774	0	0	0	0	0	0	0	0
Chemehuevi Indians, California	4	0	0	9/	3	0	0	9/	0	0	0	0
Kingman, Arizona	0	0	0	0	9	-9	-9	0	9	-9	-9	0
Mohave Valley I&D District, Arizona	11	0	4	2,000	11	0	4	2,000	0	0	0	0
Havasu National Wildlife Refuge, Arizona	3	0	0		0	0	0	0	0	0	0	0
New District, Arizona	4	0	0	9/	2	0	0	9/	2	0	0	9/
Lake Havasu I&D District, Arizona	7	0	0	9/	0	0	0	0	0	0	0	0
Needles, California	5	0	0	9/	5	0	0	9/	0	0	0	0
Central Arizona Project, Arizona8/												
Metropolitan Water District, California												
Between the above gage and the gage Colorado River at Imperial Dam, Arizona and California												
Other Users, Arizona and California	3	0	0	9/	0	0	0	0	0	0	0	0
Palo Verde Irrigation District, California	2	0	1	500	0	0	0	0	0	0	0	0
Cibola National Wildlife Refuge.	8	-8	-8	0	0	0	0	0	0	0	0	0
Colorado River Indian Reservation A-C.	70	0	35	17,500	33	0	16	8,183	0	0	0	0
Subtotal Lower Basin.	269	-97	-35	30,774	133	-28	9	12,183	65	0	0	0
Total Colorado River	1369	-422	-106	190,779	653	-120	-29	82,353	110	29	29	0

8/ The Central Arizona Project diversions will vary depending on the depletions by other projects on the river and depending on the total amount of water available from the system in a given year. Maximum annual diversions to Central Arizona could be 2,172,000 acre-feet. With the full depletions by the projects tabulated, the consumptive use to California would be reduced to an annual 4,400,000 acre-feet. Water supply studies based on the 1906-1979 runoff period in the Colorado River Basin show average diversions for the Central Arizona Project of 1,711,000 acre-feet in the year 1990, 1,248,000 acre-feet in the year 2000 and 934,000 in the year 2010.

9/ In-basin depletion without new irrigated lands.

10/ Assumes a new contract for water will be obtained for the Mohave Steam Plant.

PART VIII. COLORADO RIVER SALINITY CONTROL PROGRAM

Section 206 of Title II of the Colorado River Basin Salinity Control Act, Public Law 93-320, of June 24, 1974, directs the Secretary of the Interior, commencing on January 1, 1975, and every 2 years thereafter, to submit, simultaneously, to the President, the Congress, and the Advisory Council, a report on the Colorado River Salinity Control Program covering the progress of investigations, planning, and construction of salinity control units for the 2 previous fiscal years. The report is to include the effectiveness of the units, anticipated work to be accomplished to meet the objectives of Title II with emphasis on the needs during the 5 years immediately following the date of each report, and any special problems that may be impeding progress in attaining an effective salinity control program. Section 206 also provides that this report may be included in the Quality of Water-Colorado River Basin biennial progress report.

A. Projects Authorized for Construction

Title II of Public Law 93-320 authorized the Secretary of the Interior to construct as the initial stage of the Colorado River Water Quality Improvement Program, the Paradox Valley Unit, Colorado; the Grand Valley Unit, Colorado; the Crystal Geyser Unit, Utah; and the Las Vegas Wash Unit, Nevada. The schedule of definite plan reports for projects authorized for construction is shown on Figure 4. This section of the report presents a brief description and summary of the status of investigations for each of the projects authorized for construction.

1. Paradox Valley Unit

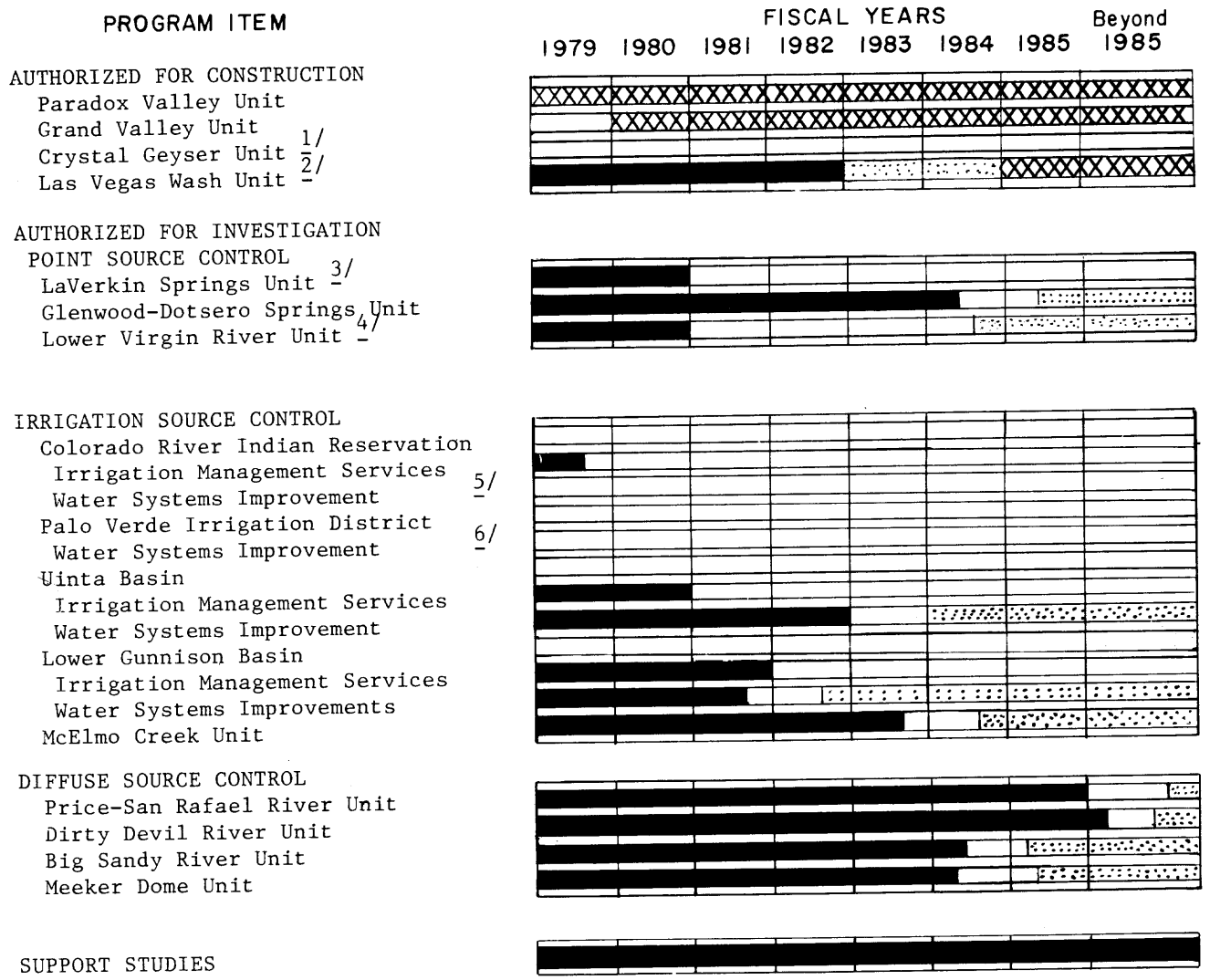
Paradox Valley, a collapsed salt anticline, is a northwest-southeast trending valley 3 to 5 miles (5 to 8 km) wide located in southwestern Colorado. It has an arid climate, dry and hot in the summer and dry and cold in the winter.

Geologic investigations in the Colorado Plateau have established the existence of a series of five major northwest-southeast trending salt anticlines (elongated swells) about 100 miles (160 km) long. Paradox Valley lies along the axis of one of these salt anticlines and was formed from erosion of faulted and uplifted sandstone and shale formations from above a residual gypsum cap overlying about 14,000 feet (4300 m) of pure salt and salt-rich shale. The Dolores River remained in its ancient streambed as the uplift and erosion of the valley developed. West Paradox Creek heads in the La Sal Mountains and flows southeast through the northwestern half of Paradox Valley to the Dolores River. East Paradox Creek, an intermittent stream, drains the southeastern half of Paradox Valley before flowing into the Dolores River.

Previous estimates of the salinity contribution from the Paradox Valley were based on spot measurements of flow and water quality of the Dolores River as it enters and leaves the valley. Two stream gaging

INVESTIGATION AND CONSTRUCTION SCHEDULE

COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM



1/ Construction not scheduled.
2/ Las Vegas Wash Unit will require reformulation of plans because of changing conditions of flow and salinity concentration.
3/ Status report released December 1979.
4/ Status report scheduled for completion in 1980.
5/ Concluding Report released Oct. 1979-BIA will improve the canals and laterals.
6/ Status Report released Mar. 1980.

INVESTIGATION
PRECONSTRUCTION INVESTIGATION
CONSTRUCTION

Fig. 4

stations and a water quality sampling program were established in 1972. Analysis of 5 years of streamflow and water quality records modified the previous estimate to 205,000 tons (186 000 t) of salt per year.

Feasibility studies were initiated in 1972. Investigations are covered in previous reports for fiscal years 1972-77. The plan involves pumping the brine from the well field to a nearby hydrogen sulfide stripping plant. The treated brine and sulfur would be pumped to the proposed Radium Evaporation Pond or deep well injection site for disposal. A third option is being simultaneously explored - disposal into a pipeline collection system.

Ten additional piezometer clusters have been added in the well field to improve the monitoring network. Two holes were drilled at each cluster consisting of a deep-piezometer to monitor pressure changes and a shallow observation well to monitor the changes in water table and brine-fresh water interface levels.

Erosion control jacks have been placed on the river side of the temporary brine pond. During high river flows some of the pond embankment was being eroded away. The jacks are doing a good job in controlling erosion.

Testing to remove the hydrogen sulfide gas from the brine is continuing. A pilot electrolytic oxidation plant was tested at the well field in late 1978. Earlier, an aeration process was tested using a nickel sulfate catalyst to oxidize the hydrogen sulfide into elemental sulfur. The testing program is about 70 percent complete and is scheduled to end in early 1981.

Water rights and land acquisition are now in the process of being obtained. Legal work in these areas is continuing and does not appear to present any major problems.

Studies to determine the impacts an evaporation pond would have on waterfowl have been done by Colorado State University and Water and Power personnel. Some pertinent information has been obtained from the studies but no specific conclusions have been reached. The U.S. Fish and Wildlife Service will help determine if additional studies are needed.

The brine well field is presently being test pumped to determine the rate of pumping needed to stop the brine flow into the river. The test pumping will continue through 1981 or until adequate information is collected.

A professional services contract will be awarded in 1980 to study the possibility of disposing of the brine by deep well injection. The request for proposals was mailed on August 13, 1980. If the possibilities of deep well injection prove favorable, injection tests will be attempted.

2. Grand Valley Unit

The Grand Valley is located near the western edge of Mesa County in western Colorado. Grand Junction in the southern part of the valley is the largest city in Colorado west of the Continental Divide. The valley was carved in the Mancos Shale formation (a high salt bearing marine shale) by the Colorado River and its tributaries. Within the valley the irrigated lands have been developed on recent alluvial plains consisting of broad coalescing alluvial fans and on older and higher alluvial fans, terraces, and mesas. Other lands in this arid setting, where rainfall averages only about 9 inches (230 mm) per year, include stream flood plains, rough broken terrace escarpments, high knobs, and remnants of former mesas.

Irrigation in the valley began in 1882 with the construction of what is now the Grand Valley Canal (Grand Valley Irrigation Company). Other private systems were built during the period between 1882 and 1908. Construction of the last major system, the Grand Valley Project under the Reclamation Service, began in 1908 with the major construction completed in 1926. This project consists of two divisions, Garfield Gravity and Orchard Mesa, on the north and south sides of the river respectively.

A total of about 71,000 acres (29 000 ha) are served water by these irrigation entities with approximately 38,000 acres (15 000 ha) under the Federal project. Major crops produced in the valley are corn, small grains, alfalfa, pasture, and various orchard crops.

The Grand Valley is estimated to contribute an average of about 780,000 tons (708 000 t) of salt annually to the Colorado River. Most of these salts are leached from the soil and underlying Mancos Shale by deep percolation and seepage from water delivery systems, and are washed into the river by ground water inflow.

The Mancos shale is a very thick sequence of saline drab gray fissile shale that lies between the underlying Dakota sandstone and the overlying Mesa Verde Formation. The thickness of the shale usually varies between 3,000 feet (900 m) and 5,000 feet (1500 m). Due to this great thickness and its easy erodibility, the shale fills most of the large valleys in western Colorado and eastern Utah. Many white patches of salt and alkali are visible on the nonirrigated surfaces and some patches are also visible on the irrigated lands where drainage is poor. The salts present in the Mancos shale are mostly calcium sulfate with smaller amounts of sodium chloride, sodium sulfate, and magnesium sulfate. Calcium sulfate (gypsum) is commonly found in crystal form in open joints and fractures of the shale.

Due to the compactness of the clay and silt particles making up the shale, the formation is not considered water bearing at depth. However, the weathered zone near the surface does transmit water along joints, fractures, and open bedding plains. This zone is the area from which percolating water, often originating from irrigation of croplands, may dissolve salts present in the shale. In addition, most of the soil forming the irrigated lands have been derived from Mancos shale. As a result, the soils are also a source of salt.

Existing data shows that a narrow confined aquifer in the weathered shale conducts most of the canal seepage. A gravel and cobble layer also has been found under some of the irrigated areas in the Grand Valley and is believed to serve as a aquifer for ground water. Studies have identified areas where the ground water has artesian pressure in the cobble aquifer due to the confining effect of the Mancos shale beneath and the tight clay soil above. This situation is believed to be responsible for some areas of high water tables. The cobble aquifer is being studied to determine its extent and influence on the ground water system.

An operation and maintenance contract has been signed with the Grand Valley Water Users Association preparatory to construction of the water system improvements in the Stage One area. Construction contracts were being awarded in 1980 for a field station and for lining 6.8 miles (11 km) of the Government Highline Canal. Congress did not disapprove placing the laterals in pipe, but amendatory legislation is pending for mitigating wildlife habitat losses. The pipe lateral contract for Stage I will be awarded in early 1981 with completion expected in 1983.

A monitoring plan has been devised by the Water and Power Resources Service to measure salinity reductions and wildlife habitat impacts in the Stage One area resulting from on-farm and water system improvements. The plan has been reviewed by other agencies involved in the salinity project and is being put into operation.

Except for the Stage One area the Irrigation Management Services (IMS) program has been terminated in Grand Valley. Research and development funds are being used to continue the IMS program in the Stage One area to further test its effectiveness in reducing salinity.

Data collection is continuing inside and outside the Stage One area including discharge and water quality measurements in natural drainage ways tributary to the Colorado River and water level measurements in a network of ground water observation wells. Planning for the remainder of the Grand Valley Unit is to be completed in 1985 with a construction start projected for 1986.

The Department of Agriculture received appropriations of $1.7 million in 1979 and $1.8 million in 1980 to initiate construction of on-farm improvements for reducing salinity. Where possible the on-farm improvements are being concentrated in the Stage One area to complement the water systems improvements being done by the Water and Power Resources Service.

3. Crystal Geyser Unit

The Crystal Geyser, a privately owned abandoned oil test well, located 3.5 miles (5.6 km) south of the town of Green River, Utah, on the east bank of the Green River, contributes about 3,000 tons (2700 t) of salt annually to the Colorado River System. The saline water erupts in the form of a geyser at about 5-hour intervals due to carbon dioxide accumulations. The concentrations of the water range from 11 000 to 14 000 mg/L

and the annual flow amounts to about 150 acre-feet (185 000 m^3). The climate at the geyser is desert-like with an average annual temperature of 52° F (11° C) and an average annual precipitation of 6 inches (150 mm). The vegetation in the geyser area is sparse with tamarisk and scattered cottonwood trees along the edges of the river and cactus, Brigham tea, greasewood, and shadscale elsewhere.

The estimated annual removal of salt by the alternative plans is about 3,000 tons (2700 t), a relatively minor amount. Salinity concentrations of the Colorado River at Imperial Dam would be reduced by an estimated 0.3 mg/L.

The Definite Plan Report (DPR), Environmental Assessment, and Negative Determination of Environmental Impact have been completed and were submitted in June 1976.

The plan is to collect and convey the flows to evaporation ponds about 3 miles (5 km) downstream. A compacted earth embankment would be constructed on the stream side of the geyser to collect and temporarily store the water from the eruptions. A plastic pipe would convey the water from the temporary storage pond at a uniform rate to the evaporation ponds. The pipeline would cross many small drainages and the Little Grand Wash. Bedrock may present some difficulties in laying the pipe. The evaporation ponds would be located on a typical river flood plain of lean clay with lenses of silt, sand (sometimes clean), and gravel. The ponds would require a flexible polyvinyl lining to assure that no leakage back to the river occurs. About 2 miles (3 km) of the access road to the geyser would need improvement by grading, installing culverts, and possibly gravel surfacing. The access road to the evaporation ponds would also need some improvement.

Construction on this unit has been delayed indefinitely due to high construction costs and low cost effectiveness.

4. Las Vegas Wash Unit

Las Vegas Wash is a natural drainage channel providing the only surface water outlet for the entire 2,193 square miles (5680 km^2) Las Vegas Valley. A drainage area of 1,586 square miles (4108 km^2) directly contributes to the Wash which conveys stream runoff and wastewater to Las Vegas Bay, an arm of Lake Mead. Located in Clark County in Southern Nevada, the Las Vegas Valley contains the largest population center in the state. Three cities (North Las Vegas, Las Vegas, and Henderson) and other communities are drained by tributaries to Las Vegas Wash. Studies evaluating salinity contributed by the wash are concerned mainly with the 10 mile (6 km) reach upstream of Las Vegas Bay. The wash flood plain and adjacent area support about 1,800 acres (730 ha) of halophyte, hydrophyte, and phreatophyte vegetation.

Before water development in the valley, Las Vegas Wash has been a generally barren and sandy channel with contained discharge only during brief periods of major storm runoff. The growth of the communities in the valley contributed increasing amounts of wastewater discharge to the wash until the flow became perennial. Return flows to the wash are from secondary treated sewage plant effluent, industrial cooling water, and urban irrigation and agricultural drainage. The water from some of these sources contains nutrients, salts, and other solutes. However, all of the wastewater leaches additional salts from the soil as it flows into and through the Las Vegas Wash.

Past investigations associated with plan development have been described in previous progress reports. Construction according to a draft definite plan was begun in 1977, but it was delayed in 1978 to allow time to reevaluate the changing ground water conditions in the Lower Las Vegas Valley.

Status of Investigations - The principle investigation objectives for the reevaluation were to identify the potential for cost effective salinity control and to formulate a practical and cost effective plan. Data collection and analysis have been sufficiently completed to indicate possible cost effective plans, but the formulation of such plans is contingent upon the waste-water management practices of valley water users. Therefore, development of a definite plan for the Las Vegas Unit has been delayed to compliment a schedule for Las Vegas Wash nutrient control planning conducted by a group of various other entities. During the time required to develop a comprehensive water and solute management plan with other entities, the monitoring of changes in the saline ground water would continue.

The ground-water monitoring program would be augmented by the addition of a recharge control verification program. A 3 mile (2 km), 24-inch (61 cm) pipeline would be installed to prevent once-through cooling water from infiltrating through salt laden soils and carrying up to 20,000 tons (18 000 t) per year of salt into Las Vegas Wash and thence to the Colorado River. By transferring the surface discharge conveyed in unlined ditches into the pipeline, the ground water flow in the adjacent area is expected to diminish. This reduction would reduce required evaporation and pond capacity for any future diversion of remaining saline ground water. The amount of reduced salt loading resulting from the recharge control would be verified by the ground-water monitoring program. This verification may be used to indicate the potential salinity control in other areas that may be affected by reducing ground water recharge.

A study of the amount of salt stored in soils above the water table began in May 1980 and should be completed by September 1981. Accumulated salt in this zone could have a significant future impact on the Colorado River which may not be evident in dissolved salt flow analysis.

The EPA has collected ground water and soil samples in the Lower Las Vegas Valley for a survey of potential hazardous wastes. The magnitude and type of materials in the Las Vegas Wash ground water may influence both the planning and design of salinity and nutrient control features. Evaporation ponds may require more stringent lining requirements if they are expected to concentrate hazardous materials.

A report of the findings of the ground water investigations would be provided in a status report that is scheduled for completion in July 1981. The recommended comprehensive water and solute management plan may be developed in 1981 and provide the basis for a salinity control definite plan report in mid-1982.

B. Projects Authorized for Planning

Section 203(a)(1) of Public Law 93-320 authorized and directed the Secretary of the Interior to expedite completion of the planning reports on units described in the Secretary's report, "Colorado River Water Quality Improvement Program, February 1972," Section 203(b)(2) and directs the Secretary to undertake research on additional methods of accomplishing the objective of this title, (Title II of Public Law 93-320).

There are three categories of projects listed under Section 203, (1) irrigation source control, (2) point source control, and (3) diffuse source control. The schedule of reports for projects authorized for investigation is shown on Figure 4. The investigative program for each project is reviewed periodically to accelerate the completion of the reports. A brief description and status of the listed projects follows:

1. Irrigation Source Control Projects

Under the Colorado River Water Quality Improvement Program major program emphasis for control of irrigation sources is placed on improved irrigation management through an IMS program and improved control of water flow in canals, laterals, and drainage systems through a Water Systems Improvements (WSI) program. Basically, the IMS program is a nonstructural management technique for increasing irrigation water efficiency and reducing salt loading. This is a demonstration-type program based on the concept that the water user will take over and operate the program. Under requirements in provisions of Public Law 92-500, this practice is expected to spread to other irrigated areas in the basin. Benefits expected to be derived from IMS irrigation scheduling include increased yields, labor savings, reduced leaching of soils, and reduced drainage requirements.

The WSI program, on the other hand, involves a structural water management tool for improving water delivery conveyances and, thus, reducing seepage and salinity pickup. The lining of canals and laterals would result in decreased deep percolation losses, thus reducing water contact with highly saline soils, shales, and saline ground waters.

A considerable amount of water diverted for irrigation in the Colorado River Basin is returned to the parent stream. However, with continued use the water becomes concentrated with salt, thus lowering the quality. In some cases, particularly after repeated use the return flow water becomes undesirable for irrigation or municipal and industrial use without treatment. A few specialized industries, however, can use water of poor quality for cooling purposes. With the advent of increased need for electric generating and fuel-producing entities, wastewater flows have assumed new importance. In addition to the above program, planning reports evaluating irrigation source control units will also indicate the potential for collection of return flows for industrial use or of treatment to improve the quality of the receiving streams.

Lower Gunnison Basin Unit. The Stage I area of the Lower Gunnison Basin Unit is located in the Uncompahgre Valley in west-central Colorado, between the communities of Delta and Colona. The Stage II area, currently not under study by the Water and Power Resources Service is located to the northeast of Stage I, and is called the North Fork area centered around the community of Hotchkiss.

The Uncompahgre Valley is mainly an agricultural area relying on irrigation water delivery via a 550 mile (880 km) system of canals and laterals. The source of irrigation water is the Uncompahgre River which flows through the middle of the valley, and the Gunnison River which is partially diverted through a 6 mile (10 km) tunnel.

Field data indicate that about 400,000 tons (363 000 t) of salt are leached from the valley each year, and this salt ultimately finds its way into the Colorado River by way of the Gunnison River and its tributary, the Uncompahgre River. The objective of the Lower Gunnison Basin Unit is to reduce salinity in the Colorado River by controlling seepage from the delivery system and by appropriate on-farm measures.

Feasibility level investigations were initiated for the Lower Gunnison Basin Unit in 1977. The Water and Power Resources Service is investigating the delivery system salt load contributions, and the Soil Conservation Service is investigating on-farm measures.

The Feasibility Report is scheduled for completion in December 1981 and the Draft Environmental Statement in January 1982.

Investigations since 1977 are as follows:

Ponding Tests - In the Fall of 1977, three ponding seepage tests were made, one each on the Selig East, Garnet, and Ironstone Canals. The Garnet Canal showed the highest seepage rate, about 0.4 ft/day (120 mm/d) while the East Canal had the lowest seepage rate, measured at less than 0.1 ft/day (30 mm/d). Two additional sites were tested in the fall of 1978; one on the South Canal and one on the Loutzenhizer Canal. The test results for the Loutzenhizer Canal showed about 0.4 ft/day (120 mm/d) loss for what

was considered the normal water surface elevation of the canal. The results for the South Canal showed about 0.17 ft/day (50 mm/d) seepage loss. Of the six ponding tests, only two are reasonably good, the Ironstone Canal test in 1977 and the Loutzenhizer Canal test in 1978. All other test locations had problems, and the level of confidence varies.

Inflow-Outflow Tests - In October 1977, 19 lateral reaches were tested for seepage by current meter measurements of inflow and outflow. Of the 19 test reaches, only 6 showed definite losses. In the spring and summer of 1978, an additional 20 inflow-outflow tests were made. Once again only seven reaches showed a decrease of the outflow over inflow. This is about the same percentage as was found in the 1977 testing.

There appears to be many interferences involved in testing for seepage by the inflow-outflow method. Unseen return flows are probably the greatest single factor. Measurement error undoubtedly is also a factor. Fluctuations in lateral flows also cause errors and are difficult to control.

Four sets of Parshall flumes were installed on four reaches of laterals in 1978. It was hoped that continuous flow recording would take care of the fluctuation problems. Two reaches showed good results, one seeps about 0.3 ft/day (90 mm/d) while the other about 0.6 ft/day (180 mm/d). These laterals are not influenced by irrigation return flows and the tests are considered reliable.

Drill Hole Tests - During the summers of 1978 and 1979 a program of determining canal seepage by measuring parameters in Darcy's equation such as permeability and gradient was accomplished. The program was undertaken to circumvent the problems encountered with ponding tests and inflow-outflow measurements as a means of determining canal seepage. A total of 96 holes were drilled along the access roads of those canals east of the Uncompahgre River. It became apparent that both an artesian and free water table aquifer were present. The artesian aquifer is located within the weathered Mancos shale and the free water table aquifer is more shallow in the reworked Mancos shale soils. A total of 39 aquifer tests (Piezometer, auger-hole, and Pomona) were made to determine the hydraulic conductivities for the two types of aquifers. The mean seepage rate for the artesian aquifer was found to be 0.264 $ft^3/ft^2/day$ (80 $mm/m^2/d$) and the mean seepage rate for the free water table aquifer was found to be 0.202 $ft^3/ft^2/$ day (60 $mm/m^2/d$).

Public Participation - The planning team for the Lower Gunnison Basin Unit was organized on May 4, 1977. The team was reorganized in October 1977, and one of the spin-offs from reorganization was that an advisory subteam was established to permit greater public participation.

The first public meeting was held in August 1979 in Olathe, Colorado. At this meeting, the public was asked to determine which types of alternative solutions the valley residents preferred and which types they definitely could accept. The public was also asked for any recommendations

which had not yet been considered. Participants indicated a strong preference for concrete lining and disapproval of institutional-type controls such as land retirement and limitations of water delivery. One recommendation from the public was that certain areas may not be suitable for rigid concrete linings and a flexible lining might be considered.

At the second public meeting in Montrose, Colorado, in September 1979, the public made a choice regarding the preferred degree of lining. The new result was that as much of the delivery systems be lined as can be justified under the salinity program. A close second in terms of support was the alternative to line only adobe soil areas (which correspond to the higher saline areas).

The third public meeting which was called an Environmental Scoping Meeting was held in Olathe on April 30, 1980. The purpose of the meeting was to solicit both significant and nonsignificant environmental concerns the public may have regarding the recommended plan and any of the more acceptable alternatives. Such concerns were obtained and will be listed in the project's Environmental Impact Statement.

Uinta Basin Unit. The Uinta Basin lies between the Uinta Mountains on the north and the Tavaputs Plateau on the south in northeastern Utah. The climate in the basin is extremely variable. Summers are hot, with low humidity, and winters are relatively severe. Extreme fluctuations in precipitation and temperature occur over the area. The average annual precipitation is about 7.5 inches (190 mm) at Roosevelt, Utah. The average annual temperature is about 47° F (8° C) ranging from -32° F to 105° F (-36° C to 41° C). Irrigated lands in the Uinta Basin totaling 170,000 acres (69 000 ha) are located primarily on alluvial materials adjacent to rivers and on benches and mesas. The Uinta Mountains, several peaks of which exceed 13,000 feet (3960 m), are the main source of irrigation water for the basin. The mountain front streams above the irrigated lands produce high-quality water with total dissolved solids ranging from 30 to 350 mg/L. Water quality in the basin deteriorates as return flows from irrigated lands enter the Duchesne River and its tributaries. Concentrations in the Duchesne River below most irrigated lands range from 200 to 4000 mg/L with an average of 680 mg/L.

The Uinta Basin and Ashley Valley contribute about 450,000 tons (408 000 t) of salt annually to the Colorado River, much of it from irrigated areas.

(a) Irrigation Management Service - Irrigation scheduling was begun in the Uinta Basin in the spring of 1973 on 1,312 acres (531 ha) irrigated under the Moon Lake Project. In 1974, the program was expanded to 5,000 acres (2000 ha) and in 1975, to 10,000 acres (4000 ha), including irrigated lands served by the Uinta Basin Irrigation Company and the Ute Indian Tribe. In 1976, the Moon Lake Water Users discontinued the program and the Ashley Valley water users were added. A total of 6,000 acres

(2430 ha) were scheduled in 1976. Since 1976, only the Ute Indian Tribal lands have been scheduled amounting to about 3,200 acres (1300 ha). The Ute Indian Tribe has now taken over management of the scheduling program and the Service will act as technical consultants.

A scheduling technician working for the Ute Indian Tribe demonstrated the effectiveness of this program on a 587 acre (238 ha) farm which had a history of poor crop yields. By utilizing the scheduling program to the maximum extent possible the crop yield was increased by 1,400 percent during the 1979 season. This increase may not be typical for the entire project area.

(b) Water Systems Improvement Program - Systems improvement possibilities consist principally of improving irrigation conveyance systems such as lining canals and laterals, use of pipe systems, and upgrading diversion and flow measuring structures.

Seepage loss studies have been completed on canal systems presently proposed for rehabilitation. Studies were conducted by Water and Power Resources Service, Soil Conservation Service, Geological Survey, and by contract with a consulting engineering firm. Infrared photography, soils data, observation well data, canal company interviews and results of geological studies were used in addition to seepage measurements to determine reaches of canal to be photographed and mapped for feasibility designs.

Contracts for topography and cross sections on 132 miles (212 km) of canal have been completed. Cross drainage, sizing, and preliminary design and cost estimate studies have been completed. These data will be used for feasibility designs in the recommended plan. The canals will be sized to existing capacities unless sizing studies show larger capacities are needed to remove restrictions in certain reaches.

A detailed study of salt loading mechanisms in the Hancock Cove area has been completed and more detailed mass balance studies for other areas in the Uinta Basin and Ashley Valley have been initiated. The first detailed mass balance studies included analysis of return flows, irrigation efficiencies, deep percolation, drainability of soils, phreatophyte use of surface runoff, and inflow-outflow and salt balance by subareas. These studies are now being refined to include variations in ground water quality, irrigation water quality, consumptive use by phreatophytes and crops, deep percolation, surface runoff, and reuse of surface runoff.

Water quality data at 90 surface water stations have been collected for 4 years and at 30 ground water stations for 1 year for the mass balance studies. Since 1978, water quality data have been collected at 39 key surface water stations. In many areas, the primary mechanism for salt loading appears to be dissolution of salts from the soil and subsurface materials overlaying the shale or sandstone barriers coupled with the displacement of saline ground water.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 5 1981

The President
The White House
Washington, DC 20500

Dear Mr. President:

Enclosed is the biennial report (Progress Report No. 10 dated January 1981) on continuing studies of the quality of water of the Colorado River Basin.

The report is transmitted pursuant to section 15 of the Act of April 11, 1956 (70 Stat. 105), authorizing the Colorado River Storage and Participation Projects; section 15 of the Act of June 13, 1962 (76 Stat. 96), authorizing the Navajo Indian Irrigation Project and the initial stage of the San Juan-Chama Reclamation Project; section 6 of the Act of August 16, 1962 (76 Stat. 389), authorizing the Fryingpan-Arkansas Project; and section 206 of the Act of June 24, 1974 (88 Stat. 274), the Colorado River Basin Salinity Control Act.

Sincerely,

Acting Assistant SECRETARY

Enclosure

Identical letters to:

Honorable Thomas P. O'Neill, Jr.
Speaker of the House of Representatives
Washington, D.C. 20515

Honorable Walter F. Mondale
President of the Senate
Washington, D.C. 20510

Mr. George L. Christopulos
Chairman, Colorado River Basin
Salinity Control Advisory Council
State Office Building East
Cheyenne, WY 82002

Wildlife habitat and archeological studies have been completed by contract with a consulting firm for most areas affected by the program. Presently 1,030 acres (417 ha) are affected by canal seepage.

Public involvement meetings have been held jointly with the Soil Conservation Service (SCS) to discuss general problems and needs concerning the program, both on-farm and system improvement. Formation of a planning team has been initiated by Water and Power Resources Service to deal specifically with the rehabilitation of canal systems.

The Agricultural Stabilization and Conservation Service (ASCS), in cooperation with the SCS, has begun a 10-year program to spend $20 million for on-farm irrigation improvements in the Uinta Basin and Ashley Valley. In 1980, $2 million was appropriated to initiate the on-farm work.

A feasibility report which will contain benefits and cost analysis for a coordinated system improvement plan is scheduled for completion in 1982.

An estimated 155,000 tons (141 000 t) of salt could be removed annually from the Colorado River System if both the on-farm and the systems improvement programs are implemented. This would result in a reduction of salinity at Imperial Dam of 16 mg/L.

Colorado River Indian Reservation Unit, Arizona. The Colorado River Indian Reservation has a total of 268,850 acres (108 800 ha) located in the Lower Colorado River Basin below Parker Dam in northern Yuma County, Arizona, and the eastern part of the San Bernardino and Riverside Counties, California.

The United States Supreme Court allocated water to irrigate 107,588 acres (43 541 ha), of which 99,374 acres (40 217 ha) are in Arizona and 8,213 acres (3324 ha) are in California. The court's allocation also provided for a maximum diversion of 717,148 acre-feet (884 x $10^6 m^{3/2}$). In 1978, 75,405 acres (26 700 ha) were irrigated with Colorado River water diverted at Headgate Rock Dam. About 200 miles (320 km) of canals and laterals delivered water to irrigate this acreage. Irrigation return flows are collected in a 100-mile (160 km) drainage system and are returned to the river.

The purpose of the Colorado River Indian Reservation Unit investigation was to formulate a plan to reduce the salt loading to the Colorado River from irrigation on the reservation. An analysis of the diversions to and drainage from the Reservation indicated that the Reservation did not make a net salt contribution to the river. Consequently the investigation was terminated and a concluding report was released in October 1979 to present the studies performed.

Palo Verde Irrigation District Unit, California. The Palo Verde Irrigation District is a privately developed district located in Riverside and Imperial Counties, California. Water for irrigation is diverted from the Colorado River at the Palo Verde Diversion Dam and is conveyed

through 295 miles (475 km) of main canals and laterals to serve approximately 91,400 acres (37 000 ha) of irrigated land within the District. The irrigation return flows are collected in a 153-mile (246 km) drainage system and returned to the Colorado River.

An analysis based on 1974 operational data indicated that the 914,000 acre-feet (1130 x $10^6 m^3$) diverted contained 945,000 tons (847 000 t) of salt, and that 467,000 acre-feet (576 x $10^6 m^3$) of return flows to the river contained 1,097,000 tons (995 000 t) of salt. The difference of 152,000 tons (138 000 t) of salt was the net discharge to the river. For analysis the District was divided into seven subareas, which were found to vary greatly in their salt discharge. Based largely on 1974 data, five subareas were found to discharge various amounts of salt and two were found to retain salt. The variation among them apparently results mainly from differences in the quality of the underlying ground water.

The subarea with the greatest discharge by a substantial margin is the Palo Verde Subarea in the southwestern part of the District, which discharged 144,000 tons (131 000 t). This subarea was found to be underlain by a sizeable body of saline ground water that is gradually being flushed out by percolating irrigation leaching water and canal seepage. The ground water aquifer subject to flushing contains an estimated 6.65 million tons (6.03 x 10^6 t) of salt, which is expected to be flushed out gradually by deep percolation of irrigation water.

The rate of salt discharged is theoretically proportional to the amount of subsurface drainage, so an improvement in water use efficiency would result in a reduction in annual salt discharge. The present on-farm irrigation efficiency in the Palo Verde Subarea is estimated to be approximately 42 percent. The unlined water distribution system also contributes seepage to ground water system.

Preliminary studies indicated that increasing the on-farm irrigation efficiency to 60 percent would cause as estimated reduction in salt discharges of 67,400 tons (61 000 t) at present, but the reduction would decline gradually in the future. On-farm efficiency would be improved both by on-farm improvements to facilitate more efficient irrigation, and better irrigation water management. Salt discharge could be further reduced by lining irrigation canals. More detailed studies are needed to verify these conclusions and to implement a salinity control project. A status report was completed in March 1980.

Federal, state, District and other local interest are currently pursuing the possibility of using the temporarily surplus flows in the Colorado River to speed up the leaching of salts from the southern part of the District. Conceptual agreement has been reached for the United States to lease and instrument 320 acres of farmland, to be used during the coming winter as a water spreading basin. The results of this flushing test will be evaluated to verify hydrogeological assumptions and to determine whether a full-scale flushing effort is technically feasible.

McElmo Creek Unit. In the past McElmo Creek Unit has been included with the diffuse source units, however, recent studies have shown that the salt loading is coming from irrigation sources. In the future McElmo Creek will be included with the irrigation source units.

The McElmo Creek Basin is located in southwestern Colorado and covers approximately 720 square miles (1900 km^2). About 150 square miles (390 km^2) of the basin, mostly in the east, are agricultural land.

McElmo Creek runs through the southern half of the basin, flowing an average of 32,400 acre-feet (40 x $10^6 m^3$) annually with a salt load averaging 115,000 tons (104 000 t) at the gage near the Colorado-Utah State line.

Eighty-five percent of the salt load is measured just downstream of the confluence with Mud Creek, about 5 miles (8 km) downstream from Cortez. The majority of water in McElmo Creek at this point comes from irrigation return flows except when spring runoff is substantial. Below this point the majority of the water entering McElmo Creek is natural runoff and ground water inflow.

The soils in the basin can be divided into two types. The Billings (gray) soil series, which is alluvial in origin, covers most of the far eastern and southeastern portions of the basin. The Monticello (red) series, derived from Dakota Sandstone and Eolian in nature, covers the north and western portions of the basin. Where the two soils meet, the red and gray soils are intermixed.

The irrigated gray soils have the potential of producing 9.6 tons (8.7 t) of salt per deep percolated acre-foot of water, which is eight times as much salt as the irrigated red soils. Red soil can produce up to 1.2 tons (1.1 t) of salt per deep percolated acre-foot of water. The nonirrigated areas contribute low amounts of salt to McElmo Creek.

The Montezuma Valley Irrigation Company (MVI) diverts water from the Dolores River and serves the McElmo Creek basin. The diverted water contains around 200 to 300 mg/L of salt. McElmo Creek water contains about 2600 mg/L salt at the Colorado-Utah State line. This salt accounts for 12 mg/L of the salinity at Imperial Dam.

Ponding tests have been run on one MVI Canal in the Billings series soils. So far these tests indicate seepage is low to moderate with the possibility of high seepage in shale and sandstone cuts. More tests are needed before definite conclusions can be reached.

Presently a ground water research program consisting of 125 wells being monitored for water table elevation, salinity and hydraulic conductivity, is being conducted in the basin.

Irrigation research was done on seven test farms in the basin representing various soil types, farm sizes, irrigation methods, and farm management. During the irrigation season, water inflow and outflow from these farms was constantly monitored, and available soil moisture contents measured. Results on gravity irrigated fields show as much as 25 percent of the farm delivery is lost through deep percolation.

The SCS is presently inventorying all farm laterals in the basin. This information will be used with results of seepage and permeability tests to determine the amount of water lost through the irrigation conveyance systems. This inventory will also give information on size, characteristics, and location of the laterals.

The data collected is being used in a number of computer models to determine what proportion irrigation, canal seepage, and precipitation contribute to the total salt load in McElmo Creek. The models will show salt and water movement throughout the McElmo Creek drainage and four major subbasins within the drainage. The models take into account surface water, ground water, precipitation, and the salts associated with water movement.

Alternative concepts that have been developed to reduce the salt loading fall into two categories: (1) removal of salt from the water through desalting or selective withdrawing and ponding high salinity flows, and (2) keeping the salts in the soil through irrigation management and land retirement.

Alternatives involving removal of salt from the water were generally unacceptable to the local people. Alternatives which involve keeping the salts in place are: (1) improve gravity farm management, (2) convert to sprinkler irrigation, (3) re-route Towaoc Canal (proposed under the Dolores Project) to provide gravity pressure for sprinkler irrigation, (4) canal lining, (5) ponding small creek flows, (6) coal slurry pipeline, (7) cooling water for a powerplant, (8) land retirement, and (9) leaving the basin alone.

In addition to the Multiple Objective Planning (MOP) process, a Public Information and Involvement Program (PIIP) is also being conducted. The Unit has been the subject of newspaper articles and radio broadcasts of an informational nature. An open house was held on one test farm, and a project tour was conducted.

A recommended plan to affect salinity control should be selected by the end of January 1981 through public involvement processes. Data collection will continue through 1982 and the feasibility report will be prepared by the end of fiscal year 1983. The Final Environmental Impact Statement should be filed with EPA by July 1984.

2. Point Source Control Projects

The four units in the following section have been identified as point source contributors of salt to the Colorado River. They are thermal springs that discharge high concentrations of dissolved salts.

LaVerkin Spring Unit. LaVerkin Springs, located on the Virgin River in the southwestern corner of Utah, contribute an average salt load of 109,000 tons (98 900 t) per year with a flow of about 11.5 ft^3/s (0.325 m^3/s) that has total dissolved solids averaging 9650 mg/L. A feasibility report plan for collecting and desalting the springs was forwarded to the Commissioner's Office in December 1974. A reformulation of the LaVerkin Springs Unit under the Water Resource Council Principles and Standards of Water Resources planning was conducted subsequently.

The favored plan developed during the multiobjective planning study consisted of a desalting plant to desalt the spring water and evaporation ponds to dispose of brine from the plant. Seventy percent of the water would be returned to the Virgin River and 30 percent would be brine. A salt load of 103,000 tons (97 000 t) per year would be removed from the stream, which would reduce the salinity of the river by 10 mg/L at Imperial Dam. The total effect of the LaVerkin Springs Unit may not be immediately apparent and may not ever reach the expected salinity reduction because a part of the discharge appears to contribute to the source of Littlefield Springs which may take many years to surface. Unfortunately, when the cost estimates were finalized this plan was too expensive to be viable. Consequently, additional alternatives are being examined in more detail to determine their viability, including deep well injection of the brine, use of the spring water for powerplant cooling, disposal of the spring water in a dry lakebed, and deep well injection of the entire spring flow. Water rights or a replacement supply would need to be secured for the disposal water. Total evaporation of the spring flow was found to be impractical.

Lower Virgin River Unit. This unit encompasses southeast Nevada and northwest Arizona - Clark County, Nevada, and Mohave County, Arizona. The unit includes the natural saline springs near Littlefield, Arizona, and the irrigated areas along the Virgin River between the springs and Lake Mead. The salinity control potential could be as much as 80,000 tons (73 000 t) per year.

The future of this study is uncertain. The surface and subsurface flows along the river and under flood plain lands are being analyzed to see how much salt reaches the river system and what causes it. Desert Research Institute (DRI) has a contract for this water and salt balance study to determine the amount of existing saline ground water inflows.

Data collected so far by the Water and Power Resources Service do not warrant a water quality improvement project. But, if the DRI's study proves otherwise, a saline water disposal plan might include a ground water barrier and extraction wells and industrial use in a pipeline collector system of the extracted water.

Glenwood-Dotsero Springs Unit. The primary area of study lies along a 16 mile (26 km) reach of the Colorado River in Glenwood Canyon between Glenwood Springs and Dotsero in Garfield and Eagle Counties of western

Colorado. In this river reach numerous thermal saline springs and associated ground water inflows comprise the largest point source of dissolved solids in the Upper Colorado River Basin. Dotsero is located at the upper end of the area at the mouth of Eagle River, and Glenwood Springs is at the lower end at the mouth of Roaring Fork River.

In the 16-mile (26 km) reach about 25,000 acre-feet (31 x $10^6 m^3$) of water and more than 500,000 tons (454 000 t) of salt enter the river annually. About half of the water and salts come from 18 identified springs clustered on both sides of the river near Glenwood Springs and at a point about 2.5 miles (4 km) downstream from Dotsero. The remainder enters unseen through stream gravels as ground water inflow with a very small amount entering from surface runoff of intermittent tributaries. Ten of the identified springs are located near Glenwood Springs and eight near Dotsero.

Based on a one year period of measurements, the 18 springs have an estimated combined average flow about 16 ft^3/s (0.5 m^3/s) and an average dissolved solids concentration of about 14 420 mg/L. The average surface flow of the 10 springs at Glenwood Springs is approximately 9.5 ft^3/s (0.3 m^3/s), while the average salinity concentration is about 18 030 mg/L. The average temperature is about 120° F (49° C). At the Dotsero Springs, the combined surface flow of the eight springs is about 6.5 ft^3/s (0.2 m^3/s).

Only generalized geologic and hydrologic data are presently available on the springs and ground water inflows. These data indicate that ground water in the area travels along faults or fracture zones, dissolves salts principally from the Paradox formation, becomes heated in deep intrusive bodies, and returns to the surface as warm saline springs.

Chemical analysis indicates that the composition of total dissolved solids from the two spring areas is quite similar. The constituents are approximately 90 percent sodium chloride with the remaining 10 percent made up mostly of calcium, magnesium, potassium, bicarbonate, and sulfate.

Some of the springs at Glenwood Springs have been developed commercially. The flows are collected for distribution to swimming pools and the discharge is piped into the Colorado River. No use is made of water from the Dotsero Springs.

The appraisal investigations included use of infrared photography to locate springs not visible, chemical analyses of water samples, and preliminary methods of control.

Monitoring Program - A one year program (1972-73) was established to estimate average flow and total dissolved solids issuing from the springs.

A three year baseline monitoring program (1976-79) was started. Samples were collected bimonthly and analyzed for common ions.

Baseline monitoring is continuing, and a program to identify the presence of heavy metals and other exotic parameters was started in April 1980. Such testing will continue until the presence or absence of metals and parameters is established.

In January of 1980, the Geological Service started continuous EC and temperature recording at four gaging stations along the Colorado River. Weekly samples are collected at each station and analyzed for common ions and general chemistry.

Status of Investigations - In January of 1980 the Notice of Initiation of Investigation was issued to notify the public that feasibility level investigations were beginning.

Work on a Plan of Study (POS) also commenced in January. The technical aspects of the investigations will be done by a professional services contract, and the public involvement and investigations monitoring will be handled in-house by the service. The Request for Proposals (RFP) was mailed out to potential bidders in late April 1980.

In order to give potential contractors an opportunity to question items in the RFP, a pre-proposal conference was held in Salt Lake City, Utah, on May 8, 1980.

A contract was awarded for the feasibility investigation of the Glenwood-Dotsero Springs Unit on September 22, 1980.

The Feasibility Report and Draft Environmental Statement are scheduled for completion in 1984.

3. Diffuse Source Control Projects.

This method of control deals with salt loading or concentrating effects that occur over comparatively large areas such as tributary subbasins. The techniques available for control include collection, desalting, evaporation, special use, watershed management, and vegetative control.

Big Sandy River Unit. The Big Sandy River originates in the Wind River Mountains of west central Wyoming and flows southerly to the Big Sandy Reservoir and Dam where most of the flow is diverted to irrigate Eden Project Lands. From Big Sandy Dam, it flows southwesterly to the Green River. Near the mountains, the water is of high quality containing less than 50 mg/L of dissolved solids. After flowing across several miles of desert, the dissolved solids increase to 70-120 mg/L at Big Sandy Reservoir. Below Big Sandy Dam it picks up irrigation return flows from the Eden Project and saline seeps along the river channel. The Big Sandy River annually discharges approximately 180,000 tons (163 000 t) of dissolved solids at concentrations ranging from 300 to 3900 mg/L to the Green River.

The climate is cold and dry in the winter with minimum temperatures often -40° F (-40° C). The summers are dry and mild with maximum temperatures only occasionally getting above 90° F (32° C).

Because of the low winter temperatures, it was thought that natural freezing methods might be used to desalt low flows of the Big Sandy River.

A test of natural freezing conducted during the winter of 1973-74 indicated that a product water with a concentration of less than 100 mg/L could be produced from a saline water. The test showed however, that a source of heat was needed to prevent the spray nozzles from freezing and an impervious lining would be needed for the holding ponds and the areas of ice.

Subsequent drilling investigations have shown that the saline seeps come from an artesian aquifer below the bottom of the river. It appears that the confined aquifer extends over a wide area from the Big Bend Area above Gasson Bridge to the vicinity of the Big Sandy Reservoir. Quality of the water in the aquifer varies from about 2000 mg/L to 6500 mg/L. Twenty to 30 ft^3/s (.57 to .85 m^3/s) discharge into river channel from seeps along a 15 mile (25 km) reach. It is estimated that the seeps contribute about 110,000 tons (91 000 t) of salt annually.

Pumping test wells indicate that the saline water could be intercepted before seeping into the river.

One test well was pumped at a rate of 2,250 to 2,700 gal/min (1.5 to 1.8 m^3/s) for 5 days. A big reduction in seepage flows occurred within the area of influence.

The State of Wyoming is encouraging beneficial use of the saline water. Work is progressing toward awarding a professional services contract by February 1981 to complete the feasibility investigations. The request for proposals was mailed on September 29, 1980. The contractor will be expected to identify beneficial uses for saline water as well as alternative collection and disposal plans. A planning team and public involvement program will be organized to assist the contractor in selecting a recommended plan by the spring of 1982. The Feasibility Report is scheduled for completion in 1984.

Price-San Rafael Rivers Unit. The Price and San Rafael Rivers originate in the mountains of the Wasatch Plateau and provide tributary flows to the Green and Colorado Rivers in east-central Utah. Elevations in these river systems range from about 4,000 feet (1200 m) above sea level on the Green River to over 11,000 feet (3400 m) above sea level in the mountain ranges and high plateaus to the west. Drainage areas contain 1,900 and 1,600 square miles (4920 and 4330 km^2) for the Price and San Rafael Rivers, respectively. These study areas are principally desert with an arid to semiarid climate. The summers are hot and dry and the winters are dry and cold. Temperatures range from over 100° F (39° C) in summer to -4° F (-20° C) in the winter. Snowfall is generally light and amounts to only a few inches during the winter season, except at the higher elevations, where substantial amounts accumulate on the ground.

The geologic formations in these river basins consist primarily of sedimentary rock. About 75 percent of the Price and San Rafael drainages are composed of mudstones, claystones, and shales which could be the main source of salt pickup in these rivers. Much of the irrigated lands are located on these salt-producing formations in the upper portions of the drainages.

Salinity concentrations range from 200 to 5000 mg/L for both rivers with an average of 3500 mg/L for the Price River and an average of 4000 mg/L for the San Rafael River.

The estimated total dissolved solids contributed by the Price and San Rafael Rivers are 240,000 and 190,000 tons (218 000 and 172 000 t), respectively.

The estimated annual removal of salt potential control programs are 100,000 tons (91 000 t) on the Price River and 80,000 tons (72 000 t) on the San Rafael River. Salinity concentrations of the Colorado River at Imperial Dam would be reduced by an estimated 11 to 12 mg/L with depletions of flow by the project estimated at 60,000 acre-feet (74 x $10^6 m^3$) annual evaporation.

Investigations to date have consisted of field surveys and data gathering. Streamflow and water quality data are being obtained at several key locations on both rivers and tributaries. Data is collected by both local residents who collect samples on a weekly basis and Service personnel who visit each station quarterly. Flow data is collected by the Geological Survey at 10 of the water quality stations. The Geological Survey has studied areas and causes of salt leaching in both drainages. (See Mundorff, 1972, and Mundorff and Thompson, 1980.) (21) (22)

These data and future investigations will locate areas of greatest salt loading. Further studies will be made to determine if other methods such as water systems improvement, irrigation scheduling, and farm management could be used along with selective withdrawal. The SCS has initiated an on-farm investigation.

Additional sampling stations will be established as needed in conjunction with geologic investigations of each drainage basin.

A professional services contract is planned to be awarded in October 1981 to conduct appraisal and feasibility investigations to identify alternative plans capable of reducing the salinity in the rivers. A planning team and public involvement program will be organized to assist the contractor in selecting a recommended plan by November 1983. The Feasibility Report is scheduled for completion in 1986.

Dirty Devil River Unit. The Dirty Devil River drainage area, containing about 4,200 square miles (10 900 km^2), originates in the mountains of Wasatch, Fishlake, Awapa, and Aquarius Plateaus and discharges into the Colorado River at the upper end of Lake Powell. About 47 percent of the area is tributary to the Fremont River, about 37 percent to Muddy Creek, and about 16 percent directly to the Dirty Devil River, which is formed by the confluence of the Fremont River and Muddy Creek. Ground surface elevations range from about 3,600 feet (1100 m) above sea level at the mouth of the Dirty Devil River to 11,000 feet (3350 m) in the mountain ranges at the west end of the drainage. The drainage basin is principally

desert with annual rainfall averaging 10 inches (250 mm) or less. Precipitation ranges from less than 6 inches (150 mm) along the Dirty Devil River to 30 inches (750 mm) in the headwater areas with elevations above 10,000 feet (3050 m). Temperatures range from over 100° F (38° C) in summer to -20° F (-29° C) in winter.

The geologic formations in the drainage basin consist primarily of sedimentary deposits. About 60 percent of the drainage basin is composed of mudstones, claystones, and shales. The Carmel Formation of Jurassic Age and the Mancos Shale Formations of Cretaceous Age are major contributors of dissolved solids in the basin. Irrigation of alluvial soils derived from shales increases the contribution of dissolved solids to the streams.

The estimated total dissolved solids contributed by the Dirty Devil River is 200,000 tons (181 000 t) annually. The estimated annual removal of dissolved solids by potential control program is 80,000 tons (72 500 t) annually. Salinity concentrations of the Colorado River at Imperial Dam would be reduced by an estimated 5 mg/L.

Investigations began in 1974 and consist of limited field surveys and data collection. Streamflow and water quality data are currently being obtained weekly at 13 stations within the basin, six of which are Geological Survey gaging stations. The Geological Survey has also done reconnaissance studies of the quality of surface water and fluvial sediment (see Mundorff, 1979.) [23] The purpose of the current data collection is to locate areas of salt loading. Additional studies will be made to determine the cause of salt loading and possible alternatives to decrease salt loading.

The Feasibility Report and Environmental Impact Statement are scheduled for completion in 1985.

Meeker Dome Unit. The Meeker Dome, site of the Meeker Well and several other abandoned oil and gas exploratory wells, is a local anticlinal uplift located in northwestern Colorado, 3 miles (5 km) east of the town of Meeker and on the right bank of the White River.

The Meeker Well, originally drilled for oil exploration purposes and abandoned in the 1920's, was identified as a significant point source of salinity in the Colorado River system. In 1968, before the well was plugged to a depth below 550 feet (170 m), it was flowing at a rate of about 3 ft^3/s (0.08 m^3/s), and its highly saline water (19 200 mg/L) was increasing the Colorado River's salt load by about 57,000 tons (52 000 t) per year.

In February 1969 two abandoned wells, 2 miles (3 km) north of the Meeker Well, were reported to be flowing saline water. These wells were also plugged in October 1969. In the late summer and fall of 1969, seepage appeared in four areas within a 1-mile (1.6 km) radius of the plugged Meeker Well.

Active feasibility investigations were initiated in early 1979 by the organization of a multidisciplinary planning team composed of interested local, State, and Federal agencies, as well as special interest groups and private citizens. These investigations are underway to gain a better understanding of the quantity, sources, and mechanisms by which saline waters enter the White River, and then to identify alternatives that would eliminate or greatly reduce the salt contribution to the river.

Technical investigations are being conducted through a Professional Services Contract with CH2M Hill Central Incorporated, a Denver-based water resources consultant. Quantification and data collection studies indicate that seepage is continuing and that variable loads of salt are being transmitted into the White River and subsequently into the Colorado River. The loading estimate for 1979 approximates 27,000 tons (25 000 t) at a flow of about 1.4 cfs (0.04 m^3/s) and a concentration of 19 000 mg/L.

Problem identification investigations indicate that of the eight oil and gas exploratory wells drilled on the Dome itself, four are adequately plugged. The other four, the Scott Well, the Meeker Well, James Well, and particularly the Marland Well, are believed to be unplugged or inadequately plugged and are acting as conduits, allowing saline water from deep geological formations to pollute surface aquifers and the White River. To verify this belief, a Problem Verification Program has been initiated to test and plug the Marland Well. Prior to verification efforts on the Marland Well a network of shallow observation wells would be installed to monitor the effects of the verification program. Efforts at plugging the Scott Well, the James Well, and the Meeker Well may also be required.

Alternatives identified for appraisal investigations involve saline water; (1) collection concepts such as deep collection wells, shallow collection wells, tile drain collection, and open drain collection; (2) geothermal and coal slurry use concepts; (3) desalting plant treatment concepts; (4) disposal concepts such as oil field disposal, deep well injection, and evaporation reservoir storage.

The Feasibility Report and Draft Environmental Statement are scheduled for completion in 1983.

C. Projection of Salinity Reduction Assuming Actual Operation of Congressionally Authorized Salinity Control Units

Table E has been included to show each salinity control unit's effect on salinity reduction. Concentration reductions were determined for each unit using approximate 1990 flow and salt load conditions. This provides a consistency of river conditions that allows the units to be compared upon their individual contribution to reducing the salinity concentration at Imperial Dam.

The decline in runoff salt loading entering Lake Powell that has occurred in recent years is continuing. Possible salinity control implications are being studied by the Water and Power Resources Service. (See footnote to Table D.)

Table E

Salinity Control Units Effects

Unit	Salt Removed Per Year[3] tons	tonnes	Concentration Reduction at Imperial Dam (mg/L)[4]
Paradox Valley[1]	180,000	160 000	18
Grand Valley[1]	410,000	370 000	43
Crystal Geyser[1][2]	3,000	2700	0.3
Las Vegas Wash[1]	41,000	37 000	4
Lower Gunnison Basin	300,000	270 000	31
Uinta Basin WSI	155,000	140 000	16
McElmo Creek	40,000	36 000	3
Colorado River Indian Reservation[2]	-	-	<1
Palo Verde Irrigation District	67,000	61 000	7
LaVerkin Springs	103,000	93 000	10
Lower Virgin River	80,000	70 000	8
Glenwood-Dotsero Springs	250,000	230 000	25
Big Sandy River	80,000	70 000	8
Price-San Rafael Rivers	180,000	160 000	11
Dirty Devil River	80,000	70 000	5
Meeker Dome	57,000	52 000	6

1/ Authorized for construction.
2/ At this time no further action is planned.
3/ Figures shown for salt removal are as currently planned and are subject to change as more detailed investigations are made.
4/ All concentration reductions were calculated using approximate 1990 flow and salt load conditions.

PART IX. OTHER WATER QUALITY ASPECTS

Although salinity is considered to be the most serious water quality problem in the Colorado River Basin, there are a number of other water quality problems of varying degrees. The following sections include discussion of the most significant sources of water quality degradation exclusive of salinity and the effects of such degradations on water uses as measured by various parameters. The EPA and States have largely controlled the discharge of pollutants through issuances of permits through the Public Law 92-500, Section 402 program. In addition, Section 404 of Public Law 92-500 requires permits to be issued by the Corps of Engineers for discharge of dredged or filled material.

A. Pollution Sources Other Than Salinity

1. Municipal Wastes

Municipal wastes are described herein as those liquid-carried wastes of domestic and service industry origin. Within the Colorado River Basin the majority of the discharges from wastewater treatment plants enter the river system and are the primary sources of bacteriological and organic pollution. Most of the municipal waste sources in the basin receive secondary treatment plus disinfection which is the minimum degree of treatment required by the Basin States.

Municipalities are required to have their waste discharges meet water quality standards set by the States. At the present time, any pollution from municipal waste sources is confined to those reaches of stream immediately downstream of the waste effluent, and measures are being enforced by the State and EPA for the control or abatement of pollution from these sources.

2. Industrial Wastes

Industrial wastes are defined as those spent process waters, cooling waters, wash waters, and other wastewaters associated with industrial operations. The principal pollutants derived from industrial wastes other than salinity are toxic materials, oils and grease, floating materials, radioactivity, organic and oxygen-demanding substances, heat, color-, taste-, odor-producing substances, and bacteria.

With the establishment of water quality standards and compliance schedules for the implementation of these standards, the pollution from industrial waste sources in the basin has been or is being abated or controlled.

3. Agricultural Wastes

Except for salinity, pesticides and fertilizers are the primary water pollutants associated with agriculture in the Colorado River Basin. Here

again the EPA and States have been endeavoring to control the discharge of these pollutants into the waterways. (Discharges from irrigated agriculture return flows, however, do not require a Section 402 NPDES permit nor does a discharge or dredge or fill material from normal farming require a Section 404, Public Law 92-500, Army Corps of Engineers Permit.)

The chlorinated hydrocarbon group, e.g., DDT and Toxaphene, are the most persistent pesticides and are of primary concern because of their long-range impact. Efforts are being made, however, to control use of these types of pesticides. The organic phosphate compounds do not persist in the environment for the period the chlorinated hydrocarbons do, but they are more toxic to fish and humans.

Nitrogen and phosphorus fertilizers are the most commonly used in the basin. Studies conducted in other areas of the United States show a relationship between the concentrations of nutrients from agricultural lands and water quality problems caused by excessive fertilization of aquatic plants. Within the Colorado River Basin the animal waste pollution is minimal because outside surface water has been prevented from entering the feedlots either by directing the drainage away from the operation or by locating the facility in a favorable topographic position. Additional discussion of toxic materials and nutrients is presented in the following Section B., subsections 5 and 6.

4. Mine Drainage

During the period 1966-68 approximately 75 locations were sampled to determine the heavy-metal concentrations contributed by mine drainages, tailing piles, and natural sources within the Colorado River Basin. Since that time the States and the EPA have been endeavoring to control the pollution from these sources.

B. Water Quality Parameters Other Than Salinity

Detailed information concerning the following parameters can be obtained from results of special studies made in the various reaches of the Colorado River Basin. Some of these studies are mentioned in Part X.

1. Dissolved Oxygen

The dissolved-oxygen concentration is a measure of the water capacity to support life and assimilate organic wastes. The records show that the dissolved-oxygen concentrations in the Colorado River Basin are generally above established standards. A marked reduction in the concentration can be found during the summer months, however, below some municipal and industrial discharges and in some streams with very low flows. A 1966 investigation indicated that there might be a wide diurnal variation in the oxygen concentrations in some reaches because of the large amount of algae in the streams with oxygen saturation being reached during a sunlit day and minimal concentration occurring at night when oxygen is used by the plants.

Samples also have indicated that at some of the lower depths in Flaming Gorge Reservoir anaerobic conditions exist. Releases are made, however, through the powerplant at higher elevations where the oxygen content is greater, thus maintaining sufficient oxygen in the stream below for fish life.

Water quality data for reservoirs have not generally been available until recently. The reservoirs in the Upper Colorado River Basin commonly have high nutrient inflows, primarily due to naturally occurring phosphate in the marine shales and lake deposits found throughout the basin.

High nutrient levels cause blue-green algae blooms. These algae blooms commonly result in dissolved oxygen sag in the deep portion of the reservoirs during summer stagnation. Dissolved oxygen deficits in the reservoirs have not caused great concern, primarily because of the agricultural uses of the water. Some fisheries have been impaired due to dissolved oxygen deficiency, particularly in the inflow area of the Flaming Gorge Reservoir according to the Wyoming Game and Fish Department. However, as the reservoirs are being developed for municipal and industrial water use, the noxious blue-green algae/dissolved oxygen problem is becoming a greater concern.

2. Temperature

The Colorado River Basin water temperatures vary widely, reaching the greatest difference during the summer months when they vary from near freezing in the high mountains to above 90° F (32° C) in the lower reaches. Warmer temperatures may increase the rate of growth and decomposition of organic matter and of chemical reactions, resulting in bad odors and tastes, and also decrease the dissolved oxygen concentration available to sustain a fishery.

Changes in water temperature in the basin result primarily from natural climatic conditions. The large reservoirs, however, may affect the stream temperatures for a considerable distance below the reservoir. Temperature records indicate that Flaming Gorge Reservoir has little effect on winter temperatures but cools the summer temperatures of the Green River up to 5° F (3° C) at the Green River, Utah, station. The temperature immediately below Flaming Gorge Dam had been too cold for maximum growth and propagation of fish life. Modification of the outlet works has recently been completed to improve this condition. The effect of this modification remains to be seen. Navajo Reservoir appears to have no effect on the temperatures of the San Juan River at the near Bluff station. Lake Powell appears to warm the winter temperatures of the Colorado River at the Grand Canyon station by up to 10° F (6° C) and cool the summer temperatures by about the same amount.

Thermal springs, wastewater discharges, and irrigation return flows may increase the temperatures in the receiving water, but the added heat is usually dissipated in a relatively short distance from the source. Flow depletions and changes in stream channel characteristics may also increase the effects of natural climatic conditions causing cooler or warmer water temperatures.

Temperature increases due to municipal and industrial waste discharges have been minimal; however, the construction of large thermal powerplants in the basin with a return of the cooling water to the streams or reservoirs could present a potential for temperature increase. For this and other water quality reasons most of the cooling water discharges from future fossil fuel powerplants will not be allowed to return to the rivers.

3. pH

The pH of the waters in the Colorado River Basin usually ranges from about 7 to 8. Formerly there were a number of streams receiving acid mine drainage. In these cases the pH was lowered to levels which precluded the establishment of aquatic life and the use of the river for fishery and other purposes. Many of these conditions, however, have been corrected by controlling the mine discharges.

4. Heavy Metals

Various heavy metals such as copper, lead, zinc, iron, manganese, arsenic, selenium, and cyanide are found in the waters of the basin. These have varied from trace amounts to potentially hazardous levels. The presence of these heavy metals is generally contributed by drainage from active and inactive mining operations.

Iron, arsenic, cadmium, selenium, and manganese concentrations occasionally exceed the Public Health Drinking Water Standards in some basin streams. This is particularly evident in the upper reaches of the Colorado, Uncompahgre, and San Juan Rivers and their tributaries. It has been determined that heavy metal concentrations have a marked effect on the aquatic life. Certain reaches of stream have been completely devoid of bottom organisms and fish because of these toxic effects. Approval of the Section 404 permit for the Ridgway Dam, Dallas Creek Project, required a monitoring program to determine the effects of the reservoir on the heavy metals found in the Uncompahgre River. Heavy metals monitoring has also been done on the Dolores Project as well as other projects in the basin.

5. Pesticides

In addition to the toxic effects of heavy metal concentration, toxic materials are also contributed to the stream through industrial and agricultural operations. Limited long-term monitoring at four surveillance stations located on the Colorado River has in the past detected the pesticides DDD, DDE, DDT, dieldrin, and endrin. A comprehensive evaluation of the effects of pesticides upon water quality cannot be made at this time because of the lack of sufficient water quality data and incomplete knowledge of the physiological and other effects of pesticides in human, wildlife, fish, and other biological forms. The mere presence of a pesticide in water does not necessarily indicate serious pollution. Pesticides were tested for in samples of fish flesh and water taken from the Wahweap and San Juan River arms of Lake Powell. Pesticides found included DDD, DDE, and DDT. All levels were well below the limits set by the Food and Drug Administration.

The Bureau of Sport Fisheries and Wildlife also ran pesticide tests on fish flesh taken from Imperial Reservoir and Lake Havasu. Their results were very similar to those from Lake Powell.

6. Nutrients

Nutrients, primarily nitrogen and phosphorus, are believed to be the most conducive to the growth of algae. The sources of these nutrients are runoff from agricultural lands, municipal and industrial wastewaters, and natural runoff. Phosphorus is normally found in only limited quantities in unpolluted water and the major contribution in the Upper Basin appears to be from natural rather than agricultural sources. Sufficient nitrogen is generally available naturally in basin waters to stimulate algae growth.

Las Vegas Wash flows into Las Vegas Bay, an arm of Boulder Basin of Lake Mead, and carries large loads of phosphorous and nitrogen. The principal sources of water in the Wash are effluents from the Clark County sewage treatment plant and the Las Vegas City sewage treatment plant, which make up between 85-95 percent of the total flow. These sources contribute about 80 percent of the nitrogen and 99 percent of the phosphorous loading found in the Wash.

In fresh waters phosphorus is most likely to be the nutrient limiting the development of noxious algae blooms. However, in the Upper Colorado River Basin natural sources of phosphorus occur in the marine shales and lake deposits. The naturally high phosphorus levels combined with the additional nutrients from municipal wastewater and agricultural runoff frequently over fertilize the water, resulting in troublesome algae blooms. In fact, the vast oil shale deposits of the Upper Colorado River Basin were formed in shallow hyper-eutrophic lakes; the oil itself a product of decomposing algae.

Alage blooms, particularly the noxious blue-green algae, cause high diurnal dissolved oxygen (D.O.) fluctuations and summer D.O. depletions in several Upper Basin Reservoirs.

The control of excessive nutrients, generally phosphorus, is the most frequently used method to prevent excessive algae blooms, however, the natural phosphorus levels in the Upper Basin have generally made phosphorus waste load allocation impractical.

In addition, new reservoirs such as those in the Upper Basin leach the nutrients and salinity from the newly inundated soil and decomposing vegetation, and thus are highly productive for a number of years, much like newly tilled virgin soil. However, as the reservoirs age, sediment covers and traps many of these nutrients, and the water becomes less productive over time until it reaches a chemical and biological equilibrium.

Man's activities have upset the chemical equilibrium due to increased leaching of nutrients and salts from irrigated lands and new reservoirs. Due to this unsteady-state, it is difficult to accurately predict the long term levels at which nutrients and salinity will stabilize.

In addition, the depth and timing of releases from the reservoirs largely determine whether nutrients and the more saline water base flows are stored or routed through the reservoir.

While much of the phosphorus budget is being stored in the Upper Basin, Lake Mead is becoming nutrient deficient and losing fish productivity. The exception is Boulder Bay, where the Las Vegas wastewater adds nutrients and causes local algae blooms.

Future studies, such as peaking power, which may change the operation and withdrawal elevations from the reservoirs should consider the routing of nutrients as well as salinity.

In the lower reaches of the Colorado River aquatic plant growths have been associated with fertilization by nutrients discharged to irrigation drains. A small increase in the nutrient levels in the river has been attributed to heavy recreational activities along the river below Davis Dam.

7. Bacteria

The coliform group of bacteria is used as an indicator of pollution. This group is made up of bacteria of diverse origin including that found in the intestinal tract of humans and other warm-blooded animals as well as in the soil and on vegetation. High coliform counts in waters indicate the probable presence of pathogenic organisms where bacterial contamination from sewage or animal wastes appears likely. This, however, is only an indicator.

In more recent years, analytical procedures have been developed whereby coliform bacteria of fecal origin can be identified. Fecal coliform tests measure bacteria from both man and animal. All the States of the basin have set standards for fecal coliform as the bacterial indicator of pollution.

High bacterial counts were observed at many locations in the Colorado River Basin during the 1966 water quality study. A number of these resulted from raw sewage discharges into a stream and some were because of poor disinfection of the municipal wastewater treatment plant effluents. The raw sewage discharges which were observed during the 1966 survey have been corrected by the addition of ponding or other treatment.

Bacteriological pollution has also been observed in popular recreation areas. For example, the fecal coliform densities in Lake Mead have been observed at densities higher than the standards set for body contact recreation.

Bacteriological pollution has an effect on most of the uses cited earlier. In those cases where it exceeds the criteria set for body contact recreation, it results in the closure of swimming areas. With high coliform counts, the use of water as a public water supply could be impaired.

8. Radioactivity

Radioactive pollution from industrial wastewater effluents, i.e., uranium mills, was, prior to 1960, the major source of radioactive pollution in the basin. The majority of the mills have been closed down but a significant portion of the increase of radioactivity originates from abandoned tailings piles.

An assessment of the radioactivity in the basin waters should also consider strontium 90 (Sr-90) radionuclides associated with atmospheric fallout in addition to radionuclides associated with industrial activities. Strontium 90, like the radionuclide (Ra-226), is damaging to human bone cells. The effects of Ra-226 and Sr-90 are additive.

Radioactivity does impair the water for beneficial use when concentrations exceed certain limits. For example, the National Interim Primary Drinking Water Regulations stipulate mandatory limits of 8 picocuries/L for Sr-90 and 5 picocuries/L for combined Ra-226 and Ra-228 in community water systems. Maximum contamination levels such as these are derived on the basis that an individual ingesting two liters of water daily will not receive an annual dosage to the body or any internal organ of more than 4 millirems. Moreover, if two or more radionuclides are present in the water supply, the sum of their dose equivalent must not exceed the 4 millirem per year limit.

9. Mercury

A report by the Lake Powell Research Project on mercury published in 1973 and reprinted in 1975 gives the following information.[8]

Samples analyzed by the flameless atomic absorption method showed that mercury levels in mean parts per billion (µg/L) were 0.1 for the lake water, 30 in bottom sediments, 10 in shoreline substrates, 145 in plant debris, 34 in plant leaves, 28 in algae, 232 in fish muscle and 10 in crayfish. The concentrations were based upon a wet-weight condition for the animals and a dry-weight basis for the rest of the samples. It was found that the mercury content was higher in the sediments with the higher organic content and that the lake transported plant debris had higher contents than the shoreline plants. In the rainbow and brown trouts, bloody tissues had higher mercury levels than the muscles while in the six other species analyzed the levels of bloody tissues, heart, kidney, liver, etc., were lower than the muscles. Larger fish of a given species and fish of higher trophic levels have higher mercury concentrations, with the muscles of some large walleye and largemouth bass exceeding the 500 ppb (500 µg/L) guideline of the U.S. Food and Drug Administration.

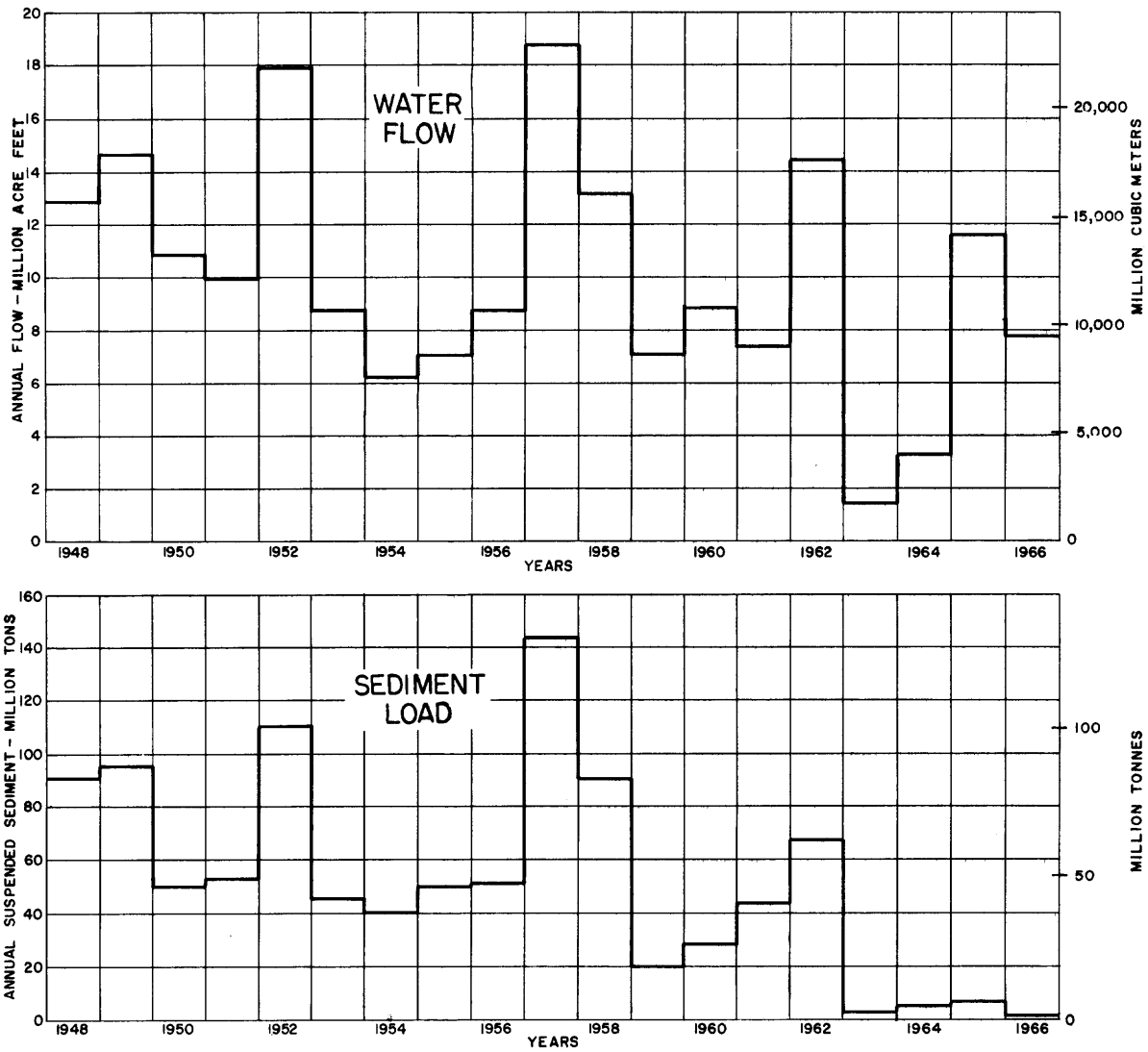
An esimated mercury budget suggested that due to the restriction of flow by the impoundment, the mercury could be accumulative.

10. Sediment

Prior to construction of the storage units of the CRSP, most of the larger tributaries and the main stem of the Colorado River carried large loads of sediment, particularly in their middle and lower reaches.

For example, in 1957 the suspended sediment load of the Colorado River at Lees Ferry, Arizona, gaging station was recorded at 143 million tons (130×10^6 t). This sediment was detrimental to water diverters for consumptive use as well as to high-type fishery and other recreational uses. The construction of Fontenelle, Flaming Gorge, Wayne N. Aspinall Unit, Navajo, and Glen Canyon Dams has produced dramatic changes in the sediment load transported by these streams. For example, the relationship between the water and sediment flows at Lees Ferry during the 1948-66 period is illustrated in Figure 5. In 1959 the cofferdam utilized in the construction of Glen Canyon Dam was finished and diversions began through the tunnels. Sediment was deposited behind the cofferdam in 1959 and 1960 at a sufficient rate to gradually fill the cofferdam lake with the result that by 1962 the annual sediment load at Lees Ferry had increased to 67 million tons (61×10^6 t). This load dropped to 2.2 million tons (2.0×10^6 t) in calendar year 1963 with the closure of Glen Canyon Dam and initial storage in Lake Powell. Lake Powell and other Colorado River Storage Project reservoirs are now effectively trapping and storing almost all of the sediment originating in the Upper Colorado River Basin. Lake Powell and the other Upper Basin Reservoirs trap approximately 75 to 80 percent of the sediment that normally would flow into Lake Mead. By storing the sediment in the CRSP reservoirs, the streams immediately below the dams have been changed to relatively clear trout water fisheries as well as desirable boating and recreational areas. Daily sampling at Lees Ferry was discontinued in water year 1966 because of the lack of sediment. Since that time samples have been collected monthly.

A comparison of the major portion of the inflowing sediment and flow into Lake Powell with the outflow was made by plotting for a number of years the sum of sediment loads and flows of the Colorado River near Cisco, San Juan River near Bluff, and Green River at Green River, Utah, stations. This is shown in Figure 6 as compared to the outflow as shown by the Lees Ferry record in Figure 5.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER
AT LEES FERRY
SEDIMENT & WATER FLOW

Fig. 5

COMBINED COLORADO RIVER NEAR CISCO,
GREEN RIVER AT GREEN RIVER, UTAH,
AND SAN JUAN RIVER NEAR BLUFF

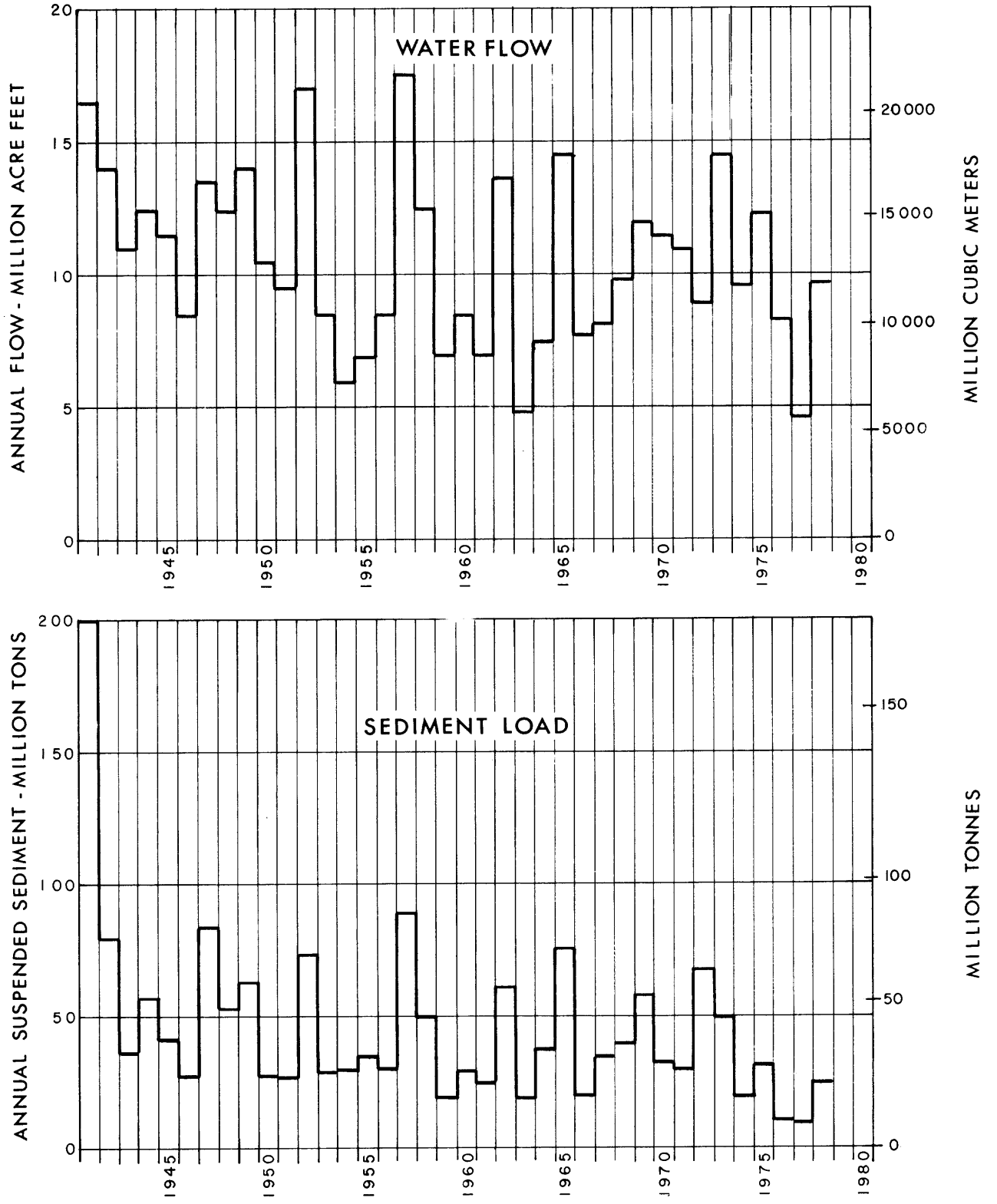


FIGURE 6

PART X. SPECIAL STUDIES

A. Flaming Gorge Reservoir

From 1966 to 1975, the Geological Survey carried out a series of studies on the water quality of Flaming Gorge Reservoir as part of a program to assess the water quality of the Colorado River Basin. The results of the latest of these studies are given in Bolke, 1978.[7]

For a synopsis of this study see Progress Report No. 9, 1979, "Quality of Water Colorado River Basin."

B. Lake Powell

A network of six sampling stations was established in Lake Powell in 1965 and sampling at these sites continued on a quarterly basis until the fall of 1971. In addition, samples were taken at the mouth of Wahweap Creek and below the Glen Canyon Dam on a monthly basis. The purpose of this program was to observe chemical changes in the reservoir. In the fall of 1971 the quarterly sampling program was increased to a monthly program to obtain sufficient data for a mathematical model of the Colorado River system. The seven sites in the reservoir are: (1) Wahweap, (2) Crossing of the Fathers, (3) Oak Creek, (4) Cha Canyon, (5) Escalante River, (6) Bullfrog, and (7) Hite Basin. The samples are taken at 50-foot (15 m) intervals to the bottom of the lake and analyzed for dissolved solids, common ions, specific conductance, pH, temperature, and dissolved oxygen. Figure 7 shows the change in salinity concentration with depth for the period of record at the Wahweap station. It appears that the concentration had stablilized since about 1972 but had risen with the drought of 1977. It appears that the concentration is returning to its lower levels in 1979-80.

From 1971 to March 1978 a research project entitled "Lake Powell Research Project" was conducted by a consortium of university groups funded by the Division of Advanced Environmental Research and Technology in Research Applied to National Needs (RANN) in the National Science Foundation. The researchers in the consortium sought to bring a wide range of expertise in natural and social sciences to bear on the general problems of the effects and ramifications of water resources management in the Lake Powell region. Their findings are presented in a series of project bulletins. The titles of those bulletins related to water quality and water quantity topics are shown as References 8 to 18 in the Bibliography.

C. Lake Mead

The Water and Power Resources Service conducted an extensive sampling program of Lake Mead from 1964-68. The data collected from the sampling program were published by the Water and Power Resources Service in Report No. CHE-70, "Water Quality Study of Lake Mead," 1970.

SALINITY CHANGES IN LAKE POWELL AT WAHWEAP SITE

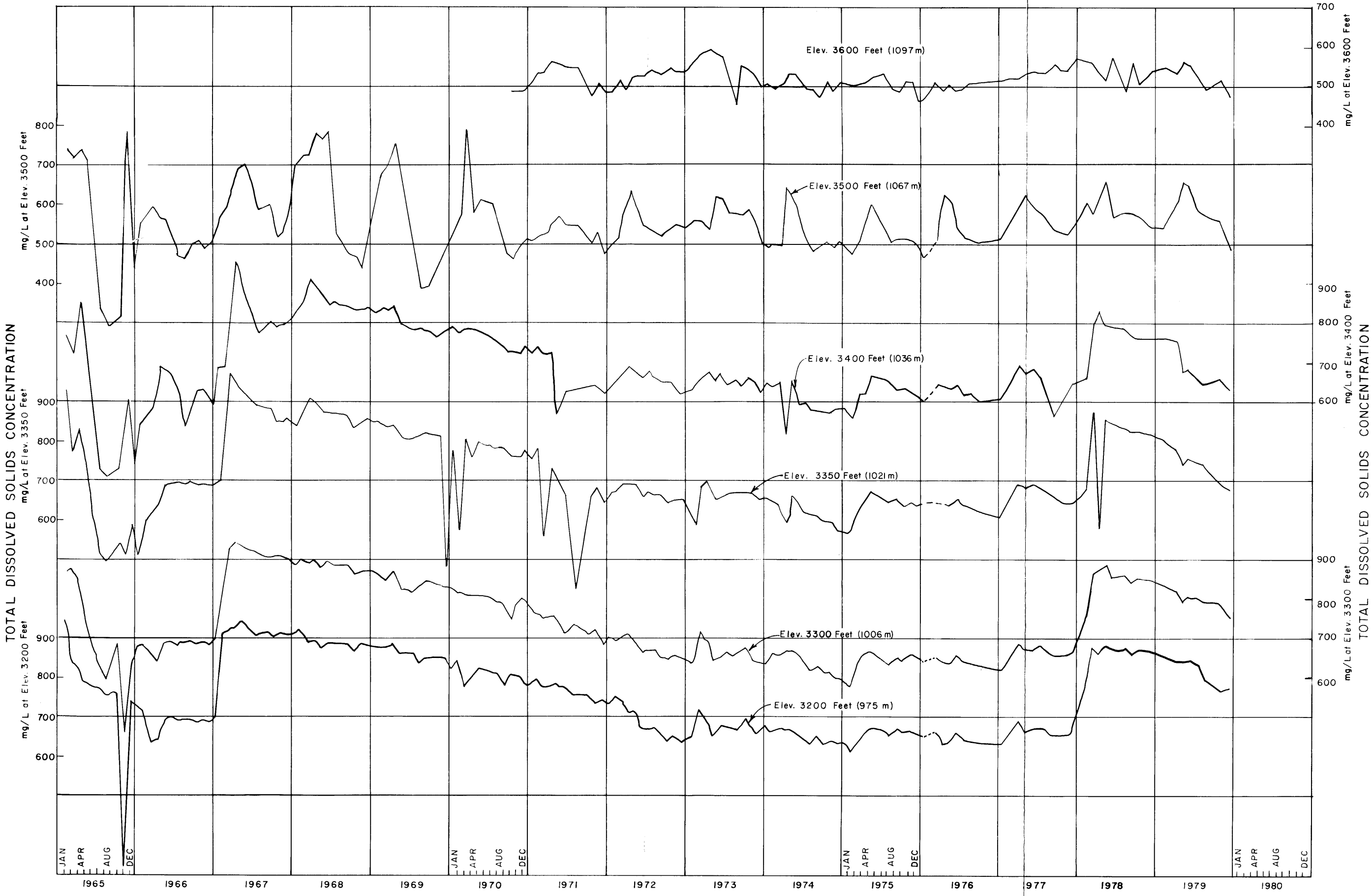


Figure 7

A more recent report funded by the Water and Power Resources Service entitled "A Mathematical Model of Primary Productivity and Limnological Patterns in Lake Mead, Technical Report No. 13," September 1972, analyzes the biological and chemical properties of Lake Mead based on eight sampling stations. This report indicates the sources of water pollution and the time of highest pollution potential. It also presents a method of quantifying eutrophication trends in Lake Mead.

Another report entitled "Final Report on Interrelationships between Chemical, Physical, and Biological Conditions of the Waters at Las Vegas Bay at Lake Mead" by Dr. James Deacon, University of Nevada, Las Vegas, May 1973, describes the effects of Las Vegas Wash, an enriched stream on Lake Mead.

The Biology Department of the University of Nevada, Las Vegas, conducted a special study called the "Lake Mead Water Quality Monitoring Program." A report on this program was issued in April 1975.

Complete chemical and nutrient analyses are made for water samples taken by the Water and Power Resources Service quarterly at three stations in Lake Mead: Hoover Dam Intake Towers, Saddle Island Station, and Station 10.

The California Department of Fish and Game just completed a limnological study of the Lower Colorado River from Needles, California, to the Northerly International Boundary. The report was completed in 1978.

The University of Nevada at Las Vegas completed a 2-year limnological study on Lake Mead in December of 1978. The report includes information on the nutrient problems which will probably be associated with the Hoover Modification program.(30)

D. Upper Colorado River Salinity Investigations

Water quality samples are being collected daily, monthly, or quarterly from approximately 100 sites on the rivers, canals, drains, and sloughs by the Water and Power Resources Service, and by the Geological Survey for the Water and Power Resources Service in the Upper Colorado River Basin. This program is in addition to the regular Geological Survey network. Samples are collected at various locations for the purpose of evaluating effects of future water resource projects on the river system, identifying sources of salinity for water quality improvement projects, obtaining basic data for research projects, and acquiring long-term records to determine trends and observe overall changes in the salinity of the river system. This monitoring system will be especially valuable in providing data for the Colorado River Water Quality Improvement Program.

E. Lower Colorado River Salinity Investigations

In February of 1970, the Water and Power Resources Service began a trial program to analyze the source and makeup of the salt load arriving at Imperial Dam on a daily basis. Conductivity measurements were made each day at 10 stations between Parker Dam and Imperial Dam. The network included essentially all significant diversions, surface return flows and major river stations.

An intensive program was carried on for 1 year. After 1 year of operation, the frequency of sampling was reduced. During the fall of 1971, an experimental program of automatic salinity monitoring was started. Conductivity probes were installed at nine stations on the lower river and the data transmitted by telemetry to the Boulder City and Imperial Dam offices. The nine stations as listed below.

1. Colorado River below Hoover Dam.
2. Colorado River Indian Reservation Main Canal near Parker.
3. Poston Wasteway near Poston.
4. Palo Verde Canal near Blythe.
5. Colorado River at Taylor Ferry near Cibola.
6. Colorado River below Cibola Valley.
7. Yuma Mesa Drain near Yuma.
8. Main Outlet Drain Extension Bifurcation for MODES 2 and 3.
9. Colorado River at the Northerly International Boundary above Morelos Dam.

Recently the Intensive Salinity Surveillance Program was changed. As of September 30, 1980 the water quality telemetering program was discontinued but weekly samples are taken from the first six of the previously mentioned stations. Daily conductivity measurements are taken at Imperial Dam in conjunction with the requirements of meeting Minute 242. The Geological Survey is now responsible for the continuous water quality monitoring probes at Imperial Dam and on the Main Outlet Drain Extension for both continued research and data gathering. There are plans to install continuous monitoring probes at Hoover and Parker Dams and at Needles. The installation at Needles will test three different probe systems to determine which best suits the needs of that and future sites.

In addition to the nine formerly telemetered stations, water quality samples are collected from five other stations. Individual samples are analyzed for conductivity. The Geological Survey Laboratory makes weekly analyses for total dissolved solids (residue at 180° C) and monthly analyses of the chemical constituents.

Sampling frequencies for all stations were selected from an analysis of past records so that samples would represent the actual salt load with an error of less than 5 percent, 95 percent of the time. The five other stations and the selected frequencies are shown in the following tabulation:

	Samples/Week
Colorado River below Parker Dam	1
Colorado River Indian Reservation Levee Drain near Parker	1
Colorado River Indian Reservation Lower Main Drain near Parker	1
Palo Verde Outfall Drain near Palo Verde	1
Colorado River At Imperial Dam	28

Data from the Intensive Salinity Surveillance Program have been valuable in analyzing salt loads from the Palo Verde Irrigation District and the Colorado River Indian Reservation for the Water Quality Improvement Program, part of the Colorado River Basin Salinity Control Project - Title II.

F. Irrigated Areas

Studies have been made in several areas to determine irrigation effects on water quality.

1. Prediction of Mineral Quality of Irrigation Return Flow

A cooperative study initiated in 1969 entitled "Predictions of Mineral Quality of Irrigation Return Flows" was conducted by the Water and Power Resources Service and EPA to develop a technique for predicting the mineral quality of irrigation return flow. The means for accomplishing this is through the use of mathematical models and high speed computers. The mathematical model is primarily a mathematical formula or expression attempting to describe conditions encountered on an irrigation project. The study utilizes data from existing irrigation projects in order to verify the technique.

The objective of the study was to use the model as a tool in predicting changes in capacity and the associated water quality distribution of the aquifer and also the quality distribution of the water as surface effluents from the system. The prediction of the system responses was compared with the historical data, both quantity and quality distributions as a measure of the reliablitiy of the model. Data from the Vernal Unit of the Central Utah Project have been used for designing and testing the model. Tests were also made using data from the Grand Valley area in Colorado and the Cedar Bluff Unit in Kansas.

A detailed return flow quality model was also developed under contract with the University of Arizona, and by the Water and Power Resources personnel over a period of about 5 years. This model provides a highly sophisticated and detailed simulation of salt and nutrient movement from the soil surface to a tile or open channel drainage system. This model can be interfaced with the conjunctive use model mentioned above to provide basinwide simulation capabilities. Information concerning these models is included in final reports dated August 1977, (EPA-60012-77-179c and 179e).

With these models the implication for water resources projects is that farm operation could be designed to use the least amount of water and return the smallest amount of salt to the river while permitting the farmer to obtain the greatest possible return from his farm. The salt load reductions expected from irrigation scheduling and management could also be verified on the Vernal Unit in the Uinta Basin.

2. Florida Project Area Study

Flow and quality data were collected at several points in the Florida Project area beginning in 1958 before the project was constructed. A study of these data for the period 1958-63 shows the effect of irrigation of these lands on the quality of return flows leaving the area.

Results show that there has been a very small amount of pickup measured in the river downstream from the irrigated area. The concentration of total dissolved solids in the inflowing water ranges from 0.14 to 0.17 ton per acre-foot (103 to 125 mg/L), and that of the outflowing water ranges from 0.17 to 0.30 ton per acre-foot (125 to 221 mg/L). About 13,720 acres (5550 ha) were irrigated at the time the measurements were made.

Other areas in the Colorado River Basin with similar type soils and underlying aquifers would yield only minor amounts of salt.

3. Grand Valley Area Agricultural Research Service

The Agricultural Research Service is doing a research study in the Grand Valley with regard to irrigation efficiencies. This is further covered in Part VIII.

4. Montezuma Valley

The Soil Conservation Service has conducted a study of on-farm improvements in the Montezuma Valley in Colorado.

5. Other Studies

Considerable variation in the effects of irrigation return flow on water quality is to be expected. Differences arise due to the size of the irrigated areas, the number of times the return flow is reused, properties of the soils and drainage area, number of years land has been irrigated, nature of aquifers, rainfall, dilution, temperature, irrigation methods, storage reservoirs, vegetation, and type of return flow channels.

Consumptive use, return flow, salinity, and pollution studies are continually being made by universities such as Utah State and Colorado State and by Federal agencies in cooperation with State and local agencies. Some of the study areas are purposely held small to achieve better control, but they will be as representative as possible of existing projects. The results pertaining to the quantity of return flow will be very

helpful in estimating effects on water quality of return flows from larger areas where measurement of inflow and outflow is not always possible or practical. Studies of local areas are also conducted under the Section 208 program (Public Law 92-500) or by private organizations under contract with the Government. These 208 studies include the investigations of all sources of salinity, as well as bacteriological, biological, heavy metals, and all other types of pollution.

Special studies in areas of the basin will continue to be made from time to time to determine water quality conditions, and studies of projects, such as Florida, Grand Valley, and Vernal areas should be repeated or continued in order to evaluate changes with time.

G. Environmental Protection Agency Report

A special 1971 report by the EPA entitled "The Mineral Quality Problem in the Colorado River Basin" presents results and recommendations obtained from a comprehensive salinity control study. This report includes a presentation of natural and manmade conditions affecting mineral quality, the physical and economic impacts, and salinity control and management aspects.(20)

H. Model Studies

1. Colorado River Storage Project Model

This mathematical model was developed by the Water and Power Resources Service for the Colorado River Reservoir Long-Range operating criteria (Public Law 90-537) and includes monthly water supply data for the period 1906-74. It does not project future quality conditions at any station above Lees Ferry. Water quality data were added to the model to obtain salt loadings. Since water quality records are not available for the years prior to about 1941, the records back to 1906 were obtained by correlations.

This model was used in the sizing study for Yuma Desalting Plant which has been authorized for construction under Title 1 of Public Law 93-320. The study shows the magnitude, duration, and frequency of extreme salinities in the lower reaches of the Colorado River.

2. Interim Water Quality Simulation Model for the Colorado River

This model was developed by the Water and Power Resources Service in 1973, and nominally duplicated the hand computed model shown in Table 18 of the January 1973 "Quality of Water Colorado River Basin Progress Report" No. 6, as it included the 1941-70 period of record. The model ("Application of a River Network Model to Water Quality Investigations for the Colorado River," September 1973 by R.W. Ribbens and R.F. Wilson) however, was different in that it simulated reservoir operations, was computed on a monthly, year-by-year, instead of an average annual basis and was developed

for the reach from Lake Powell to Imperial Dam instead of including all the Upper Basin stations as well as the Lower Basin stations. Results were comparable to the Biennial Report study. This was the model used by the work group for the Colorado River Basin Salinity Control Forum to make projection studies in developing numeric criteria and a plan of implementation of control measures to meet the criteria.

3. Colorado River Simulation System (CRSS)

This comprehensive mathematical model of the Colorado River was developed so it could be adapted to other basins as well as the Colorado River Basin, simulating both water quality and quantity. The model was first applied to the West Wide studies using a stochastic hydrologic data base.

A natural flow data base is presently being developed for both water quality and quantity. It is based on recorded data adjusted for known changes in the hydrologic regime such as consumptive use for in-basin agriculture, reservoir changes of content, evaporation, bank storage, municipal and industrial uses, and transbasin diversions. Periods of missing records have been filled in by statistical correlations.

The most recent application of the CRSS and the natural flow data base has been for this report. This model will be used to forecast the effects on water quantity and quality with future changes in project developments. We anticipate that this method will replace the currently used present modified method for all future progress reports. However, in this report both methods are being presented for comparison purposes.

Based upon past comparison, we feel the CRSS will be a much better predictive tool for estimating salinity and has the advantage of a better data base, a more complete description of the basin and a much greater degree of flexibility. Additionally CRSS will use monthly virgin flows over the entire historical period and monthly reservoir operations. CRSS operates the reservoirs according to their regular operating schedules. The salinity projections from the CRSS study are presented at the end of this section in Table F and Table G.

Specifically, a more detailed descriptive summary of the CRSS follows below.

a. GENERAL

The CRSS is a deterministic model that was developed by the Water and Power Resources Service to simulate the operation of the Colorado River. With CRSS, proposed changes to the operation of the river can be modeled, and their effect on the future quantity and quality of the water in the river may be evaluated. CRSS is made up of four major components:

(1) Input Data Files (Data Base)
  (a) Demand Data File
  (b) Hydrology Data File
  (c) Control File
(2) Programs to Process the Input Data File
  (a) SMDID - Processes the Demand Data File
  (b) EMHYDRO - Processes and Updates the Hydrology Data File
(3) Logic Model, Colorado River Simulation Model (CRSM)
(4) Output Format Program (TAPEDIT)

b. INPUT DATA FILES (DATA BASE)

(1) Demand Data File

This file contains information regarding withdrawals and depletions of water from the river. Data are entered in an ordered format which reflects the physical location of the various water demands on the river. Actual data elements are listed below:

(a) Withdrawals for a given user at a demand point.
(b) Depletions and return flows.
(c) Lag time, in months, for return flow.
(d) Year of withdrawal and depletion.
(e) Salt pickup.
(f) Reach and sequence point for withdrawal.
(g) Reach and sequence point for return flow.

(2) Hydrology Data File

The hydrology data file contains calculated natural flow and salt records from 1906 to 1978. The data for this file were developed from historical stream flow records, cropped acreages, evaporation calculations for the reservoirs and recorded diversions and return flows.

There are several assumptions that were made in developing this data base. These assumptions are listed below:

(a) Recorded flows are accurate.
(b) Diversions and acreages are recorded or can be estimated within reasonable limits.
(c) Consumptive use and reservoir evaporation are computable within reasonable limits.
(d) Return flows may be lagged, routed, and attenuated.
(e) The remaining residuals can be explained by other hydrologic parameters such as precipitation, bank storage, or ground water inflows.

(3) Control File

The control file contains reservoir operations data and powerplant operations data. Data are entered in the form of polynomial equations for the following:

(a) Reservoir elevation-area-capacity relationships.
(b) Turbine horsepower output at full gate versus head.
(c) Maximum flow versus head.
(d) Tailwater elevation versus flow.

Polynomials for the reservoir elevation-area-capacity curves were selected to reproduce the tables in general use for the reservoirs.

Manufacturer's rating curves were used for the power output of the powerplants. Other reservoir operation data contained in the control file are listed below:

(e) Target capacities for each month - rule curves.
(f) Bank storage coefficients.
(g) Evaporation rates for each month for all reservoirs.
(h) Maximum and minimum reservoir capacities.
(i) Maximum and minimum outlet capacities.
(j) Beginning reservoir storage and salinity.

During an actual run of CRSS the control file and the demand file are combined into one file.

All information in the control file must be referenced to the reach and sequence structure used to model the river. This structure will be explained further under Logic Model, CRSM.

c. LOGIC MODEL, COLORADO RIVER SIMULATION MODEL (CRSM)

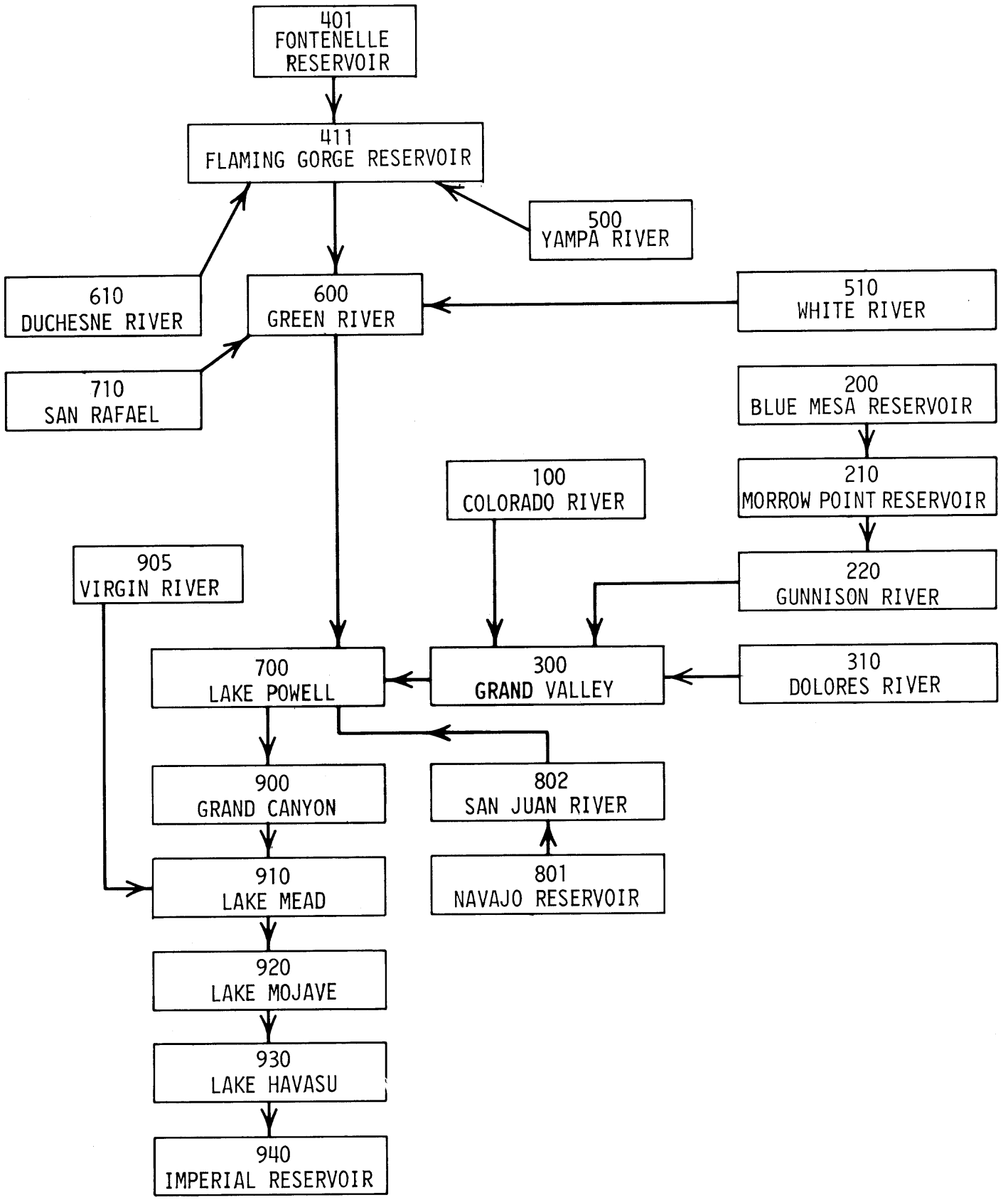
CRSM uses a reach concept to simulate the configuration of the river system. The reach structure, set up by the user, forms the pattern for all inputs and defines the order of computations for the simulation. Presently, CRSM has the capability to handle 25 reaches. Included in the reach structure are three sets of controlling information. These are:

(1) Reach order, reach identification, and destination of outflow from the reach.
(2) Sequence of inflow points, demand points, and reservoir points within the reach.
(3) Upstream reservoirs which can provide water for demands within a reach.

A block diagram of the reach configuration is shown in figure 8.

CRSM Operation

Once all the input data files have been created, the actual simulation model CRSM can be run. At the beginning of a run the reservoir operation data, initial demand data, and the first year of hydrology data are read in. Trends, capacities, etc., are calculated which set the model up for the month. A forecast is then estimated for inflow to Lake Powell. This forecast is based on a perfect forecast with an error term having a random component added to represent the inaccuracies of actual forecasting operations.



BLOCK DIAGRAM OF REACH CONFIGURATION

Fig. 8

After all preliminary calculations are made, the model starts at the most upstream point and computes flows at each point, working downstream using the continuity equation:

Flow at next sequence point = flow from preceding sequence point + inflow - demand.

Where there is not enough water to satisfy a demand, the input file defines which upstream reservoir water can be drawn from to satisfy this demand. Any releases are then routed down through the system to where they are needed. If water cannot be found to meet the demand, a shortage message is printed and calculations proceed.

All calculations for reservoir operations are based on the following form of the continuity equation:

Storage = inflow - outflow - evaporation + bank storage.

A release from a reservoir is determined by either a minimum release rate, a flood control space requirement, demands which draw from the reservoir, power releases to meet generation requirements, or demands which draw from upstream reservoirs and move water through the reservoir. Evaporation, bank storage change, and power production are calculated each time water is moved through a reservoir. Evaporation is determined by a monthly coefficient and the surface area of the lake that month. Change in bank storage is calculated as a percentage of the change in surface storage each month. This percentage ranges from 6.5 percent in Lake Mead to 15 percent in Lake Powell.

When calculations have proceeded through the last sequence point in the last reach, the system is checked for a water balance.

Salinities are computed next throughout the system by a mass balance accounting procedure. Initial salinities are read in from the hydrology file. Salt pickup is read in from the demand file and is added to the river attached to return flow. The salt is added at the inflow point of the return flow.

To route salt through a reservoir, complete mixing is assumed. This assumption may not be true in the larger reservoirs, but for lack of any better method, this assumption is used. This approach, in a simplified form, was verified by Dr. John Hendrick in his PhD dissertation (1973), Colorado State University, as applicable to Lake Mead on a monthly basis. The concentration of salt in the outflow is assumed equal to a weighted average of the beginning and ending concentrations of the salt in the reservoir.

After the salt balance and water balance are completed, the month is incremented and the procedure begins for the next month.

Present Study

For the purpose of this study, 14 estimates of the 1979-2010 conditions were made by running 14 passes through the CRSS. The initial pass was made starting with 1906 hydrology in 1978 and running for 32 years; the starting year was then incremented by 5 years, such that the 1979-2010 period used the 1911 to 1942 hydrology. In this way, incrementing the natural flow data base 5 years each time, 14 estimates of the 1979 to 2010 conditions were developed. This allows the extremes as well as the means to be displayed and considered. This whole process was done twice, once without any Water Quality Improvement Projects in place and once with all of the Water Quality Improvement Projects coming on line according to the present schedule.

Table F contains the mean flow and flow weighted mean salinity at 21 stations throughout the basin for years 1990, 2000, and 2010. It should be noted again that these estimates differ from those presented in table D for three main reasons:

A. The CRSS uses the 1906-1974 period of record, rather than 1941-1978, resulting in an average 1 million acre-feet more water available per year.

B. The reservoir levels are allowed to rise and fall over their entire permissible range, resulting in different evaporation rates, and greater water availability during low flow years.

C. The effects of development in the Upper Basin are buffered as the river passes through Lakes Powell and Mead, resulting in a lag of 3 to 5 years before the impacts are perceived at Imperial Dam.

Table G contains the same parameters as Table F but with the effects of the salinity control projects considered.

Figures 9 and 10 represent the range of salinities that may be anticipated at Imperial Dam, without and with the effects of the Water Quality Improvement Projects. For the CRSS, four curves are presented:

1. Probable minimum
2. Mean
3. Most probable
4. Probable maximum

The probable minimum represents the average of the three lowest salinities out of the 14 passes conducted for each year; the mean is the flow weighted mean salinity of the 14 passes; the most probable curve was computed as the mode or the salinity that was exceeded 50 percent of the time; and the probable maximum is the average of the highest three out of 14 salinities for each year at Imperial Dam. For comparative purposes, figure 9 also contains the table D estimates. Figure 10 displays the schedule of Water Quality Improvement Project salt load reduction.

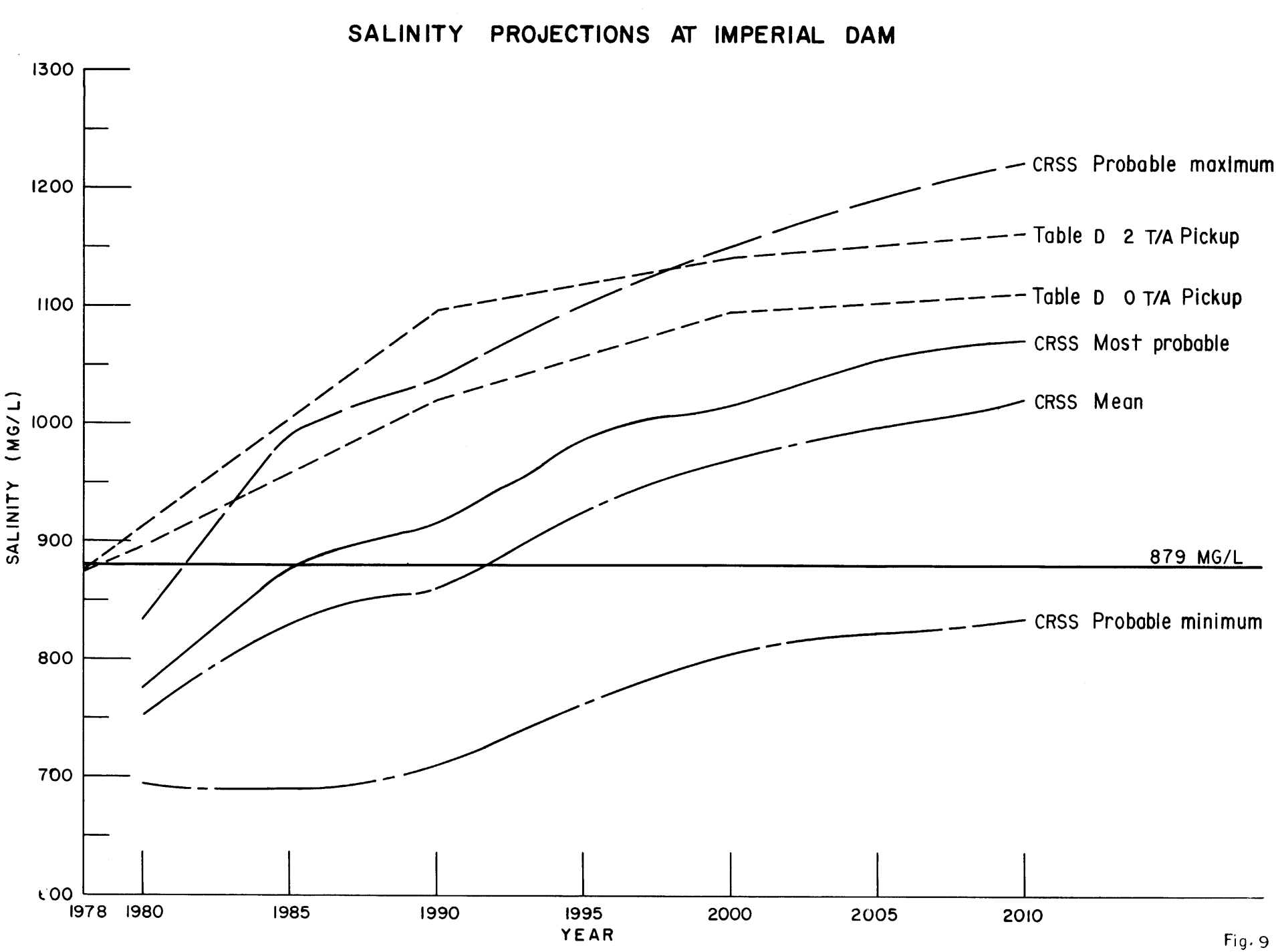

SALINITY PROJECTIONS AT IMPERIAL DAM
SALINITY (MG/L)
1300
1200
1100
1000
900
800
700
600
1978
1980
1985
1990
1995
2000
2005
2010
YEAR
CRSS Probable maximum
Table D 2 T/A Pickup
Table D 0 T/A Pickup
CRSS Most probable
CRSS Mean
879 MG/L
CRSS Probable minimum

Fig. 9

SALINITY PROJECTIONS AT IMPERIAL DAM WITH WATER QUALITY IMPROVEMENT PROJECTS

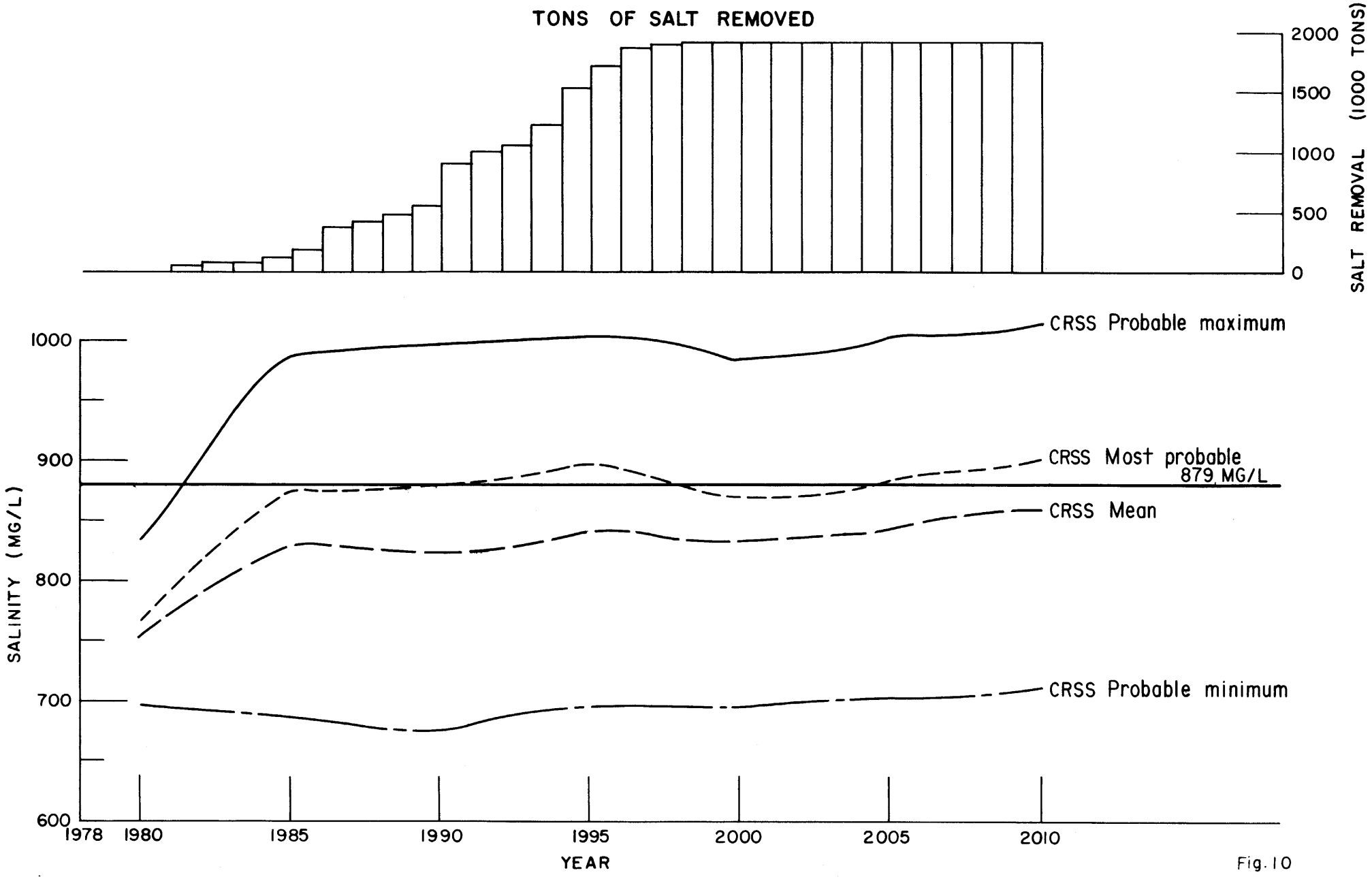


Fig. 10

Table F
Colorado River Simulation System Predictions Without Water Quality Improvement Projects

(Units: 1,000 except concentrations)

Station	1990 Condition				2000 Condition				2010 Condition			
	Flow (AF)	T.D.S. (T)	Concentration T/AF	Concentration mg/L	Flow (AF)	T.D.S. (T)	Concentration T/AF	Concentration mg/L	Flow (AF)	T.D.S. (T)	Concentration T/AF	Concentration mg/L
Green River near Green River, Wyoming	1,247	448	0.36	264	1,083	430	0.40	292	984	422	0.43	315
Green River near Greendale, Utah	1,479	847	0.57	421	1,311	792	0.60	444	1,219	766	0.63	462
Yampa River near Maybell, Colorado	1,234	240	0.19	143	1,140	234	0.21	151	1,134	233	0.21	151
Duchesne River near Randlett, Utah	265	422	1.59	1 170	223	419	1.88	1 380	217	414	1.91	1 402
White River near Watson, Utah	480	273	0.57	418	455	272	0.60	439	475	273	0.58	423
Green River at Green River, Utah	4,171	2,564	0.61	452	3,778	2,451	0.65	477	3,647	2,415	0.66	487
San Rafael River near Green River, Utah	96	158	1.65	1 214	92	158	1.72	1 226	88	150	1.71	1 254
Colorado River near Glenwood Springs, Colorado	1,682	615	0.37	269	1,475	604	0.41	301	1,373	594	0.43	318
Colorado River near Cameo, Colorado	2,893	1,605	0.55	408	2,590	1,663	0.64	472	2,468	1,638	0.66	488
Gunnison River near Grand Junction, Colorado	2,008	1,696	0.84	621	1,934	1,669	0.88	646	1,964	1,699	0.86	636
Dolores River near Cisco, Utah	575	473	0.82	605	552	485	0.88	646	582	487	0.84	615
Colorado River near Cisco, Utah	5,370	4,564	0.85	625	4,965	4,646	0.94	688	4,908	4,626	0.94	693
San Juan River near Archuleta, New Mexico	749	181	0.24	178	712	170	0.24	176	720	173	0.24	177
San Juan River near Bluff, New Mexico	1,589	1,355	0.85	627	1,411	1,464	1.04	768	1,548	1,600	1.03	760
Colorado River at Lee's Ferry, Arizona	11,593	9,334	0.81	592	10,212	9,111	0.89	656	10,018	9,265	0.92	680
Colorado River near Grand Canyon, Arizona	11,951	10,012	0.84	616	10,575	9,794	0.93	681	10,376	9,948	0.96	705
Virgin River near Littlefield, Arizona	159	217	1.36	1 003	146	215	1.47	1 081	147	215	1.46	1 075
Colorado River below Hoover Dam, Ariz.-Nev.	11,276	10,689	0.95	697	10,198	10,624	1.04	766	9,946	10,889	1.09	805
Colorado River above Parker Dam, Ariz.-Calif.	11,282	10,740	0.95	700	10,197	10,664	1.05	769	9,940	10,923	1.10	808
Colorado River below Parker Dam, Ariz.-Calif.	8,205	8,146	0.99	730	7,539	8,284	1.10	808	7,557	8,746	1.16	851
Colorado River at Imperial Dam, Ariz.-Calif.	6,968	8,140	1.17	859	6,292	8,292	1.32	969	6,310	8,745	1.39	1 019

Table G
Colorado River Simulation System Predictions With Water Quality Improvement Projects

(Units: 1,000 except concentrations)

Station	1990 Condition				2000 Condition				2010 Condition			
	Flow (AF)	T.D.S. (T)	Concentration T/AF	mg/L	Flow (AF)	T.D.S. (T)	Concentration T/AF	mg/L	Flow (AF)	T.D.S. (T)	Concentration T/AF	mg/L
Green River near Green River, Wyoming	1,247	448	0.36	264	1,081	350	0.32	238	982	342	0.35	256
Green River near Greendale, Utah	1,479	847	0.57	421	1,314	727	0.55	407	1,218	697	0.57	421
Yampa River near Maybell, Colorado	1,234	240	0.19	143	1,140	234	0.21	151	1,134	233	0.21	151
Duchesne River near Randlett, Utah	265	402	1.52	1 115	223	318	1.43	1 050	217	314	1.45	1 065
White River near Watson, Utah	478	227	0.47	349	453	226	0.50	367	473	228	0.48	355
Green River at Green River, Utah	4,169	2,506	0.60	442	3,749	2,152	0.57	422	3,615	2,109	0.58	429
San Rafael River near Green River, Utah	96	158	1.65	1 214	75	77	1.03	754	71	73	1.03	754
Colorado River near Glenwood Springs, Colorado	1,682	615	0.37	269	1,475	604	0.41	301	1,373	594	0.43	318
Colorado River near Cameo, Colorado	2,893	1,605	0.55	408	2,586	1,428	0.55	406	2,464	1,404	0.57	419
Gunnison River near Grand Junction, Colorado	2,008	1,633	0.81	598	1,934	1,399	0.72	532	1,964	1,400	0.71	524
Dolores River near Cisco, Utah	571	294	0.51	378	549	305	0.56	409	579	307	0.53	390
Colorado River near Cisco, Utah	5,370	3,966	0.74	543	4,961	3,522	0.71	522	4,904	3,501	0.71	525
San Juan River near Archuleta, New Mexico	749	181	0.24	178	712	170	0.24	176	720	173	0.24	177
San Juan River near Bluff, New Mexico	1,589	1,355	0.85	627	1,405	1,425	1.01	746	1,542	1,558	1.01	743
Colorado River at Lee's Ferry, Arizona	11,594	8,846	0.76	561	10,057	7,632	0.76	558	9,887	7,705	0.78	573
Colorado River near Grand Canyon, Arizona	11,951	9,524	0.80	586	10,420	8,304	0.80	586	10,246	8,389	0.82	602
Virgin River near Littlefield, Arizona	154	39	0.26	188	141	51	0.36	268	142	47	0.33	245
Colorado River below Hoover Dam, Ariz.-Nev.	11,277	10,306	0.91	672	10,028	9,042	0.90	663	9,912	9,180	0.93	681
Colorado River above Parker Dam, Ariz.-Calif.	11,283	10,373	0.92	676	10,026	9,095	0.91	667	9,906	9,228	0.93	685
Colorado River below Parker Dam, Ariz.-Calif.	8,206	7,879	0.96	706	7,422	7,096	0.96	703	7,405	7,261	0.98	721
Colorado River at Imperial Dam, Ariz.-Calif.	6,968	7,809	1.12	824	6,174	7,028	1.14	837	6,202	7,245	1.17	859

4. Two Dimensional Reservoir Modeling

The Water and Power Resources Service is planning to contract in fiscal year 1981, a two-dimensional reservoir model of Lake Powell and possibly Lake Mead to improve temperature and salinity modeling capability for reservoirs.

Two dimensional reservoir modeling is necessary to more accurately predict salinity levels throughout the system. The major reservoirs tend to selectively route the high quality spring runoff and trap the cold saline winter base flows which have greater density. These large seasonal variations in salinity and temperature produce density currents which result in significant horizontal and vertical total dissolved solids variance in the reservoirs. Two-dimensional reservoir modeling together with a comprehensive reservoir sampling program should provide valuable data for more accurately predicting salinity levels throughout the river/reservoir system. This study is scheduled to last 2 years.

I. Geologic Factors that Affect Salinity in the Upper Colorado River Basin

In 1977 the U.S. Geological Survey compiled a report for the Bureau of Land Management that describes the effects of geology in the Colorado, Utah, and Wyoming parts of the Upper Colorado River Basin on salinity in the river system (U.S. Bureau of Land Management, 1978, p. 15-23).(2)

J. Salt Pickup and Transport in Surface Runoff from Rangelands and Ground Water

The Bureau of Land Management (BLM) is continuing to study the process of salt pickup and transport in surface runoff from rangelands and ground water. The 1978-79 Salinity Status Report (Bently et. al., 1980) discusses results and conclusions of BLM's efforts through 1979 fiscal year. (24)

1. Ground Water investigations

Recent investigations on the contribution of interflow to salinity of ground water in arid and semiarid regions of western Colorado reveal that recharge does not come from precipitation falling on large areas of rangeland. Salinity profiles in the weathered materials suggested these soils are not an avenue for recharge. Evidence from both regions indicates the direction of net water movement in soils is upward rather than downward. It is theorized recharge occurs when runoff of snowmelt on the upper borders of the watershed intersects exposed bedrock. Data from a series of observed wells shows that ground water moves along a contact between bedrock and the soild profile.

The U.S. Geological Survey conducted an extensive ground water study for BLM in that part of the Upper Basin above the confluence of the

Green and Colorado Rivers. This large region was divided into nine subregions or basins. Data were collected on streamflow, conductivity, and water quality through chemical analyses. Measurements were taken in December and January when streamflow was at a low level, made up primarily by ground water discharge. Cold temperatures at this time of year would have made surface runoff from melting snow very unlikely, and there was no observed rainfall. The volume of irrigation returnflow should also have been at a minimum. Measurements were not taken as a part of this study in areas where adequate data existed as a result of previous studies, as, for example, the Piceance Basin oil shale investigations.

The area covered by this investigation yields 74 percent of the water and 77 percent of the salt contributed by the Upper Basin. The measured ground water contribution to the total annual salt load of this part of the Upper Basin was 55 percent. However, the ground contributed by each of the nine subbasins varied considerably, from a low of 30 percent in the Upper Green River Basin, to a high of 93 percent in the Lower Colorado River headwaters. In general, the percent of total salt load contributed by ground water was higher for subbasins in the Colorado River Region, an average of 69 percent, than for subbasins in the Green River Region, an average of only 38 percent.

The Upper Colorado Headwaters subbasin is an area of high mountain country on the west slopes of the Continental Divide. The geologic formations are classed as slightly saline to nonsaline. The soils are Inceptisols, Alfisols, and Mollisols which are normally low in salts or have been leached by virture of their location at higher elevations.

Vegetation is alpine tundra, conifers, mountain scrub, and meadowlands. Salt concentration in runoff would be very low. This subbasin produces 28 percent of the total water for the study region and only 16 percent of the total salt load. However, the subbasin accounts for 26 percent of the total salt contributed from ground water. Of the salt produced by the subbasin, 87 percent comes from the ground water yielded by the Eagle Valley Evaporate Formation and from Glenwood and Dotsero Hot Springs. Point source salt contributions can be very significant. The Water and Power Resources Service estimates that 500,000 tons (450 000 t) of salt, or nearly one half of the total subbasin salt load, are produced annually by the Glenwood and Dotsero Springs.

The effect of irrigation returnflow on the salt load from ground water during the base flow period (winter) is very small for most subbasins, especially those at high elevations. Soils being irrigated are the alluvial, relatively well-drained deposits along streams. The distance ground water (irrigation returnflow) must travel before entering a stream channel are in most cases, relatively short. Therefore, water quality data collected in December or January should reflect a minimal influence from irrigated agriculture. However, the large blocks of farmland located on fine-textured, poorly drained soils, and/or at long distances from streams can have a great influence on ground water. Examples of these would be the Uinta and Price River Basins in Utah, the Lower Gunnison and Grand Valley Projects in Colorado, and the Eden-Farson Project in Wyoming.

Water quality data were collected on drainage channels in the Lower Gunnison and Grand Valley areas thought to be yielding only irrigation returnflow. The annual salt loads from these channels were subtracted from salt loads estimated to be contributed by natural ground water. All of the base flow salt load contributed by the Price River was believed to be from irrigation return flow and was subtracted from the total. An average value of 50 percent of the base flow salt load was arbitrarily set for irrigation return flow on the San Rafael, Duchesne, and Blacks Fork Rivers, and Piceance Creek. A value of 20 percent was similarly estimated for irrigation returnflow salt load from the Big Sandy River. These were all subtracted from computed total salt loads for the subbasins. Table 1 shows the results of this exercise.

It is estimated that the contribution of ground water from natural sources to the total salt load of the Green and Colorado Rivers above their confluence is 38 percent. This is a reduction from the 55 percent measured as ground water-contributed salt load. The remaining 17 percent of salt load would theoretically be from irrigation returnflow during the base flow period. This 38 percent from natural ground water sources is in contrast to the 58 percent estimated by the EPA, 1971[26] to be from natural diffuse and point sources. The EPA also estimates that the total annual yield to the salt load from the irrigation returnflow is 41 percent and 1 percent from industrial and municipal sources. BLM, 1978,[25] estimated that surface runoff from the public lands yielded a total of 8 percent of the total salt load of the Upper Basin. Surface runoff from similar lands owned or administered by private individuals, states, Indian tribes, and other Federal agencies probably yields an additional 7 percent of the Upper Basin salt load. These estimates account for 95 percent of the total salt load. The 5 percent unaccounted for is well within the error of these calculations. Table H shows salt load contributions from natural and irrigation returnflow ground water for the nine subbasins.

In summary, salt contributions from the Upper Basin can be outlined as follows:

Natural Ground Water (diffuse & point sources)	38%
Surface Runoff from Rangelands (BLM, private, & State)	15%
Surface Runoff from Forest & Error in Calculations	5%
Irrigation Returnflow	41%
Industrial & Municipal	1%
Total	100

This exercise gives a gross accounting of sources of salt in the Upper Basin. It was done for the purpose of trying to better identify the contribution of natural sources, an area that has been ignored because of the difficulty in obtaining data. Hyatt et. al., 1970, indicate that only 20 percent of the 1931 to 1960 average annual salt load from the Upper Basin is traced to its area of origin through actual measurements.[27] Therefore, most estimates of the natural salt are derived by determining the salt load from agriculture, industry, municipalities, and natural point sources, then attributing the remaining salt to "other natural sources." It is believed that the estimates presented in this report give a more accurate value for the salt load contributed from natural diffuse sources.

TABLE H

Estimated Values for Salt Load Contributed by Natural and Irrigation Returnflow Ground Water

Subbasin	Total Salt Load[1]		Measured Base Flow Salt Load[2]		Less Amount Estimated for Irrigation Returnflow		Total Natural Base Flow Salt Load	
	tons/year	tonnes/year	tons/year	tonnes/year	tons/year	tonnes/year	tons/year	tonnes/year
Upper Colorado River Headwaters	1,117,300	1 013 600	974,200	883 800	0	0	974,200	883 800
Gunnison River Basin	1,364,600	1 238 000	726,200	658 800	344,400	312 400	381,800	346 400
Lower Colorado River Headwaters	1,113,100	1 009 800	1,040,000	943 500	690,000	630 000	349,200	316 800
Dolores River Basin	489,800	443 500	282,500	256 300	0	0	282,500	256 300
Middle Upper Colorado River	-268,800	-243 900	-384,700	-349 000	0	0	-384,700	-349 000
Upper Green River Basin	1,135,000	1 029 700	335,400	304 300	36,000	33 000	299,400	271 600
Yampa River Basin	411,700	373 500	161,100	146 100	0	0	161,100	146 100
White River Basin	275,100	249 600	195,700	177 500	8,000	7000	187,700	170 300
Lower Green River Basin	1,213,300	1 100 700	466,100	422 800	129,700	117 700	336,400	305 200
Totals	6,851,100	6 214 500	3,796,500	3 444 100	1,208,900	1 100 100	2,587,600	2 347 500

[1] Taken from BLM 1977 Salinity Status Report, 1978.(25)

[2] Taken from Warner and Heims, 1979.(25)

2. Salt From Surface Runoff

A number of activities, including livestock grazing, off-road vehicle use (ORV), oil and gas activity, mining claim exploration and development, and coal mining activity, can be contributing factors to salt in surface runoff from public lands. Each of these factors must be dealt with on a site-specific basis to determine the extent of salt contribution and to plan measures necessary to reduce the concentration to acceptable levels.

Improper livestock grazing can have a significant influence on the amount of sediment and salt yielded in surface runoff from rangelands. The importance of controlling the period and intensity of grazing, the kind of animal, and the need for rest from grazing to improve range condition is stressed. Light to moderate grazing during the season when plants or soils are least likely to be damaged, periodic rest from grazing through the use of grazing management systems, and total removal of livestock from areas with unstable soils or little potential to support a protective cover of vegetation are specific ways livestock can be managed to reduce salinity.

Salinity control through grazing management will vary with the concentration of salts in the soil. Specific management which may be employed for each type is as follows:

a. Nonsaline - Slightly Saline Lands

Grazing management to meet salinity objectives should strive to produce a maximum volume of runoff while at the same time maintaining a stable soil with a minimum loss of sediment through erosion. This loss of water to the soil-water reservoir will reduce forage production for livestock and wildlife below its natural potential. However, the higher quality water (usually below 300 mg/L salt concentration) will dilute the more saline waters in the Colorado River system and at Imperial Dam, and thus reduce salinity.

b. Moderately Saline Lands

Grazing of livestock at a light to moderate level, in accordance with a schedule of use and rest treatments designed to provide maximum protection for soil and plants, will reduce salinity in surface runoff. The objective on these lands is to increase infiltration and reduce runoff and loss of saline sediment. Salt concentration in runoff water exceeds that measured in receiving streams.

c. Highly Saline Lands

Moderate grazing in winter when soils are frozen may not significantly increase salinity on areas where forage production is sufficient to support grazing animals. Soil factors have a most important influence on infiltration and runoff on areas having a very sparse ground cover of perennial vegetation. Plants have only a slight influence due to their scarcity.

3. Future Studies

The conclusions in BLM's 1977 and 1978-79 Salinity Status Reports regarding effects of man's activities on salinity have been drawn primarily from published results dealing mainly with effects on infiltration, runoff, and sedimentation. Recent results (studies funded by BLM and USDI, Office of Water Research and Technology) have shown a relationship between increased salinity and increased runoff and soil loss. These data were used as a justification for this extrapolation. However, the duration of the studies was short, 3 years at the maximum. Further studies relating to the effects on salinity levels of control of oil-gas activities, mining, ORV, and grazing are needed. Additional data are also needed on the feasibility of controlling natural and man-caused point sources of salinity from ground water.

The following studies are suggested for future consideration in order to better understand the facts influencing salinity and the best means of reducing salt yields from public lands.

a. Research on the Effects of Grazing on Hydrologic Responses, and Ultimately on Salinity, Should be Continued

As contrasted with previous studies, the main feature of this project would be the direct measurement of salinity as affected by grazing treatments. Data on other more conventional parameters, such as runoff, sedimentation, changes in vegetation, erosion, and infiltration properties, would also be collected. These data would improve our knowledge of the relationships between hydrologic responses and salinity.

b. A Demonstration and Experimental Evaporation Pond Salinity Control Project Could be Constructed

Salt Creek in western Colorado is a likely candidate for a site. Such a project would be studied to provide BLM with data on design problems, construction techniques and costs, maintenance problems and costs, evaporation rates, and effects on wildlife and other aspects of the environment.

c. Water Quality Data Are Necessary for Preparing and Monitoring Success of Land Use and Activity Plans (i.e., allotment management plans)

In response to this and other resources' needs for information, a series of stream-gaging stations have been located in Colorado and Utah on ephemeral and perennial channels. These gages are providing valuable data on salinity levels from arid and seimarid public rangelands. The stations are located in regions where little data on water quality have been previously collected. Maintenance and operation of these stations should be continued. In addition, biological data should be collected on the watelands. The stations are located in regions where little date on

water quality have been previously collected. Maintenance and operation of these stations should be continued. In addition, biological data should be collected on the watersheds above the gaging stations. These would provide information on factors relating to levels of salinity monitored by the gages.

Grazing treatments could be instituted on several watersheds or new gages installed on watersheds with existing grazing systems. New gaging stations are also needed in areas not presently included in the BLM salinity monitoring network, such as areas in northeastern Utah and Wyoming.

K. Saline Water Use and Disposal Opportunities Study

Water and Power is making an appraisal investigation to study alternatives to current methods of onsite brine disposal. One innovative option involves a pipeline collector system to use saline water to support energy development.

The appraisal study has two thrusts: One is the investigation of using saline water for energy development. Second is the feasibility of a pipeline collection and disposal system for saline water and other collected wastewaters, such as wastewater from powerplants and oil shale development.

About 250,000 acre-feet (310 x $10^6 m^3$) per year of saline water could be collected for disposal or for use in energy development - for cooling coal-fired powerplants and for use in slurry lines which transport coal. Of special concern in this study are legal and institutional, environmental, and cost-sharing issues. To assure that these issues are addressed early, special steps are being taken. A series of legal, institutional, and financial options have been discussed with the Forum's work group. Those options are designed to be compatible with the existing law of the river and normal Federal cost-sharing procedures. To assure that environmental issues are identified and addressed, the study will include an environmental assessment of the alternatives that appear to hold the most promise. Public involvement activities will be conducted throughout the study.

METRIC CONVERSIONS

Multiply U.S. Customary Units	By Conversion Factor	To Obtain SI Units
	Length	
inches (in)	0.0254	meters (m)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	Area	
acres (A)	4047	square meters (m^2)
acres (A)	0.4047	hectare (ha)
square miles (mi^2)	2.590	square kilometers (km^2)
	Volume	
gallons (gal)	3.785×10^{-3}	cubic meters (m^3)
gallons (gal)	3.785	liters (L)
cubic feet (ft^3)	0.0283	cubic meters (m^3)
cfs-days (dsf)	2447	cubic meters (m^3)
acre-feet (AF)	1233	cubic meters (m^3)
	Mass	
tons (T)	0.9072	tonne (t)
	Concentration	
tons per acre-foot (T/AF)	735.29	milligrams per liter (mg/L)
parts per million (ppm)	1.0	milligrams per liter (mg/L)
	Salt Pickup	
tons per acre (T/A)	2.242	tonne per hectare (t/ha)
	Flow	
cubic feet per second (ft^3/s), (cfs)	0.02832	cubic meters per second (m^3/s)
	28.32	liters per second (L/s)
gallons per minute (gal/min), (gpm)	6.309×10^{-5}	cubic meters per second (m^3/s)
	0.06309	liters per second (L/s)

COMMON MULTIPLES OF SI UNITS

Factor	Prefix Name	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	u
10^{-9}	nano	n
10^{-12}	pico	p

COMMON U.S. CUSTOMARY UNIT CONVERSIONS

Multiply	By	To Obtain
acre-foot (AF)	43,560	cubic feet (ft^3)
ton (T)	2,000	pounds (lb)
acre (A)	43,560	square feet (ft^2)

COMMON SI UNIT CONVERSIONS

Multiply	By	To Obtain
tonne (t)	1000	kilograms (kg)
liter (L)	1000	cubic centimeter (cm^3)

Definitions of Terms

Acre-foot (A.F., acre-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or about 326,000 gallons or 1233 cubic meters.

C.f.s.-day is the volume of water represented by flow of 1 cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, approximately 1.9835 acre-feet, about 646,000 gallons or 2447 cubic meters.

Concentration is the flow-weighted average concentration of total dissolved solids (salt) measured in mg/L or tons/acre-foot.

Consumptive Use is the total amount of water taken up by vegetation for transpiration and evaporation.

Cubic feet per second (c.f.s.) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute or 0.028 32 cubic meters per second.

Depletion is the total loss of water from the river system due to consumptive uses, evaporation, seepage, evapotranspiration and transmountain diversion.

Discharge is the volume of water plus suspended sediment that passes a given point within a given period of time.

Diversion is the total amount of water diverted.

Drainage Basin is a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Estimated Flow is the flow that is estimated for periods of time in which no records of flow are available. The flow may be estimated by correlation or other accepted methods.

Gaging Station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Historical Flow is the flow actually experienced at the gaging station or point of measurement. It is the total runoff of a drainage area above the point of measurement as influenced by nature and the activities of man. It may be recorded or estimated.

Instantaneous Discharge is the discharge at a particular instant of time.

Mean Discharge is the arithmetic mean of individual daily mean discharge during a specific period.

Natural Flow - See definition of virgin flow.

Pickup of salts is the amount of additional salts introduced into the system when irrigating new lands. The terms pickup rate is usually measured in tons/acre and generally varies from zero tons to two tons per acre.

Present modified flow is the historic flow adjusted to reflect the present level of depletions with corrections to remove the effects of major reservoirs, computed with an average present level of evaporation.

Recorded Flow is the flow passing a specific point on a stream which is measured and a record kept for a period of time.

Return Flow is the amount of water returned to the river system after being diverted for a use.

Salt is a compound derived from an acid by replacing hydrogen with a metal or an electropositive radical.

Sediment is a solid material that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope, soil characteristics, land usage, and quantity and intensity of precipitation.

Specific conductance is a measure of the ability of a water to conduct an electrical current. It is expressed in micromhos per centimeter at 25° C. Specific conductance is related to the type and concentration of ions in water and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream, and it may vary in the same source with changes in the composition of the water.

Stream Flow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "stream flow" uniquely describes the discharge in a surface stream source. The term "stream flow" is more general than "runoff" as stream flow may be applied to discharge whether or not it is affected by diversion or regulation.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Tons per acre-foot indicates the dry mass of total dissolved solids in 1 acre-foot of water. It is computed by multiplying the concentration in milligrams per liter by 0.00136.

Total Dissolved Solids (TDS) is an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc., of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. High TDS solutions have the capability of changing the chemical nature of water. High TDS concentrations exert varying degrees of osmotic pressures and often become lethal to the biological inhabitants of an aquatic environment. The common term for TDS is salt.

Total Salt Load is the total quantity of salts, as measured by dry mass or volume, that is dissolved in a specific amount of water (discharge) passing a given point during a given time.

Transmountain Diversion is the total amount of water diverted out of its original basin.

Virgin Flow is the historical flow at the point of measurement corrected for the effects of manmade developments in the drainage basin above the point of measurement.

Water Year is the 12 month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1978, is called the "1978 water year."

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Table I

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Green River, Wyoming

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	22	0.73	16
	Feb.	19	.74	14
	Mar.	45	.69	31
	Apr.	95	.54	51
	May	174	.52	90
	June	342	.34	116
	July	137	.37	51
	Aug.	81	.46	37
	Sept.	48	.54	26
	Oct.	67	.60	40
	Nov.	53	.64	34
	Dec.	26	.81	21
	TOTAL	1,109	.48	527
1942	Jan.	24	.79	19
	Feb.	23	.83	19
	Mar.	43	.70	30
	Apr.	200	.41	82
	May	151	.50	75
	June	337	.34	114
	July	205	.32	66
	Aug.	58	.52	30
	Sept.	32	.62	20
	Oct.	29	.76	22
	Nov.	26	.81	21
	Dec.	26	.77	20
	TOTAL	1,154	.45	518
1943	Jan.	28	.78	22
	Feb.	29	.76	22
	Mar.	59	.63	37
	Apr.	200	.41	82
	May	237	.39	92
	June	476	.29	138
	July	359	.25	90
	Aug.	121	.39	47
	Sept.	50	.54	27
	Oct.	48	.67	32
	Nov.	43	.67	29
	Dec.	30	.77	23
	TOTAL	1,680	.38	641
1944	Jan.	25	.80	20
	Feb.	25	.80	20
	Mar.	31	.77	24
	Apr.	267	.37	99
	May	155	.46	71
	June	351	.33	116
	July	230	.30	69
	Aug.	60	.50	30
	Sept	31	.65	20
	Oct.	38	.71	27
	Nov.	31	.74	23
	Dec.	21	.81	17
	TOTAL	1,265	.42	536
1945	Jan.	24	.79	19
	Feb.	27	.74	20
	Mar.	41	.68	28
	Apr.	78	.58	45
	May	111	.52	58
	June	245	.38	93
	July	284	.28	80
	Aug.	125	.39	49
	Sept.	76	.45	34
	Oct.	64	.62	40
	Nov.	42	.69	29
	Dec.	33	.73	24
	TOTAL	1,150	.45	519
1946	Jan.	32	.75	24
	Feb.	26	.77	20
	Mar.	65	.62	40
	Apr.	131	.48	63
	May	212	.41	87
	June	320	.34	109
	July	153	.35	54
	Aug.	74	.47	35
	Sept.	52	.52	27
	Oct.	58	.64	37
	Nov.	51	.67	34
	Dec.	51	.67	34
	TOTAL	1,225	.46	564
1947	Jan.	26	0.81	21
	Feb.	30	.73	22
	Mar.	141	.47	66
	Apr.	75	.57	43
	May	368	.33	121
	June	501	.29	145
	July	327	.26	85
	Aug.	199	.32	64
	Sept.	81	.44	36
	Oct.	75	.59	44
	Nov.	59	.63	37
	Dec.	44	.68	30
	TOTAL	1,926	.37	714
1948	Jan.	38	.71	27
	Feb.	33	.73	24
	Mar.	64	.62	40
	Apr.	95	.54	51
	May	187	.43	80
	June	396	.31	123
	July	121	.39	47
	Aug.	56	.52	29
	Sept.	32	.62	20
	Oct.	36	.72	26
	Nov.	29	.76	22
	Dec.	26	.81	21
	TOTAL	1,113	.46	510
1949	Jan.	27	.78	21
	Feb.	24	.79	19
	Mar.	45	.69	31
	Apr.	104	.52	54
	May	211	.41	86
	June	372	.32	119
	July	179	.36	64
	Aug.	65	.48	31
	Sept.	38	.58	22
	Oct.	52	.65	34
	Nov.	54	.65	35
	Dec.	34	.74	25
	TOTAL	1,205	.45	541
1950	Jan.	29	.79	23
	Feb.	33	.73	24
	Mar.	102	.53	54
	Apr.	251	.38	95
	May	270	.37	100
	June	582	.34	198
	July	427	.23	98
	Aug.	140	.37	52
	Sept.	76	.45	34
	Oct.	66	.61	40
	Nov.	71	.59	42
	Dec.	49	.65	32
	TOTAL	2,096	.38	792
1951	Jan.	34	.74	25
	Feb.	47	.66	31
	Mar.	70	.59	41
	Apr.	154	.45	69
	May	317	.35	111
	June	528	.28	148
	July	349	.25	87
	Aug.	298	.28	58
	Sept.	91	.43	39
	Oct.	81	.53	43
	Nov.	50	.68	34
	Dec.	43	.70	30
	TOTAL	1,972	.36	716
1952	Jan.	41	.63	26
	Feb.	42	.62	26
	Mar.	52	.63	33
	Apr.	190	.52	99
	May	348	.32	111
	June	399	.27	108
	July	171	.33	56
	Aug.	99	.38	38
	Sept.	57	.51	29
	Oct.	42	.64	27
	Nov.	28	.82	23
	Dec.	27	.78	21
	TOTAL	1,496	.40	597
1953	Jan.	32	0.69	22
	Feb.	33	.70	23
	Mar.	44	.68	30
	Apr.	77	.58	45
	May	74	.57	42
	June	381	.28	107
	July	206	.29	60
	Aug	104	.39	41
	Sept.	39	.56	22
	Oct.	34	.74	25
	Nov.	36	.75	27
	Dec.	24	.88	21
	TOTAL	1,084	.43	465
1954	Jan.	26	.81	21
	Feb.	27	.74	20
	Mar.	48	.67	32
	Apr.	88	.55	48
	May	282	.28	79
	June	232	.30	70
	July	250	.25	62
	Aug.	86	.40	34
	Sept.	47	.55	26
	Oct.	40	.68	27
	Nov.	39	.69	27
	Dec.	18	.89	16
	TOTAL	1,183	.39	462
1955	Jan.	20	.80	16
	Feb.	20	.80	16
	Mar.	33	.76	25
	Apr.	74	.59	44
	May	127	.39	50
	June	245	.27	66
	July	116	.36	42
	Aug.	68	.41	28
	Sept.	35	.57	20
	Oct.	33	.70	23
	Nov.	28	.79	22
	Dec.	39	.74	29
	TOTAL	838	.45	381
1956	Jan.	42	.69	29
	Feb.	29	.66	19
	Mar.	91	.56	51
	Apr.	158	.45	71
	May	310	.37	115
	June	555	.25	139
	July	197	.31	61
	Aug.	98	.38	37
	Sept.	41	.56	23
	Oct.	39	.59	23
	Nov.	35	.69	24
	Dec.	26	.77	20
	TOTAL	1,621	.38	612
1957	Jan.	22	.77	17
	Feb.	37	.70	26
	Mar.	57	.68	39
	Apr.	60	.62	37
	May	176	.46	81
	June	476	.27	129
	July	380	.25	95
	Aug.	117	.35	41
	Sept.	68	.47	32
	Oct.	66	.55	36
	Nov.	48	.67	32
	Dec.	41	.71	29
	TOTAL	1,548	.38	594
1958	Jan.	33	.76	25
	Feb.	47	.66	31
	Mar.	51	.63	32
	Apr.	99	.56	55
	May	291	.31	90
	June	266	.31	82
	July	76	.45	34
	Aug.	51	.53	27
	Sept.	36	.64	23
	Oct.	33	.79	26
	Nov.	32	.78	25
	Dec.	31	.74	23
	TOTAL	1,046	.45	473
1959	Jan.	24	0.71	17
	Feb.	25	.72	18
	Mar.	49	.65	32
	Apr.	73	.64	47
	May	79	.51	40
	June	322	.26	84
	July	140	.34	48
	Aug.	79	.40	32
	Sept.	42	.55	23
	Oct.	51	.57	29
	Nov.	42	.60	25
	Dec.	27	.74	20
	TOTAL	953	.44	415
1960	Jan.	27	.74	20
	Feb.	23	.78	18
	Mar.	75	.53	40
	Apr.	84	.49	41
	May	66	.48	32
	June	173	.30	52
	July	68	.43	29
	Aug.	38	.45	17
	Sept.	28	.54	15
	Oct.	42	.57	24
	Nov.	47	.49	23
	Dec.	27	.69	19
	TOTAL	698	.47	330
1961	Jan.	20	.60	12
	Feb.	19	.58	11
	Mar.	30	.57	17
	Apr.	50	.60	30
	May	60	.43	26
	June	162	.27	44
	July	47	.43	20
	Aug.	35	.43	15
	Sept.	39	.46	18
	Oct.	41	.51	21
	Nov.	29	.52	15
	Dec.	27	.52	14
	TOTAL	559	.43	243
1962	Jan.	32	.47	15
	Feb.	48	.48	23
	Mar.	77	.51	38
	Apr.	203	.43	87
	May	256	.36	92
	June	355	.27	96
	July	250	.27	68
	Aug.	94	.37	35
	Sept.	38	.58	22
	Oct.	38	.63	24
	Nov.	35	.66	23
	Dec.	25	.88	22
	TOTAL	1,451	.38	545
1963	Jan.	18	.72	13
	Feb.	18	.72	13
	Mar.	42	.67	28
	Apr.	51	.63	32
	May	100	.45	45
	June	337	.26	88
	July	143	.32	46
	Aug.	76	.47	36
	Sept.	77	.43	33
	Oct.	58	.50	29
	Nov.	52	.60	31
	Dec.	30	.60	18
	TOTAL	1,002	.41	412
1964	Jan.	23	.56	13
	Feb.	22	.59	13
	Mar.	29	.59	17
	Apr.	68	.56	38
	May	138	.32	44
	June	323	.38	123
	July	335	.26	87
	Aug.	87	.39	34
	Sept.	37	.65	24
	Oct.	24	.92	22
	Nov.	25	.88	22
	Dec.	25	.84	21
	TOTAL	1,136	.40	458
1965	Jan.	28	0.79	22
	Feb.	30	.70	21
	Mar.	38	.74	28
	Apr.	44	.86	38
	May	94	.60	56
	June	429	.38	163
	July	466	.30	140
	Aug.	184	.36	66
	Sept.	461	.41	189
	Oct.	86	.73	63
	Nov.	75	.65	49
	Dec.	29	.90	26
	TOTAL	1,964	.44	861

To obtain mg/L multiply T/AF by 735.29

Table I

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Green River, Wyoming

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	37	.76	28
	Feb.	35	.77	27
	Mar.	88	.72	63
	Apr.	138	.50	69
	May	160	.39	62
	June	171	.31	53
	July	91	.43	39
	Aug.	56	.52	29
	Sept.	45	.60	27
	Oct.	35	.77	27
	Nov.	30	.83	25
	Dec.	25	.96	24
	TOTAL	911	.52	473
1967	Jan.	19	1.01	19
	Feb.	19	1.04	20
	Mar.	33	.87	29
	Apr.	129	.54	70
	May	138	.48	66
	June	456	.28	128
	July	448	.25	112
	Aug.	88	.39	34
	Sept.	65	.50	32
	Oct.	62	.56	35
	Nov.	49	.64	31
	Dec.	17	1.07	18
	TOTAL	1,523	.39	594
1968	Jan.	17	1.03	18
	Feb.	16	1.03	16
	Mar.	33	.86	28
	Apr.	31	.93	29
	May	56	.68	38
	June	271	.40	108
	July	88	.41	36
	Aug.	136	.40	54
	Sept.	126	.37	47
	Oct.	117	.44	51
	Nov.	54	.58	31
	Dec.	30	.85	26
	TOTAL	975	.49	482
1969	Jan.	51	.61	31
	Feb.	89	.46	41
	Mar.	80	.56	45
	Apr.	141	.46	65
	May	207	.36	75
	June	302	.28	86
	July	154	.34	52
	Aug.	97	.47	46
	Sept	68	.51	35
	Oct.	81	.49	40
	Nov.	50	.60	30
	Dec.	42	.69	29
	TOTAL	1,362	.42	575
1970	Jan.	38	.74	28
	Feb.	33	.76	25
	Mar.	58	.60	35
	Apr.	75	.69	52
	May	84	.58	49
	June	204	.37	75
	July	127	.36	46
	Aug.	86	.43	37
	Sept.	75	.45	34
	Oct.	62	.55	34
	Nov.	49	.67	33
	Dec.	43	.70	30
	TOTAL	934	.51	478
1971	Jan.	42	.71	30
	Feb.	47	.62	29
	Mar.	76	.60	45
	Apr.	107	.53	57
	May	280	.41	116
	June	480	.30	143
	July	291	.28	81
	Aug.	126	.37	47
	Sept.	77	.46	35
	Oct.	72	.49	35
	Nov.	63	.54	34
	Dec.	87	.51	44
	TOTAL	1,748	.40	696
1972	Jan.	85	.54	46
	Feb.	77	.56	43
	Mar.	106	.58	62
	Apr.	154	.48	73
	May	294	.40	118
	June	625	.27	169
	July	255	.30	78
	Aug.	122	.39	48
	Sept.	75	.48	36
	Oct.	79	.53	42
	Nov.	85	.51	43
	Dec.	51	.61	31
	TOTAL	2,008	.39	789
1973	Jan.	73	.58	42
	Feb.	95	.48	46
	Mar.	92	.53	49
	Apr.	110	.60	66
	May	171	.46	78
	June	162	.36	58
	July	127	.40	51
	Aug.	107	.44	47
	Sept.	75	.53	40
	Oct.	67	.57	38
	Nov.	61	.62	38
	Dec.	53	.62	33
	TOTAL	1,193	.49	586
1974	Jan.	78	.56	44
	Feb.	110	.49	54
	Mar.	114	.57	65
	Apr.	104	.58	60
	May	207	.43	89
	June	346	.31	106
	July	210	.31	65
	Aug.	102	.42	43
	Sept.	53	.60	32
	Oct.	57	.61	35
	Nov.	54	.65	35
	Dec.	59	.63	37
	TOTAL	1,494	.45	665
1975	Jan.	62	.61	38
	Feb.	57	.60	34
	Mar.	62	.66	41
	Apr.	70	.67	47
	May	125	.54	67
	June	296	.36	108
	July	329	.32	105
	Aug.	133	.38	50
	Sept.	60	.57	34
	Oct.	57	.60	34
	Nov.	60	.58	35
	Dec.	74	.55	41
	TOTAL	1,385	.46	634
1976	Jan.	71	.58	41
	Feb.	65	.55	36
	Mar.	99	.54	53
	Apr.	106	.54	57
	May	296	.40	117
	June	292	.30	88
	July	177	.34	60
	Aug.	141	.39	55
	Sept.	65	.51	33
	Oct.	58	.55	32
	Nov.	56	.54	30
	Dec.	60	.53	32
	TOTAL	1,486	.43	634
1977	Jan.	61	.55	34
	Feb.	55	.57	32
	Mar.	42	.73	30
	Apr.	33	.81	27
	May	30	.76	23
	June	25	.81	20
	July	23	.85	19
	Aug.	23	.88	20
	Sept.	33	.68	22
	Oct.	31	.73	23
	Nov.	32	.73	24
	Dec.	43	.64	27
	TOTAL	431	.70	301
1978	Jan.	64	.51	32
	Feb.	59	.51	30
	Mar.	79	.56	44
	Apr.	104	.49	51
	May	167	.44	74
	June	378	.31	117
	July	302	.25	75
	Aug.	142	.31	43
	Sept.	82	.39	32
	Oct.	46	.56	26
	Nov.	50	.52	26
	Dec.	59	.49	29
	TOTAL	1532	.38	581
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 1

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Green River, Wyoming

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	1,109	.48	527	1368	349	478
1942	1,154	.45	518	1423	330	470
1943	1,680	.38	641	2072	281	582
1944	1,265	.42	536	1560	312	486
1945	1,150	.45	519	1419	332	471
1946	1,225	.46	564	1511	339	512
1947	1,926	.37	714	2376	273	648
1948	1,113	.46	510	1373	337	463
1949	1,205	.45	541	1486	330	491
1950	2,096	.38	792	2585	278	719
1951	1,972	.36	716	2432	267	650
1952	1,496	.40	597	1845	294	542
1953	1,084	.43	465	1337	316	422
1954	1,183	.39	462	1459	287	419
1955	838	.45	381	1034	335	346
1956	1,621	.38	612	1999	278	555
1957	1,548	.38	594	1909	282	539
1958	1,046	.45	473	1290	333	429
1959	953	.44	415	1176	320	376
1960	698	.47	330	861	347	299
1961	559	.43	243	690	319	220
1962	1,451	.38	545	1790	276	494
1963	1,002	.41	412	1236	303	374
1964	1,136	.40	458	1401	296	415
1965	1,964	.44	861	2423	322	781
1966	911	.52	473	1124	382	429
1967	1,523	.39	594	1879	287	539
1968	975	.49	482	1203	363	437
1969	1,362	.42	575	1680	311	522
1970	934	.51	478	1152	377	434
1971	1,748	.40	696	2156	293	631
1972	2,008	.39	789	2477	289	716
1973	1,193	.49	586	1472	361	532
1974	1,494	.45	665	1843	327	603
1975	1,385	.46	634	1708	337	575
1976	1,486	.43	634	1833	314	575
1977	431	.70	301	532	513	273
1978	1,532	.38	581	1890	279	527
Total	49,456		20,914	61 004		18 974
Average	1,301	.42	550	1605	311	499

Table 2

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Greendale, Utah

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	27	0.93	25
	Feb.	25	1.16	29
	Mar.	72	.94	68
	Apr.	131	.56	74
	May	276	.58	160
	June	441	.40	175
	July	171	.55	94
	Aug.	110	.73	80
	Sept.	67	.78	52
	Oct.	94	.97	91
	Nov.	71	.93	66
	Dec.	36	1.19	43
	TOTAL	1,521	.63	957
1942	Jan.	30	1.00	30
	Feb.	31	1.00	31
	Mar.	69	1.07	74
	Apr.	261	.65	170
	May	235	.76	180
	June	434	.44	193
	July	239	.40	97
	Aug.	73	.57	42
	Sept.	40	.72	29
	Oct.	36	1.00	36
	Nov.	35	1.17	41
	Dec.	34	1.06	36
	TOTAL	1,517	.63	959
1943	Jan.	33	1.09	36
	Feb.	37	.97	36
	Mar.	96	.74	71
	Apr.	262	.48	125
	May	338	.38	130
	June	552	.33	182
	July	393	.29	115
	Aug.	163	.47	76
	Sept.	64	.56	36
	Oct.	60	.72	43
	Nov.	54	.83	45
	Dec.	37	.89	33
	TOTAL	2,089	.44	928
1944	Jan.	30	.93	28
	Feb.	32	1.00	32
	Mar.	48	1.48	71
	Apr.	345	.55	190
	May	245	.58	142
	June	469	.37	174
	July	278	.39	109
	Aug.	76	.49	37
	Sept	36	.61	22
	Oct.	47	.83	39
	Nov.	39	.92	36
	Dec.	27	.85	23
	TOTAL	1,672	.54	903
1945	Jan.	29	.97	28
	Feb.	34	.94	32
	Mar.	65	.88	57
	Apr.	113	.70	79
	May	176	.60	105
	June	310	.46	144
	July	325	.37	120
	Aug.	174	.47	82
	Sept.	103	.43	44
	Oct.	74	.74	55
	Nov.	52	.88	46
	Dec.	42	.81	34
	TOTAL	1,497	.55	826
1946	Jan.	39	.90	35
	Feb.	33	.85	28
	Mar.	88	.67	59
	Apr.	237	.48	115
	May	298	.44	130
	June	354	.37	133
	July	162	.40	64
	Aug.	81	.57	46
	Sept.	62	.60	37
	Oct.	68	.76	52
	Nov.	63	.82	52
	Dec.	62	.77	48
	TOTAL	1,547	.52	799
1947	Jan.	32	0.81	26
	Feb.	37	.89	33
	Mar.	195	.62	120
	Apr.	136	.62	84
	May	521	.40	210
	June	628	.36	225
	July	372	.35	131
	Aug.	218	.45	99
	Sept.	91	.53	48
	Oct.	90	.70	63
	Nov.	71	.77	55
	Dec.	56	.87	49
	TOTAL	2,447	.47	1,143
1948	Jan.	47	.91	43
	Feb.	40	.88	35
	Mar.	102	.79	81
	Apr.	157	.70	110
	May	336	.38	126
	June	454	.36	162
	July	126	.50	63
	Aug.	59	.56	33
	Sept.	33	.76	25
	Oct.	39	.77	30
	Nov.	34	.85	29
	Dec.	31	1.00	31
	TOTAL	1,458	.53	768
1949	Jan.	31	.90	28
	Feb.	29	.93	27
	Mar.	73	.89	65
	Apr.	152	.69	105
	May	310	.53	165
	June	493	.47	230
	July	205	.52	106
	Aug.	72	.61	44
	Sept.	42	.74	31
	Oct.	70	.93	65
	Nov.	66	.97	64
	Dec.	40	.97	39
	TOTAL	1,583	.61	969
1950	Jan.	36	1.19	43
	Feb.	45	.95	43
	Mar.	150	.61	92
	Apr.	323	.46	150
	May	416	.46	190
	June	741	.37	275
	July	458	.34	154
	Aug.	153	.51	78
	Sept.	86	.62	53
	Oct.	76	.72	55
	Nov.	80	.75	60
	Dec.	61	.84	51
	TOTAL	2,625	.47	1,244
1951	Jan.	45	.80	36
	Feb.	61	.82	50
	Mar.	93	.78	73
	Apr.	212	.47	100
	May	395	.45	177
	June	626	.36	225
	July	366	.36	132
	Aug.	228	.44	101
	Sept.	98	.56	55
	Oct.	99	.71	70
	Nov.	57	.91	52
	Dec.	54	.87	47
	TOTAL	2,334	.48	1,118
1952	Jan.	49	.82	40
	Feb.	52	.81	42
	Mar.	63	.75	47
	Apr.	318	.62	198
	May	600	.39	235
	June	554	.36	201
	July	205	.56	114
	Aug.	121	.60	72
	Sept.	67	.67	45
	Oct.	49	.86	42
	Nov.	37	1.11	41
	Dec.	34	1.18	40
	TOTAL	2,149	.52	1,117
1953	Jan.	48	0.81	39
	Feb.	48	.85	41
	Mar.	73	.86	63
	Apr.	96	.76	73
	May	110	.64	70
	June	452	.39	175
	July	198	.39	77
	Aug	105	.54	57
	Sept.	43	.63	27
	Oct.	35	.89	31
	Nov.	42	.98	41
	Dec.	32	.97	31
	TOTAL	1,282	.57	725
1954	Jan.	28	1.11	31
	Feb.	39	.87	43
	Mar.	62	.81	50
	Apr.	101	.65	66
	May	302	.31	94
	June	223	.36	81
	July	265	.28	73
	Aug.	81	.43	35
	Sept.	45	.69	31
	Oct.	42	.95	40
	Nov.	41	.85	35
	Dec.	20	1.05	21
	TOTAL	1,249	.47	591
1955	Jan.	24	.75	18
	Feb.	24	.71	17
	Mar.	44	1.11	49
	Apr.	106	.64	68
	May	168	.52	88
	June	288	.33	95
	July	130	.38	49
	Aug.	80	.52	42
	Sept.	38	.58	22
	Oct.	38	.68	26
	Nov.	36	.75	27
	Dec.	45	.82	37
	TOTAL	1,021	.53	538
1956	Jan.	50	.86	43
	Feb.	38	.76	29
	Mar.	150	.47	70
	Apr.	203	.43	87
	May	368	.39	144
	June	615	.29	178
	July	207	.33	69
	Aug.	104	.42	44
	Sept.	48	.44	21
	Oct.	46	.74	34
	Nov.	39	.82	32
	Dec.	26	.88	23
	TOTAL	1,894	.41	774
1957	Jan.	28	.86	24
	Feb.	43	.79	34
	Mar.	66	.91	60
	Apr.	86	.67	58
	May	275	.54	148
	June	685	.37	251
	July	433	.36	155
	Aug.	142	.57	81
	Sept.	82	.58	48
	Oct.	77	.69	53
	Nov.	57	1.00	57
	Dec.	46	.91	42
	TOTAL	2,020	.50	1,011
1958	Jan.	43	.77	33
	Feb.	55	.80	44
	Mar.	66	.71	47
	Apr.	134	.67	90
	May	386	.39	151
	June	335	.38	127
	July	87	.50	44
	Aug.	57	.56	32
	Sept.	39	.69	27
	Oct.	36	.72	26
	Nov.	34	.70	24
	Dec.	38	.84	32
	TOTAL	1,310	.52	677
1959	Jan.	29	0.86	25
	Feb.	32	.91	29
	Mar.	65	.92	60
	Apr.	98	.71	70
	May	115	.57	66
	June	368	.36	132
	July	176	.51	90
	Aug.	93	.47	44
	Sept.	58	.79	46
	Oct.	68	.72	49
	Nov.	51	.76	39
	Dec.	37	.99	37
	TOTAL	1,190	.58	687
1960	Jan.	26	.81	21
	Feb.	29	.86	25
	Mar.	149	.70	104
	Apr.	140	.55	77
	May	127	.58	74
	June	216	.43	93
	July	78	.49	38
	Aug.	43	.47	20
	Sept.	35	.56	20
	Oct.	49	.65	32
	Nov.	54	.67	36
	Dec.	27	.84	23
	TOTAL	973	.58	563
1961	Jan.	27	.73	20
	Feb.	27	.77	21
	Mar.	64	.86	55
	Apr.	76	.69	52
	May	79	.59	47
	June	192	.32	61
	July	56	.44	25
	Aug.	43	.58	25
	Sept.	55	.68	37
	Oct.	64	.70	45
	Nov.	54	.70	38
	Dec.	44	.78	34
	TOTAL	781	.59	460
1962	Jan.	43	.65	28
	Feb.	83	.81	67
	Mar.	150	.84	126
	Apr.	374	.55	206
	May	394	.41	162
	June	456	.40	182
	July	297	.39	116
	Aug.	109	.48	52
	Sept.	44	.64	28
	Oct.	48	.79	38
	Nov.	5	.80	4
	Dec.	16	.94	15
	TOTAL	2,019	.51	1,024
1963	Jan.	23	.91	21
	Feb.	26	.92	24
	Mar.	6	.83	5
	Apr.	8	.87	7
	May	8	.87	7
	June	7	.86	6
	July	6	.83	5
	Aug.	6	.83	5
	Sept.	7	.86	6
	Oct.	8	.87	7
	Nov.	19	.58	11
	Dec.	46	.63	29
	TOTAL	170	.78	133
1964	Jan.	58	.57	33
	Feb.	56	.57	32
	Mar.	37	.59	22
	Apr.	35	.63	22
	May	91	.64	58
	June	86	.60	52
	July	150	.61	92
	Aug.	122	.61	74
	Sept.	131	.61	80
	Oct.	159	.64	102
	Nov.	139	.60	83
	Dec.	194	.62	120
	TOTAL	1,258	.61	770
1965	Jan.	216	0.63	136
	Feb.	213	.70	149
	Mar.	233	1.05	245
	Apr.	204	.83	169
	May	66	.80	53
	June	86	.86	74
	July	29	.86	25
	Aug.	31	.87	27
	Sept.	44	.89	39
	Oct.	79	.79	62
	Nov.	120	.73	88
	Dec.	116	.65	75
	TOTAL	1,437	.79	1,142

To obtain mg/L multiply T/AF by 735.29

Table 2

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Greendale, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	72	0.64	46
	Feb.	72	.65	47
	Mar.	71	.76	54
	Apr.	130	.79	103
	May	83	.78	65
	June	95	.76	72
	July	104	.75	78
	Aug.	118	.72	85
	Sept.	124	.73	91
	Oct.	124	.77	95
	Nov.	85	.81	69
	Dec.	111	.76	84
	TOTAL	1,189	.75	889
1967	Jan.	142	.74	105
	Feb.	96	.75	72
	Mar.	67	.77	52
	Apr.	85	.81	69
	May	122	.83	101
	June	195	.83	162
	July	171	.85	145
	Aug.	188	.86	162
	Sept.	180	.82	148
	Oct.	188	.87	164
	Nov.	173	.85	147
	Dec.	197	.72	142
	TOTAL	1,804	.81	1,469
1968	Jan.	187	.70	131
	Feb.	123	.72	89
	Mar.	76	.83	63
	Apr.	96	.88	84
	May	119	.81	96
	June	97	.77	75
	July	198	.75	148
	Aug.	200	.75	150
	Sept.	181	.75	136
	Oct.	140	.73	102
	Nov.	137	.68	93
	Dec.	137	.68	93
	TOTAL	1,691	.75	1,260
1969	Jan.	183	.70	128
	Feb.	219	.73	160
	Mar.	166	.74	123
	Apr.	150	.78	117
	May	191	.78	149
	June	108	.74	80
	July	158	.74	117
	Aug.	194	.72	140
	Sept	165	.72	119
	Oct.	129	.69	89
	Nov.	129	.63	81
	Dec.	196	.62	122
	TOTAL	1,988	.72	1,425
1970	Jan.	101	.62	63
	Feb.	78	.62	48
	Mar.	81	.64	52
	Apr.	109	.66	72
	May	64	.67	43
	June	87	.67	58
	July	119	.65	77
	Aug.	127	.68	86
	Sept.	117	.70	82
	Oct.	59	.71	42
	Nov.	66	.68	45
	Dec.	80	.63	50
	TOTAL	1,088	.66	718
1971	Jan.	55	.61	34
	Feb.	43	.62	26
	Mar.	48	.63	30
	Apr.	81	.63	51
	May	90	.66	59
	June	100	.66	66
	July	117	.64	75
	Aug.	151	.65	99
	Sept.	136	.67	91
	Oct.	117	.69	81
	Nov.	171	.66	114
	Dec.	200	.61	123
	TOTAL	1,309	.65	869
1972	Jan.	170	.59	100
	Feb.	168	.62	104
	Mar.	102	.63	65
	Apr.	140	.65	90
	May	244	.64	156
	June	190	.63	119
	July	181	.62	113
	Aug.	161	.64	104
	Sept.	93	.66	62
	Oct.	195	.67	131
	Nov.	216	.67	144
	Dec.	223	.63	140
	TOTAL	2,083	.64	1,328
1973	Jan.	220	.63	138
	Feb.	203	.65	131
	Mar.	113	.69	78
	Apr.	62	.76	47
	May	160	.71	114
	June	188	.72	136
	July	166	.68	113
	Aug.	211	.65	137
	Sept.	150	.65	98
	Oct.	148	.66	98
	Nov.	154	.66	102
	Dec.	156	.63	98
	TOTAL	1,931	.67	1,290
1974	Jan.	127	.64	81
	Feb.	45	.67	30
	Mar.	51	.71	36
	Apr.	60	.73	44
	May	183	.71	130
	June	132	.67	89
	July	87	.68	59
	Aug.	137	.69	95
	Sept.	141	.70	98
	Oct.	180	.73	131
	Nov.	147	.71	105
	Dec.	148	.68	101
	TOTAL	1,438	.69	999
1975	Jan.	154	.71	109
	Feb.	163	.72	117
	Mar.	98	.71	70
	Apr.	62	.73	45
	May	89	.75	67
	June	206	.76	155
	July	266	.73	195
	Aug.	198	.70	139
	Sept.	94	.70	66
	Oct.	86	.74	64
	Nov.	126	.71	89
	Dec.	212	.68	145
	TOTAL	1,754	.72	1,261
1976	Jan.	179	.67	119
	Feb.	111	.66	73
	Mar.	108	.69	75
	Apr.	138	.84	116
	May	259	.72	187
	June	212	.72	152
	July	172	.70	120
	Aug.	162	.71	115
	Sept.	160	.64	103
	Oct.	167	.66	111
	Nov.	168	.72	121
	Dec.	192	.65	124
	TOTAL	2,028	.70	1,416
1977	Jan.	178	.66	118
	Feb.	148	.61	90
	Mar.	235	.62	145
	Apr.	173	.65	113
	May	179	.72	129
	June	145	.66	95
	July	140	.67	93
	Aug.	131	.69	91
	Sept.	107	.69	73
	Oct.	71	.68	48
	Nov.	64	.68	43
	Dec.	64	.67	42
	TOTAL	1,633	.66	1,082
1978	Jan.	76	.72	54
	Feb.	70	.76	53
	Mar.	99	.75	75
	Apr.	74	.79	59
	May	66	.81	54
	June	98	.76	74
	July	125	.70	87
	Aug	105	.73	77
	Sept.	92	.73	67
	Oct.	78	.70	55
	Nov.	97	.72	69
	Dec.	120	.72	86
	TOTAL	1,100	.74	810
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 2

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Greendale, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	1,521	.63	957	1876	463	868
1942	1,517	.63	959	1871	465	870
1943	2,089	.44	928	2577	327	842
1944	1,672	.54	903	2062	397	819
1945	1,497	.55	826	1847	406	749
1946	1,547	.52	799	1908	380	725
1947	2,447	.47	1,143	3018	344	1037
1948	1,458	.53	768	1798	388	697
1949	1,583	.61	969	1953	450	879
1950	2,625	.47	1,244	3238	349	1129
1951	2,334	.48	1,118	2879	352	1014
1952	2,149	.52	1,117	2651	382	1013
1953	1,282	.57	725	1581	416	658
1954	1,249	.47	591	1541	348	536
1955	1,021	.53	538	1259	388	488
1956	1,894	.41	774	2336	301	702
1957	2,020	.50	1,011	2492	368	917
1958	1,310	.52	677	1616	380	614
1959	1,190	.58	687	1468	424	623
1960	973	.58	563	1200	426	511
1961	781	.59	460	963	433	417
1962	2,019	.51	1,024	2490	373	929
1963	170	.78	133	210	576	121
1964	1,258	.61	770	1552	450	699
1965	1,437	.79	1,142	1773	584	1036
1966	1,189	.75	889	1467	550	807
1967	1,804	.81	1,469	2225	599	1333
1968	1,691	.75	1,260	2086	548	1143
1969	1,988	.72	1,425	2452	527	1293
1970	1,088	.66	718	1342	485	651
1971	1,000	.65	849	1615	477	770
1972	2,083	.64	1,328	2569	469	1205
1973	1,931	.67	1,290	2382	491	1170
1974	1,438	.69	999	1774	511	906
1975	1,754	.72	1,261	2164	529	1144
1976	2,028	.70	1,416	2502	514	1285
1977	1,633	.66	1,082	2014	488	982
1978	1,100	.74	810	1357	541	735
Total	60,079		35,622	74 106		32 317
Average	1,581	.59	937	1950	436	850

Table 3

Colorado River Basin

Historical Flow and Quality of Water Data

Yampa River near Maybell, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	14	.43	6
	Feb.	17	.41	7
	Mar.	39	.36	14
	Apr.	92	.23	21
	May	451	.15	69
	June	240	.18	43
	July	50	.28	14
	Aug.	21	.33	7
	Sept.	11	.45	5
	Oct.	40	.35	14
	Nov.	28	.39	11
	Dec.	24	.42	10
	TOTAL	1,027	.22	221
1942	Jan.	21	.38	8
	Feb.	19	.42	8
	Mar.	50	.34	17
	Apr.	239	.18	43
	May	361	.16	59
	June	329	.17	55
	July	58	.26	15
	Aug.	14	.36	5
	Sept.	5	.60	3
	Oct.	10	.50	5
	Nov.	15	.47	7
	Dec.	13	.46	6
	TOTAL	1,134	.20	231
1943	Jan.	12	.42	5
	Feb.	13	.46	6
	Mar.	46	.35	16
	Apr.	190	.19	37
	May	237	.18	43
	June	270	.17	47
	July	70	.26	18
	Aug.	20	.35	7
	Sept.	9	.44	4
	Oct.	10	.50	5
	Nov.	14	.43	6
	Dec.	12	.42	5
	TOTAL	903	.22	199
1944	Jan.	10	.50	5
	Feb.	10	.50	5
	Mar.	18	.44	8
	Apr.	44	.27	12
	May	311	.17	53
	June	347	.16	57
	July	64	.25	16
	Aug.	8	.50	4
	Sept	2	.50	1
	Oct.	9	.44	4
	Nov.	16	.44	7
	Dec.	13	.46	6
	TOTAL	852	.21	178
1945	Jan.	12	.42	5
	Feb.	10	.50	5
	Mar.	24	.38	9
	Apr.	89	.24	21
	May	439	.15	68
	June	393	.16	62
	July	163	.20	33
	Aug.	56	.27	15
	Sept.	20	.35	7
	Oct.	17	.41	7
	Nov.	19	.42	8
	Dec.	16	.44	7
	TOTAL	1,258	.20	247
1946	Jan.	14	.43	6
	Feb.	18	.44	8
	Mar.	60	.35	14
	Apr.	215	.19	40
	May	220	.19	41
	June	228	.18	42
	July	43	.28	12
	Aug.	16	.38	6
	Sept.	9	.44	4
	Oct.	20	.40	8
	Nov.	25	.40	10
	Dec.	20	.40	8
	TOTAL	868	.23	199
1947	Jan.	14	.43	6
	Feb.	15	.47	7
	Mar.	76	.37	24
	Apr.	164	.20	33
	May	492	.15	74
	June	317	.17	53
	July	119	.22	26
	Aug.	32	.31	10
	Sept.	17	.35	6
	Oct.	22	.41	9
	Nov.	26	.38	10
	Dec.	38	.37	14
	TOTAL	1,332	.20	272
1948	Jan.	37	.35	13
	Feb.	37	.35	13
	Mar.	57	.33	19
	Apr.	195	.19	37
	May	453	.15	69
	June	240	.18	43
	July	51	.27	14
	Aug.	20	.35	7
	Sept.	6	.50	3
	Oct.	16	.44	7
	Nov.	17	.41	7
	Dec.	16	.44	7
	TOTAL	1,145	.21	239
1949	Jan.	15	.47	7
	Feb.	16	.44	7
	Mar.	44	.34	15
	Apr.	192	.19	37
	May	422	.16	66
	June	433	.15	67
	July	120	.22	26
	Aug.	20	.35	7
	Sept.	11	.45	5
	Oct.	24	.38	9
	Nov.	20	.40	8
	Dec.	15	.47	7
	TOTAL	1,332	.20	261
1950	Jan.	15	.47	7
	Feb.	15	.47	7
	Mar.	28	.39	11
	Apr.	133	.21	28
	May	271	.17	47
	June	327	.17	55
	July	78	.24	19
	Aug.	14	.36	5
	Sept.	11	.45	5
	Oct.	16	.44	7
	Nov.	17	.41	7
	Dec.	17	.38	6
	TOTAL	942	.22	204
1951	Jan.	14	.39	5
	Feb.	15	.47	7
	Mar.	33	.40	13
	Apr.	110	.31	34
	May	329	.15	49
	June	315	.11	35
	July	108	.14	15
	Aug.	29	.26	7
	Sept.	13	.36	5
	Oct.	21	.31	6
	Nov.	16	.36	6
	Dec.	13	.40	5
	TOTAL	1,016	.18	187
1952	Jan.	14	.40	6
	Feb.	15	.39	6
	Mar.	19	.41	8
	Apr.	240	.30	72
	May	516	.17	88
	June	474	.13	62
	July	73	.21	15
	Aug.	33	.29	9
	Sept.	14	.37	5
	Oct.	12	.46	5
	Nov.	12	.48	6
	Dec.	14	.48	7
	TOTAL	1,436	.20	289
1953	Jan.	15	.44	7
	Feb.	12	.46	6
	Mar.	25	.43	11
	Apr.	72	.34	24
	May	221	.20	44
	June	364	.12	44
	July	52	.22	11
	Aug.	24	.34	8
	Sept.	6	.54	3
	Oct.	9	.52	5
	Nov.	16	.41	6
	Dec.	12	.48	6
	TOTAL	828	.21	175
1954	Jan.	15	.43	6
	Feb.	15	.44	7
	Mar.	23	.44	10
	Apr.	103	.25	26
	May	209	.14	29
	June	85	.16	14
	July	17	.34	6
	Aug.	8	.44	3
	Sept.	11	.45	5
	Oct.	23	.29	7
	Nov.	16	.36	6
	Dec.	13	.44	6
	TOTAL	538	.23	125
1955	Jan.	12	.40	5
	Feb.	11	.40	4
	Mar.	28	.43	12
	Apr.	119	.30	36
	May	300	.15	45
	June	200	.12	24
	July	31	.23	7
	Aug.	15	.34	5
	Sept.	4	.56	2
	Oct.	8	.49	4
	Nov.	16	.41	7
	Dec.	20	.40	8
	TOTAL	764	.21	159
1956	Jan.	17	.43	7
	Feb.	14	.44	6
	Mar.	30	.42	13
	Apr.	214	.27	28
	May	401	.15	60
	June	259	.12	31
	July	33	.24	8
	Aug.	17	.37	6
	Sept.	4	.59	2
	Oct.	8	.52	4
	Nov.	13	.45	6
	Dec.	12	.44	5
	TOTAL	1,022	.20	206
1957	Jan.	12	.43	5
	Feb.	13	.42	5
	Mar.	29	.49	14
	Apr.	125	.39	49
	May	440	.22	97
	June	680	.17	115
	July	358	.13	47
	Aug.	64	.25	16
	Sept.	27	.33	9
	Oct.	29	.36	10
	Nov.	29	.41	12
	Dec.	25	.44	11
	TOTAL	1,831	.21	390
1958	Jan.	20	.41	8
	Feb.	28	.45	13
	Mar.	41	.50	21
	Apr.	162	.40	65
	May	549	.18	99
	June	330	.12	40
	July	35	.27	9
	Aug.	11	.46	5
	Sept.	10	.50	5
	Oct.	13	.42	5
	Nov.	15	.46	7
	Dec.	13	.47	6
	TOTAL	1,227	.23	283
1959	Jan.	13	.46	6
	Feb.	14	.48	7
	Mar.	21	.46	10
	Apr.	89	.38	34
	May	265	.16	42
	June	287	.11	31
	July	48	.21	10
	Aug.	22	.33	7
	Sept.	12	.43	5
	Oct.	41	.28	11
	Nov.	32	.29	9
	Dec.	23	.37	8
	TOTAL	867	.21	180
1960	Jan.	14	.42	6
	Feb.	13	.39	5
	Mar.	41	.41	17
	Apr.	240	.23	55
	May	287	.16	46
	June	268	.12	32
	July	36	.26	9
	Aug.	10	.51	5
	Sept.	6	.59	3
	Oct.	12	.43	5
	Nov.	15	.46	7
	Dec.	13	.48	6
	TOTAL	955	.20	196
1961	Jan.	12	.46	6
	Feb.	12	.43	5
	Mar.	19	.44	8
	Apr.	56	.38	21
	May	233	.17	40
	June	195	.12	23
	July	22	.28	6
	Aug.	8	.45	4
	Sept.	32	.31	10
	Oct.	61	.23	14
	Nov.	34	.31	10
	Dec.	22	.37	8
	TOTAL	706	.22	154
1962	Jan.	20	.37	7
	Feb.	41	.45	18
	Mar.	45	.47	21
	Apr.	387	.28	108
	May	439	.17	75
	June	305	.24	73
	July	113	.16	18
	Aug.	18	.35	6
	Sept.	7	.62	4
	Oct.	18	.45	8
	Nov.	17	.45	8
	Dec.	13	.52	7
	TOTAL	1,423	.25	353
1963	Jan.	13	.53	7
	Feb.	22	.49	11
	Mar.	29	.46	13
	Apr.	79	.30	24
	May	251	.14	35
	June	147	.14	20
	July	17	.35	6
	Aug.	13	.50	7
	Sept.	12	.43	5
	Oct.	7	.55	4
	Nov.	12	.53	6
	Dec.	8	.58	5
	TOTAL	610	.23	143
1964	Jan.	8	.45	4
	Feb.	9	.43	4
	Mar.	14	.43	6
	Apr.	67	.39	26
	May	334	.17	57
	June	292	.11	32
	July	83	.23	19
	Aug.	19	.34	6
	Sept.	11	.40	4
	Oct.	11	.43	5
	Nov.	14	.48	7
	Dec.	17	.49	8
	TOTAL	879	.20	178
1965	Jan.	17	.44	7
	Feb.	15	.49	7
	Mar.	18	.51	9
	Apr.	156	.27	42
	May	386	.14	54
	June	455	.11	50
	July	150	.15	22
	Aug.	46	.26	12
	Sept.	30	.26	8
	Oct.	37	.35	13
	Nov.	25	.46	12
	Dec.	20	.39	8
	TOTAL	1,355	.18	244

To obtain mg/L multiply T/AF by 735.29

Table 3

Colorado River Basin

Historical Flow and Quality of Water Data

Yampa River near Maybell, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	21	.43	9
	Feb.	15	.46	7
	Mar.	88	.22	19
	Apr.	122	.16	20
	May	237	.32	75
	June	110	.48	53
	July	17	.58	10
	Aug.	8	.53	4
	Sept.	3	.49	1
	Oct.	16	.45	7
	Nov.	13	.46	6
	Dec.	13	.46	6
	TOTAL	663	.33	217
1967	Jan.	12	.50	6
	Feb.	12	.50	6
	Mar.	42	.52	22
	Apr.	88	.27	24
	May	250	.19	48
	June	316	.16	49
	July	109	.22	24
	Aug.	21	.42	9
	Sept.	14	.37	5
	Oct.	17	.41	7
	Nov.	15	.47	7
	Dec.	12	.42	5
	TOTAL	908	.23	212
1968	Jan.	14	.43	6
	Feb.	14	.43	6
	Mar.	28	.50	14
	Apr.	89	.30	27
	May	343	.16	56
	June	466	.24	110
	July	94	.39	36
	Aug.	37	.43	15
	Sept.	15	.40	6
	Oct.	22	.45	10
	Nov.	19	.53	10
	Dec.	17	.53	9
	TOTAL	1,158	.26	305
1969	Jan.	17	.53	9
	Feb.	16	.50	8
	Mar.	26	.38	10
	Apr.	248	.15	36
	May	400	.17	68
	June	222	.17	37
	July	75	.32	24
	Aug.	21	.38	8
	Sept	20	.35	7
	Oct.	28	.43	12
	Nov.	25	.48	12
	Dec.	22	.45	10
	TOTAL	1,120	.22	241
1970	Jan.	22	.45	10
	Feb.	22	.59	13
	Mar.	30	.63	19
	Apr.	82	.52	43
	May	510	.16	81
	June	443	.16	69
	July	123	.28	35
	Aug.	27	.37	10
	Sept.	17	.35	6
	Oct.	29	.45	13
	Nov.	26	.50	13
	Dec.	21	.52	11
	TOTAL	1,352	.24	323
1971	Jan.	23	.57	13
	Feb.	21	.48	10
	Mar.	66	.27	18
	Apr.	277	.20	55
	May	393	.16	62
	June	462	.15	70
	July	117	.23	27
	Aug.	20	.45	9
	Sept.	15	.47	7
	Oct.	19	.42	8
	Nov.	21	.62	13
	Dec.	19	.47	9
	TOTAL	1,453	.21	301
1972	Jan.	21	.48	10
	Feb.	25	.52	13
	Mar.	72	.38	27
	Apr.	126	.22	28
	May	261	.16	43
	June	290	.13	38
	July	33	.27	9
	Aug.	9	.44	4
	Sept.	12	.50	6
	Oct.	25	.32	8
	Nov.	23	.30	7
	Dec.	22	.32	7
	TOTAL	919	.22	200
1973	Jan.	19	.37	7
	Feb.	16	.38	6
	Mar.	26	.38	10
	Apr.	97	.18	17
	May	473	.17	82
	June	358	.16	58
	July	131	.21	28
	Aug.	32	.31	10
	Sept.	12	.42	5
	Oct.	15	.47	7
	Nov.	20	.40	8
	Dec.	22	.41	9
	TOTAL	1,221	.20	247
1974	Jan.	19	.42	8
	Feb.	15	.47	7
	Mar.	35	.37	13
	Apr.	225	.18	41
	May	596	.14	85
	June	369	.16	60
	July	76	.25	19
	Aug.	19	.37	7
	Sept.	5	.60	3
	Oct.	13	.46	6
	Nov.	17	.41	7
	Dec.	9	.44	4
	TOTAL	1,398	.19	260
1975	Jan.	14	.43	6
	Feb.	17	.41	7
	Mar.	28	.39	11
	Apr.	93	.24	22
	May	334	.16	55
	June	433	.15	67
	July	208	.19	39
	Aug.	31	.32	10
	Sept.	11	.45	5
	Oct.	15	.40	6
	Nov.	18	.44	8
	Dec.	17	.47	8
	TOTAL	1,219	.20	244
1976	Jan.	15	.40	6
	Feb.	20	.50	10
	Mar.	33	.61	20
	Apr.	87	.41	36
	May	308	.16	50
	June	221	.14	30
	July	61	.21	13
	Aug.	22	.32	7
	Sept.	10	.50	5
	Oct.	13	.54	7
	Nov.	11	.45	5
	Dec.	9	.56	5
	TOTAL	810	.24	194
1977	Jan.	8	.48	4
	Feb.	12	.44	5
	Mar.	21	.52	11
	Apr.	52	.37	19
	May	114	.29	33
	June	90	.36	33
	July	5	.71	3
	Aug.	5	.67	3
	Sept.	5	.55	3
	Oct.	11	.39	4
	Nov.	12	.37	4
	Dec.	11	.37	4
	TOTAL	345	.37	127
1978	Jan.	14	.36	5
	Feb.	15	.37	6
	Mar.	34	.46	16
	Apr.	198	.31	61
	May	398	.18	72
	June	531	.12	65
	July	184	.12	23
	Aug.	32	.24	8
	Sept.	12	.38	5
	Oct.	12	.39	4
	Nov.	14	.40	6
	Dec.	13	.44	6
	TOTAL	1,456	.19	276
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 3

Colorado River Basin

Historical Flow and Quality of Water Data

Yampa River near Maybell, Colorado

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	1,027	.22	221	1267	158	200
1942	1,134	.20	231	1399	150	210
1943	903	.22	199	1114	162	181
1944	852	.21	178	1051	153	161
1945	1,258	.20	247	1552	144	224
1946	868	.23	199	1071	169	181
1947	1,332	.20	272	1643	150	247
1948	1,145	.21	239	1412	154	217
1949	1,332	.20	261	1643	144	237
1950	942	.22	204	1162	159	185
1951	1,016	.18	187	1253	136	170
1952	1,436	.20	289	1771	148	262
1953	828	.21	175	1021	156	159
1954	538	.23	125	664	170	113
1955	764	.21	159	942	153	144
1956	1,022	.20	206	1261	148	187
1957	1,831	.21	390	2259	157	354
1958	1,227	.23	283	1514	170	257
1959	867	.21	180	1069	152	163
1960	955	.20	196	1178	151	178
1961	706	.22	154	871	161	140
1962	1,423	.25	353	1755	182	320
1963	610	.23	143	752	173	130
1964	879	.20	178	1084	149	161
1965	1,355	.18	244	1671	132	221
1966	663	.33	217	818	241	197
1967	908	.23	212	1120	171	192
1968	1,158	.26	305	1428	194	277
1969	1,120	.22	241	1382	158	219
1970	1,352	.24	323	1668	176	293
1971	1,453	.21	301	1792	152	273
1972	919	.22	200	1134	160	181
1973	1,221	.20	247	1506	149	224
1974	1,398	.19	260	1724	137	236
1975	1,219	.20	244	1504	147	221
1976	810	.24	194	999	176	176
1977	345	.37	127	426	271	115
1978	1,456	.19	276	1796	139	250
Total	40,272		8,660	49 676		7856
Average	1,060	.22	228	1307	158	207

Table 4

Colorado River Basin

Historical Flow and Quality of Water Data

Duchesne River near Randlett, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	25	1.12	28
	Feb.	24	1.29	31
	Mar.	21	1.71	36
	Apr.	20	1.50	30
	May	155	.50	78
	June	232	.38	88
	July	35	1.11	39
	Aug.	18	1.50	27
	Sept.	15	1.60	24
	Oct.	54	.93	50
	Nov.	51	.90	46
	Dec.	44	1.04	46
	TOTAL	694	.75	523
1942	Jan.	40	.90	36
	Feb.	39	1.00	39
	Mar.	39	1.23	48
	Apr.	50	.90	45
	May	83	.72	60
	June	171	.46	79
	July	23	1.43	33
	Aug.	8	2.12	17
	Sept.	5	2.40	12
	Oct.	18	1.50	27
	Nov.	22	1.41	31
	Dec.	28	1.28	36
	TOTAL	526	.88	463
1943	Jan.	26	1.12	29
	Feb.	29	1.17	34
	Mar.	29	1.51	44
	Apr.	43	1.00	43
	May	100	.64	64
	June	103	.62	64
	July	28	1.21	34
	Aug.	23	1.39	32
	Sept.	8	2.00	16
	Oct.	22	1.40	31
	Nov.	24	1.29	31
	Dec.	25	1.28	32
	TOTAL	460	.99	454
1944	Jan.	23	1.08	25
	Feb.	26	1.31	34
	Mar.	43	1.20	52
	Apr.	48	.94	45
	May	128	.57	73
	June	255	.37	94
	July	82	.72	59
	Aug.	8	2.00	16
	Sept	7	2.14	15
	Oct.	24	1.37	33
	Nov.	26	1.30	34
	Dec.	28	1.32	37
	TOTAL	698	.74	517
1945	Jan.	30	1.00	30
	Feb.	27	1.18	32
	Mar.	32	1.40	45
	Apr.	24	1.29	31
	May	59	.86	51
	June	91	.67	61
	July	30	1.23	37
	Aug.	31	1.19	37
	Sept.	12	1.75	21
	Oct.	21	1.38	29
	Nov.	26	1.27	33
	Dec.	24	1.37	33
	TOTAL	407	1.08	440
1946	Jan.	23	1.13	26
	Feb.	21	1.38	29
	Mar.	29	1.41	41
	Apr.	40	1.00	40
	May	70	.78	55
	June	47	.95	45
	July	5	2.60	13
	Aug.	6	2.33	14
	Sept.	4	2.75	11
	Oct.	17	1.53	26
	Nov.	32	1.22	39
	Dec.	30	1.20	36
	TOTAL	324	1.16	375
1947	Jan.	26	1.07	28
	Feb.	36	1.08	39
	Mar.	36	1.27	46
	Apr.	23	1.30	30
	May	143	.53	76
	June	158	.49	78
	July	33	1.18	39
	Aug.	25	1.28	32
	Sept.	12	1.75	21
	Oct.	17	1.65	28
	Nov.	29	1.21	35
	Dec.	31	1.19	37
	TOTAL	569	.86	489
1948	Jan.	29	1.00	29
	Feb.	26	1.31	34
	Mar.	40	1.20	48
	Apr.	31	1.23	38
	May	70	.79	55
	June	51	.92	47
	July	3	3.00	9
	Aug.	2	3.50	7
	Sept.	1	3.00	3
	Oct.	5	2.40	12
	Nov.	14	1.71	24
	Dec.	26	1.27	33
	TOTAL	298	1.14	339
1949	Jan.	24	1.08	26
	Feb.	23	1.30	30
	Mar.	44	1.20	53
	Apr.	46	.98	45
	May	127	.56	71
	June	230	.39	90
	July	50	.94	47
	Aug.	7	2.14	15
	Sept.	8	2.13	17
	Oct.	25	1.28	32
	Nov.	29	1.21	35
	Dec.	28	1.29	36
	TOTAL	641	.78	497
1950	Jan.	31	1.00	31
	Feb.	26	1.23	32
	Mar.	40	1.30	52
	Apr.	44	1.00	44
	May	97	.67	65
	June	193	.43	83
	July	45	1.00	45
	Aug.	9	2.00	18
	Sept.	13	1.77	23
	Oct.	16	1.56	25
	Nov.	27	1.26	34
	Dec.	33	1.36	45
	TOTAL	574	.87	497
1951	Jan.	26	1.00	26
	Feb.	26	1.31	34
	Mar.	23	1.56	36
	Apr.	14	1.71	24
	May	79	.75	59
	June	124	.73	91
	July	31	1.29	40
	Aug.	26	1.46	38
	Sept.	10	1.90	19
	Oct.	25	1.28	32
	Nov.	32	1.22	39
	Dec.	32	1.22	39
	TOTAL	448	1.06	477
1952	Jan.	28	1.07	30
	Feb.	26	1.31	34
	Mar.	31	1.42	44
	Apr.	111	.60	67
	May	304	.34	103
	June	302	.33	100
	July	70	.79	55
	Aug.	49	.94	46
	Sept.	30	1.20	36
	Oct.	21	1.38	29
	Nov.	26	1.31	34
	Dec.	37	1.11	41
	TOTAL	1,035	.60	619
1953	Jan.	39	0.90	35
	Feb.	33	1.12	37
	Mar.	34	1.41	48
	Apr.	13	1.77	23
	May	15	1.60	24
	June	107	.60	64
	July	13	1.77	23
	Aug	12	1.75	21
	Sept.	5	2.20	11
	Oct.	9	2.00	18
	Nov.	20	1.40	28
	Dec.	26	1.31	34
	TOTAL	326	1.12	366
1954	Jan.	27	1.11	30
	Feb.	25	1.28	32
	Mar.	20	1.80	36
	Apr.	13	1.77	23
	May	36	1.11	40
	June	5	2.40	12
	July	2	3.00	6
	Aug.	1	4.00	4
	Sept.	6	2.33	14
	Oct.	17	1.59	27
	Nov.	18	1.50	27
	Dec.	18	1.50	27
	TOTAL	188	1.48	278
1955	Jan.	25	1.08	27
	Feb.	21	1.43	30
	Mar.	34	1.38	47
	Apr.	22	1.41	31
	May	45	1.00	45
	June	34	1.09	37
	July	2	3.00	6
	Aug.	8	2.25	17
	Sept.	4	2.50	10
	Oct.	6	2.33	14
	Nov.	15	1.60	24
	Dec.	29	1.21	35
	TOTAL	245	1.32	323
1956	Jan.	27	1.00	27
	Feb.	23	1.35	31
	Mar.	25	1.60	40
	Apr.	17	1.59	27
	May	74	.76	56
	June	90	.68	61
	July	4	2.75	11
	Aug.	2	4.00	8
	Sept.	1	5.00	5
	Oct.	4	2.25	9
	Nov.	17	1.59	27
	Dec.	19	1.21	23
	TOTAL	303	1.07	325
1957	Jan.	21	1.05	22
	Feb.	20	1.05	21
	Mar.	22	1.54	34
	Apr.	12	1.83	22
	May	39	1.23	48
	June	184	.41	75
	July	35	.91	32
	Aug.	18	1.61	29
	Sept.	15	1.47	22
	Oct.	19	1.74	33
	Nov.	41	1.41	58
	Dec.	30	1.07	32
	TOTAL	456	.94	428
1958	Jan.	29	.83	24
	Feb.	31	1.00	31
	Mar.	35	1.37	48
	Apr.	29	1.07	31
	May	141	.46	65
	June	103	.42	43
	July	4	2.50	10
	Aug.	1	4.00	4
	Sept.	3	2.33	7
	Oct.	5	2.60	13
	Nov.	14	1.93	27
	Dec.	21	1.24	26
	TOTAL	416	.79	329
1959	Jan.	22	1.14	25
	Feb.	24	1.04	25
	Mar.	17	1.29	22
	Apr.	5	2.00	10
	May	4	2.75	11
	June	34	.85	29
	July	6	2.00	12
	Aug.	4	2.75	11
	Sept.	4	2.50	10
	Oct.	11	1.54	17
	Nov.	13	1.54	20
	Dec.	22	1.32	29
	TOTAL	166	1.33	221
1960	Jan.	23	.87	20
	Feb.	23	.83	19
	Mar.	27	1.15	31
	Apr.	8	1.62	13
	May	18	1.17	21
	June	23	.91	21
	July	1	4.00	4
	Aug.	1	4.00	4
	Sept.	1	4.00	4
	Oct.	5	2.40	12
	Nov.	12	1.58	19
	Dec.	18	1.33	24
	TOTAL	160	1.20	192
1961	Jan.	21	1.19	25
	Feb.	19	1.47	28
	Mar.	10	1.50	15
	Apr.	2	3.50	7
	May	3	2.33	7
	June	3	2.67	8
	July	1	4.00	4
	Aug.	1	3.00	3
	Sept.	13	1.15	15
	Oct.	19	1.47	28
	Nov.	27	1.11	30
	Dec.	26	1.00	26
	TOTAL	145	1.35	196
1962	Jan.	21	.81	17
	Feb.	43	.93	40
	Mar.	49	1.04	51
	Apr.	70	.69	48
	May	88	.64	56
	June	146	.47	69
	July	27	1.04	28
	Aug.	4	2.75	11
	Sept.	4	2.50	10
	Oct.	15	1.73	26
	Nov.	15	1.60	24
	Dec.	23	1.26	29
	TOTAL	505	.81	409
1963	Jan.	18	1.17	21
	Feb.	29	1.14	33
	Mar.	10	1.90	19
	Apr.	5	3.20	16
	May	31	.97	30
	June	50	.76	38
	July	3	2.67	8
	Aug.	5	2.40	12
	Sept.	14	1.64	23
	Oct.	7	2.43	17
	Nov.	16	1.62	26
	Dec.	22	1.14	25
	TOTAL	210	1.28	268
1964	Jan.	18	1.00	18
	Feb.	18	.94	17
	Mar.	23	1.04	24
	Apr.	14	1.57	22
	May	72	.68	49
	June	122	.66	81
	July	29	.97	28
	Aug.	6	2.17	13
	Sept.	4	2.75	11
	Oct.	5	2.80	14
	Nov.	18	1.67	30
	Dec.	27	1.26	34
	TOTAL	356	.96	341
1965	Jan.	27	1.00	27
	Feb.	21	1.38	29
	Mar.	26	1.54	40
	Apr.	32	1.16	37
	May	71	1.11	79
	June	302	.49	148
	July	175	.51	89
	Aug.	57	.96	55
	Sept.	58	1.09	63
	Oct.	47	1.15	54
	Nov.	47	1.13	53
	Dec.	42	1.12	47
	TOTAL	905	.80	721

To obtain mg/L multiply T/AF by 735.29

Table 4

Colorado River Basin

Historical Flow and Quality of Water Data

Duchesne River near Randlett, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	39	.90	35
	Feb.	38	.74	28
	Mar.	47	1.02	48
	Apr.	35	1.20	42
	May	58	1.07	62
	June	16	1.81	29
	July	3	3.00	9
	Aug.	3	3.00	9
	Sept.	6	2.50	15
	Oct.	11	2.36	26
	Nov.	19	1.79	34
	Dec.	31	1.35	42
	TOTAL	306	1.24	379
1967	Jan.	33	1.01	33
	Feb.	30	.98	29
	Mar.	41	1.44	59
	Apr.	19	1.71	32
	May	56	.82	46
	June	253	.45	114
	July	76	.70	53
	Aug.	11	1.89	21
	Sept.	10	2.05	20
	Oct.	12	2.17	26
	Nov.	18	1.74	31
	Dec.	32	1.02	33
	TOTAL	591	.84	497
1968	Jan.	34	.85	29
	Feb.	34	1.12	38
	Mar.	40	1.49	60
	Apr.	31	1.61	50
	May	45	1.14	51
	June	250	.40	100
	July	24	1.23	30
	Aug.	26	1.40	36
	Sept.	13	1.91	25
	Oct.	20	1.77	35
	Nov.	27	1.45	39
	Dec.	38	1.03	39
	TOTAL	582	.91	532
1969	Jan.	42	.88	37
	Feb.	37	.93	34
	Mar.	52	1.16	60
	Apr.	69	.89	61
	May	183	.43	79
	June	139	.75	104
	July	17	1.60	27
	Aug.	9	2.26	20
	Sept	10	2.27	23
	Oct.	20	1.65	33
	Nov.	22	1.45	32
	Dec.	20	1.05	21
	TOTAL	620	.86	531
1970	Jan.	14	1.07	15
	Feb.	17	1.12	19
	Mar.	10	1.60	16
	Apr.	3	2.67	8
	May	17	1.24	21
	June	58	1.29	75
	July	9	1.67	15
	Aug.	3	2.33	7
	Sept.	5	2.20	11
	Oct.	9	2.22	20
	Nov.	11	1.82	20
	Dec.	7	2.14	15
	TOTAL	163	1.48	242
1971	Jan.	23	1.04	24
	Feb.	31	1.09	34
	Mar.	20	1.04	21
	Apr.	12	1.62	19
	May	28	1.16	32
	June	140	.49	68
	July	19	1.27	25
	Aug.	4	2.30	8
	Sept.	9	1.92	16
	Oct.	20	1.76	36
	Nov.	28	1.66	47
	Dec.	26	1.24	32
	TOTAL	360	1.01	362
1972	Jan.	24	.97	24
	Feb.	35	.91	32
	Mar.	37	1.10	41
	Apr.	13	1.54	19
	May	37	.87	32
	June	116	.51	60
	July	6	1.83	11
	Aug.	3	2.49	8
	Sept.	5	2.54	12
	Oct.	22	1.70	38
	Nov.	31	1.31	41
	Dec.	37	.92	34
	TOTAL	366	.96	352
1973	Jan.	32	.97	31
	Feb.	29	1.00	29
	Mar.	58	1.22	71
	Apr.	49	1.24	61
	May	126	.57	72
	June	138	.49	67
	July	31	1.19	37
	Aug.	13	1.62	21
	Sept.	17	1.47	25
	Oct.	20	1.45	29
	Nov.	25	1.28	32
	Dec.	28	.89	25
	TOTAL	566	.88	500
1974	Jan.	28	.82	23
	Feb.	28	.75	21
	Mar.	41	1.02	42
	Apr.	19	1.16	22
	May	61	.66	40
	June	55	.56	31
	July	13	1.46	19
	Aug.	13	1.46	19
	Sept.	5	2.00	10
	Oct.	6	2.33	14
	Nov.	7	2.57	18
	Dec.	8	1.25	10
	TOTAL	284	.95	269
1975	Jan.	11	1.18	13
	Feb.	10	1.30	13
	Mar.	7	2.00	14
	Apr.	5	1.80	9
	May	17	1.59	27
	June	160	.34	55
	July	163	.48	79
	Aug.	15	1.40	21
	Sept.	9	2.00	18
	Oct.	11	1.73	19
	Nov.	17	1.59	27
	Dec.	21	1.00	21
	TOTAL	446	.71	316
1976	Jan.	20	.75	15
	Feb.	27	1.00	27
	Mar.	38	1.16	44
	Apr.	15	2.26	34
	May	31	.90	28
	June	29	2.10	61
	July	3	2.33	7
	Aug.	4	2.25	9
	Sept.	6	2.00	12
	Oct.	7	1.86	13
	Nov.	8	2.00	16
	Dec.	8	1.12	9
	TOTAL	196	1.40	275
1977	Jan.	9	1.01	9
	Feb.	10	1.17	12
	Mar.	10	2.61	27
	Apr.	2	2.78	6
	May	3	2.41	7
	June	4	2.61	10
	July	3	2.64	7
	Aug.	2	2.55	6
	Sept.	3	2.27	8
	Oct.	4	2.43	9
	Nov.	5	2.14	10
	Dec.	6	1.85	11
	TOTAL	62	2.00	123
1978	Jan.	11	1.81	19
	Feb.	14	1.73	24
	Mar.	21	1.57	34
	Apr.	25	1.49	37
	May	18	1.58	28
	June	110	.42	46
	July	8	1.71	14
	Aug.	3	2.02	6
	Sept.	4	1.98	7
	Oct.	5	1.96	10
	Nov.	16	1.68	27
	Dec.	16	1.71	27
	TOTAL	250	1.12	280

To obtain mg/L multiply T/AF by 735.29

Table 4

Colorado River Basin

Historical Flow and Quality of Water Data

Duchesne River near Randlett, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	694	.75	523	856	554	474
1942	526	.88	463	649	647	420
1943	460	.99	454	567	726	412
1944	698	.74	517	861	545	469
1945	407	1.08	440	502	795	399
1946	324	1.16	375	400	850	340
1947	569	.86	489	702	632	444
1948	298	1.14	339	368	837	308
1949	641	.78	497	791	570	451
1950	574	.87	497	708	637	451
1951	448	1.06	477	553	783	433
1952	1,035	.60	619	1277	440	562
1953	326	1.12	366	402	826	332
1954	188	1.48	278	232	1086	252
1955	245	1.32	323	302	970	293
1956	303	1.07	325	374	789	295
1957	456	.94	428	562	690	388
1958	416	.79	329	513	581	298
1959	166	1.33	221	205	976	200
1960	160	1.20	192	197	883	174
1961	145	1.35	196	179	994	178
1962	505	.81	409	623	596	371
1963	210	1.28	268	259	938	243
1964	356	.96	341	439	704	309
1965	905	.80	721	1116	586	654
1966	306	1.24	379	377	912	344
1967	591	.84	497	729	619	451
1968	582	.91	532	718	673	483
1969	620	.86	531	765	630	482
1970	163	1.48	242	201	1095	220
1971	360	1.01	362	444	739	328
1972	366	.96	352	451	707	319
1973	566	.88	500	698	650	454
1974	284	.95	269	350	697	244
1975	446	.71	316	550	522	287
1976	196	1.40	275	242	1029	249
1977	62	2.00	123	76	1473	112
1978	250	1.12	280	309	822	254
Total	15,847		14,745	19 547		13 377
Average	417	.93	388	514	684	352

Table 5

Colorado River Basin

Historical Flow and Quality of Water Data

White River near Watson, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	18	.89	16
	Feb.	22	.77	17
	Mar.	31	.71	22
	Apr.	34	.68	23
	May	156	.38	60
	June	118	.42	50
	July	40	.65	26
	Aug.	33	.70	23
	Sept.	29	.72	21
	Oct.	44	.61	27
	Nov.	29	.72	21
	Dec.	24	.79	19
	TOTAL	578	.56	325
1942	Jan.	23	.78	18
	Feb.	22	.77	17
	Mar.	43	.63	27
	Apr.	107	.44	47
	May	158	.38	60
	June	144	.40	57
	July	44	.61	27
	Aug.	27	.74	20
	Sept.	23	.78	18
	Oct.	29	.72	21
	Nov.	27	.74	20
	Dec.	23	.78	18
	TOTAL	670	.52	350
1943	Jan.	21	.81	17
	Feb.	24	.79	19
	Mar.	33	.70	23
	Apr.	40	.65	26
	May	56	.57	32
	June	87	.48	42
	July	31	.71	22
	Aug.	44	.61	27
	Sept.	20	.80	16
	Oct.	21	.81	17
	Nov.	23	.78	18
	Dec.	22	.77	17
	TOTAL	422	.65	276
1944	Jan.	19	.84	16
	Feb.	21	.81	17
	Mar.	32	.69	22
	Apr.	29	.72	21
	May	94	.47	44
	June	112	.44	49
	July	40	.65	26
	Aug.	18	.89	16
	Sept	15	.93	14
	Oct.	19	.84	16
	Nov.	20	.80	16
	Dec.	20	.80	16
	TOTAL	439	.62	273
1945	Jan.	25	.76	19
	Feb.	26	.77	20
	Mar.	28	.71	20
	Apr.	30	.70	21
	May	108	.44	48
	June	105	.45	47
	July	57	.56	32
	Aug.	37	.68	25
	Sept.	23	.78	18
	Oct.	25	.76	19
	Nov.	27	.74	20
	Dec.	21	.81	17
	TOTAL	512	.60	306
1946	Jan.	22	.77	17
	Feb.	21	.81	17
	Mar.	30	.70	21
	Apr.	43	.63	27
	May	68	.53	36
	June	67	.52	35
	July	21	.81	17
	Aug.	29	.72	21
	Sept.	21	.81	17
	Oct.	28	.71	20
	Nov.	24	.79	19
	Dec.	23	.78	18
	TOTAL	397	.67	265
1947	Jan.	17	.88	15
	Feb.	19	.84	16
	Mar.	43	.63	27
	Apr.	35	.69	24
	May	140	.40	56
	June	116	.43	50
	July	61	.56	34
	Aug.	37	.68	25
	Sept.	26	.77	20
	Oct.	34	.68	23
	Nov.	28	.71	20
	Dec.	27	.74	20
	TOTAL	583	.57	330
1948	Jan.	24	.79	19
	Feb.	21	.81	17
	Mar.	38	.66	25
	Apr.	59	.56	33
	May	128	.41	53
	June	92	.47	43
	July	31	.71	22
	Aug.	28	.71	20
	Sept.	19	.84	16
	Oct.	24	.79	19
	Nov.	22	.77	17
	Dec.	19	.84	16
	TOTAL	505	.59	300
1949	Jan.	15	.93	14
	Feb.	14	.93	13
	Mar.	39	.64	25
	Apr.	44	.61	27
	May	106	.44	47
	June	158	.38	60
	July	73	.52	38
	Aug.	31	.71	22
	Sept.	28	.71	20
	Oct.	34	.68	23
	Nov.	26	.77	20
	Dec.	21	.81	17
	TOTAL	589	.55	326
1950	Jan.	20	.80	16
	Feb.	17	.88	15
	Mar.	30	.70	21
	Apr.	33	.70	23
	May	63	.54	34
	June	120	.43	51
	July	38	.66	25
	Aug.	20	.80	16
	Sept.	24	.79	20
	Oct.	25	.77	19
	Nov.	24	.77	18
	Dec.	23	.78	18
	TOTAL	437	.63	276
1951	Jan.	18	.87	16
	Feb.	24	.81	19
	Mar.	27	.82	22
	Apr.	26	.75	20
	May	79	.41	32
	June	112	.34	38
	July	51	.53	27
	Aug.	39	.74	29
	Sept.	21	.69	14
	Oct.	25	.73	18
	Nov.	23	.73	17
	Dec.	21	.81	17
	TOTAL	466	.58	269
1952	Jan.	20	.81	16
	Feb.	19	.80	15
	Mar.	21	.81	17
	Apr.	77	.93	72
	May	149	.52	77
	June	210	.38	80
	July	50	.59	30
	Aug.	46	.81	37
	Sept.	33	.71	23
	Oct.	26	.74	19
	Nov.	22	.80	18
	Dec.	26	.86	22
	TOTAL	699	.61	426
1953	Jan.	25	.79	20
	Feb	23	.77	18
	Mar.	36	.87	31
	Apr.	30	.84	25
	May	70	.57	40
	June	135	.42	57
	July	33	.80	26
	Aug	34	1.00	34
	Sept.	17	.86	15
	Oct.	21	.82	17
	Nov.	24	.83	20
	Dec.	21	.88	18
	TOTAL	469	.68	321
1954	Jan.	23	.80	18
	Feb.	26	.83	22
	Mar.	24	.97	23
	Apr.	35	.70	25
	May	69	.59	41
	June	32	.70	22
	July	18	1.13	20
	Aug.	13	1.03	13
	Sept.	35	.88	31
	Oct.	26	.83	22
	Nov.	20	.86	17
	Dec.	18	.96	17
	TOTAL	339	.80	271
1955	Jan.	16	.93	15
	Feb.	19	.92	17
	Mar.	47	.80	38
	Apr.	31	.87	27
	May	87	.43	37
	June	76	.81	62
	July	15	.91	14
	Aug.	21	1.16	24
	Sept.	12	.96	12
	Oct.	20	.83	17
	Nov.	22	.87	19
	Dec.	21	.85	18
	TOTAL	387	.78	300
1956	Jan.	20	.88	18
	Feb.	19	.95	18
	Mar.	44	.89	39
	Apr.	33	.69	23
	May	99	.40	40
	June	85	.36	31
	July	22	.77	17
	Aug.	21	.89	19
	Sept.	13	.87	11
	Oct.	19	.87	17
	Nov.	21	.87	16
	Dec.	18	.91	16
	TOTAL	414	.64	267
1957	Jan.	22	.88	19
	Feb.	22	.82	18
	Mar.	31	.99	31
	Apr.	29	.91	26
	May	76	.61	46
	June	218	.44	96
	July	169	.42	71
	Aug.	67	.75	50
	Sept.	36	.65	23
	Oct.	33	.75	25
	Nov.	33	.80	26
	Dec.	28	.79	22
	TOTAL	764	.59	453
1958	Jan.	24	.78	19
	Feb.	35	.76	27
	Mar.	35	.84	29
	Apr.	45	.90	40
	May	148	.47	70
	June	132	.47	62
	July	34	.69	23
	Aug.	22	.78	17
	Sept.	25	.80	20
	Oct.	27	.73	20
	Nov.	25	.75	19
	Dec.	22	.78	17
	TOTAL	574	.63	363
1959	Jan.	24	.84	20
	Feb.	21	.78	16
	Mar.	24	.84	20
	Apr.	30	.74	22
	May	64	.43	28
	June	96	.35	34
	July	30	.63	19
	Aug.	29	.89	26
	Sept.	24	.79	19
	Oct.	28	.69	19
	Nov.	23	.72	17
	Dec.	20	.79	16
	TOTAL	413	.62	256
1960	Jan.	17	.83	14
	Feb.	19	.81	15
	Mar.	35	.83	29
	Apr.	41	.59	24
	May	69	.42	29
	June	95	.36	34
	July	21	.74	15
	Aug.	14	.93	13
	Sept.	19	.86	16
	Oct.	21	.74	16
	Nov.	21	.80	17
	Dec.	19	.85	16
	TOTAL	391	.61	238
1961	Jan.	18	.87	16
	Feb.	19	.81	15
	Mar.	23	.82	19
	Apr.	22	.85	19
	May	65	.43	28
	June	65	.37	24
	July	16	.74	12
	Aug.	18	.98	18
	Sept.	38	.82	31
	Oct.	38	.72	27
	Nov.	26	.72	19
	Dec.	23	.83	19
	TOTAL	371	.67	247
1962	Jan.	21	.76	16
	Feb.	37	.84	31
	Mar.	66	.97	64
	Apr.	85	.69	59
	May	139	.43	60
	June	128	.37	47
	July	59	.48	28
	Aug.	25	.76	19
	Sept.	21	.78	16
	Oct.	28	.76	21
	Nov.	25	.76	19
	Dec.	21	.84	18
	TOTAL	655	.61	398
1963	Jan.	20	.88	18
	Feb.	24	.79	19
	Mar.	24	.82	20
	Apr.	29	.66	19
	May	71	.37	26
	June	31	.57	18
	July	12	.96	12
	Aug.	25	1.09	27
	Sept.	27	.99	27
	Oct.	15	.87	13
	Nov.	19	.90	17
	Dec.	15	1.01	15
	TOTAL	312	.74	231
1964	Jan.	17	.94	16
	Feb.	19	.86	16
	Mar.	26	.83	22
	Apr.	30	.88	26
	May	84	.41	34
	June	99	.34	34
	July	30	.65	20
	Aug.	25	.81	20
	Sept.	16	.80	13
	Oct.	20	.74	15
	Nov.	20	.79	16
	Dec.	22	.84	18
	TOTAL	408	.61	250
1965	Jan.	23	.90	21
	Feb.	22	.88	19
	Mar.	33	1.01	33
	Apr.	35	.87	30
	May	98	.47	46
	June	158	.38	60
	July	69	.66	46
	Aug.	32	.73	23
	Sept.	33	.70	23
	Oct.	34	.67	23
	Nov.	28	.72	20
	Dec.	27	.81	22
	TOTAL	592	.62	366

To obtain mg/L multiply T/AF by 735.29

Table 5

Colorado River Basin

Historical Flow and Quality of Water Data

White River near Watson, Utah

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	24	.86	21
	Feb.	21	.81	17
	Mar.	62	.86	53
	Apr.	32	.66	21
	May	71	.46	33
	June	26	.59	15
	July	10	1.13	11
	Aug.	16	1.05	17
	Sept.	14	1.00	14
	Oct.	23	.91	21
	Nov.	18	.85	15
	Dec.	19	.86	16
	TOTAL	336	.76	254
1967	Jan.	18	.87	16
	Feb.	18	.83	15
	Mar.	29	.92	27
	Apr.	24	.80	19
	May	69	.49	34
	June	102	.42	43
	July	31	.64	20
	Aug.	17	.89	15
	Sept.	19	.84	16
	Oct.	22	.77	17
	Nov.	20	.85	17
	Dec.	18	.96	17
	TOTAL	387	.66	256
1968	Jan.	18	.91	16
	Feb.	20	.92	18
	Mar.	25	.91	23
	Apr.	29	.92	27
	May	71	.57	40
	June	149	.34	51
	July	37	.71	26
	Aug.	43	.91	39
	Sept.	21	.64	13
	Oct.	26	.64	17
	Nov.	24	.66	16
	Dec.	26	.75	19
	TOTAL	489	.62	305
1969	Jan.	24	.63	15
	Feb.	19	.82	16
	Mar.	33	.83	27
	Apr.	52	.61	32
	May	116	.35	41
	June	75	.46	34
	July	33	.60	20
	Aug.	25	.73	18
	Sept	30	.81	24
	Oct.	33	.71	24
	Nov.	27	.63	17
	Dec.	24	.67	16
	TOTAL	491	.58	284
1970	Jan.	26	.65	17
	Feb.	25	.68	17
	Mar.	25	.72	18
	Apr.	27	.70	19
	May	123	.34	42
	June	141	.32	45
	July	52	.46	24
	Aug.	32	.62	20
	Sept.	29	.59	17
	Oct.	32	.68	22
	Nov.	28	.57	16
	Dec.	26	.62	16
	TOTAL	566	.48	273

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1971	Jan.	26	.62	16
	Feb.	22	.64	14
	Mar.	36	.66	24
	Apr.	43	.49	21
	May	86	.33	28
	June	135	.27	37
	July	47	.40	19
	Aug.	20	.60	12
	Sept.	29	.58	17
	Oct.	28	.57	16
	Nov.	29	.62	18
	Dec.	24	.67	16
	TOTAL	525	.45	238
1972	Jan.	24	.75	18
	Feb.	22	.68	15
	Mar.	26	.65	17
	Apr.	30	.53	16
	May	72	.35	25
	June	108	.32	35
	July	22	.59	13
	Aug.	16	.69	11
	Sept.	22	.68	15
	Oct.	30	.60	18
	Nov.	26	.65	17
	Dec.	25	.72	18
	TOTAL	423	.52	218
1973	Jan.	27	.70	19
	Feb.	21	.81	17
	Mar.	33	.85	28
	Apr.	28	.93	26
	May	129	.42	54
	June	137	.39	54
	July	56	.68	38
	Aug.	28	.82	23
	Sept.	26	.81	21
	Oct.	29	.72	21
	Nov.	27	.74	20
	Dec.	25	.76	19
	TOTAL	566	.60	340
1974	Jan.	24	.88	21
	Feb.	19	.79	15
	Mar.	42	.93	39
	Apr.	44	.86	38
	May	128	.34	44
	June	99	.35	35
	July	37	.68	25
	Aug.	23	.74	17
	Sept.	18	.89	16
	Oct.	27	.70	19
	Nov.	25	.72	18
	Dec.	19	.79	15
	TOTAL	505	.60	302
1975	Jan.	21	.76	16
	Feb.	21	.76	16
	Mar.	32	.81	26
	Apr.	29	.83	24
	May	76	.51	39
	June	159	.33	52
	July	94	.37	35
	Aug.	30	.63	19
	Sept.	26	.65	17
	Oct.	28	.64	18
	Nov.	25	.28	7
	Dec.	18	.72	13
	TOTAL	559	.50	282

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1976	Jan.	16	.75	12
	Feb.	26	.77	20
	Mar.	34	.76	26
	Apr.	31	.84	26
	May	87	.39	34
	June	72	.39	28
	July	22	.73	16
	Aug.	21	.81	17
	Sept.	17	.76	13
	Oct.	24	.58	14
	Nov.	20	.65	13
	Dec.	18	.67	12
	TOTAL	388	.60	231
1977	Jan.	20	.65	13
	Feb.	19	.71	14
	Mar.	24	.61	15
	Apr.	25	.62	15
	May	24	.55	13
	June	16	.66	10
	July	9	1.09	9
	Aug.	13	.94	12
	Sept.	13	.89	11
	Oct.	17	.77	13
	Nov.	18	.71	13
	Dec.	17	.72	12
	TOTAL	213	.71	151
1978	Jan.	18	.70	13
	Feb.	17	.71	12
	Mar.	28	.83	23
	Apr.	36	.63	22
	May	93	.37	34
	June	175	.27	47
	July	66	.38	25
	Aug	23	.58	14
	Sept.	23	.67	16
	Oct.	23	.60	14
	Nov.	23	.63	15
	Dec.	24	.61	14
	TOTAL	550	.45	249
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 5

Colorado River Basin

Historical Flow and Quality of Water Data

White River near Watson, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	578	.56	325	713	414	295
1942	670	.52	350	826	385	318
1943	422	.65	276	521	480	250
1944	439	.62	273	542	458	248
1945	512	.60	306	632	440	278
1946	397	.67	265	490	490	240
1947	583	.57	330	719	416	299
1948	505	.59	300	623	437	272
1949	589	.55	326	727	407	296
1950	437	.63	276	539	464	250
1951	466	.58	269	575	424	244
1952	699	.61	426	862	448	386
1953	469	.68	321	579	503	291
1954	339	.80	271	418	589	246
1955	387	.78	300	477	570	272
1956	414	.64	267	511	474	242
1957	764	.59	453	942	436	411
1958	574	.63	363	708	465	329
1959	413	.62	256	509	456	232
1960	391	.61	238	482	448	216
1961	371	.67	247	458	489	224
1962	655	.61	398	808	447	361
1963	312	.74	231	385	545	210
1964	408	.61	250	503	451	227
1965	592	.62	366	730	455	332
1966	336	.76	254	414	556	230
1967	387	.66	256	477	486	232
1968	489	.62	305	603	459	277
1969	491	.58	284	606	426	258
1970	566	.48	273	698	355	248
1971	525	.45	238	648	333	216
1972	423	.52	218	522	379	198
1973	566	.60	340	698	441	308
1974	505	.60	302	623	440	274
1975	559	.50	282	690	371	256
1976	388	.60	231	479	438	210
1977	213	.71	151	263	519	137
1978	550	.45	249	679	333	226
Total	18,384		11,066	22 679		10 039
Average	484	.60	291	597	442	264

Table 6

Colorado River Basin

Historical Flow and Quality of Water Data

Green River at Green River, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	100	1.01	101
	Feb.	126	1.06	134
	Mar.	216	1.01	218
	Apr.	314	.75	235
	May	1,172	.53	621
	June	1,146	.49	562
	July	359	.63	226
	Aug.	267	1.09	291
	Sept.	182	1.01	184
	Oct.	318	1.00	318
	Nov.	240	.90	216
	Dec.	168	.98	165
	TOTAL	4,608	.71	3,271
1942	Jan.	112	1.04	117
	Feb.	122	.98	120
	Mar.	264	.94	248
	Apr.	858	.65	557
	May	980	.57	558
	June	1,271	.39	495
	July	414	.57	236
	Aug.	152	.85	129
	Sept.	91	1.10	100
	Oct.	118	1.20	142
	Nov.	124	1.18	146
	Dec.	116	1.22	141
	TOTAL	4,622	.65	2,989
1943	Jan.	112	1.13	127
	Feb.	130	1.02	132
	Mar.	236	.91	215
	Apr.	569	.57	325
	May	763	.39	298
	June	1,074	.40	430
	July	612	.43	263
	Aug.	300	.83	249
	Sept.	116	.98	114
	Oct.	124	1.10	136
	Nov.	146	1.04	152
	Dec.	112	1.11	124
	TOTAL	4,294	.60	2,565
1944	Jan.	80	1.20	96
	Feb.	111	1.06	118
	Mar.	253	1.07	271
	Apr.	529	.81	428
	May	924	.48	444
	June	1,391	.30	417
	July	591	.44	260
	Aug.	143	.73	104
	Sept	73	.96	70
	Oct.	115	1.13	130
	Nov.	119	1.14	136
	Dec.	88	1.23	108
	TOTAL	4,417	.58	2,582
1945	Jan.	109	1.04	113
	Feb.	128	.99	127
	Mar.	185	1.03	191
	Apr.	291	.84	244
	May	909	.44	400
	June	1,016	.39	396
	July	701	.41	287
	Aug.	335	.74	248
	Sept.	163	.77	125
	Oct.	161	.99	159
	Nov.	149	.99	148
	Dec.	113	1.06	120
	TOTAL	4,260	.60	2,558
1946	Jan.	123	0.95	117
	Feb.	117	.91	106
	Mar.	236	.90	212
	Apr.	528	.60	317
	May	775	.41	318
	June	746	.36	269
	July	264	.47	124
	Aug.	152	.84	128
	Sept.	105	.91	96
	Oct.	149	1.00	149
	Nov.	170	.98	167
	Dec.	154	.94	145
	TOTAL	3,519	.61	2,148
1947	Jan.	92	1.07	98
	Feb.	151	.86	130
	Mar.	411	.79	325
	Apr.	422	.59	249
	May	1,400	.38	532
	June	1,348	.39	526
	July	656	.40	262
	Aug.	365	.71	259
	Sept.	166	.77	128
	Oct.	181	.91	165
	Nov.	179	.91	163
	Dec.	152	1.01	154
	TOTAL	5,523	.54	2,991
1948	Jan.	141	0.94	132
	Feb.	136	.91	124
	Mar.	313	.86	269
	Apr.	558	.69	385
	May	1,061	.39	414
	June	952	.34	324
	July	268	.54	145
	Aug.	137	.81	111
	Sept.	69	.81	56
	Oct.	92	1.02	94
	Nov.	104	1.05	109
	Dec.	97	1.10	107
	TOTAL	3,928	.58	2,270
1949	Jan.	100	1.01	101
	Feb.	110	.92	101
	Mar.	276	.92	254
	Apr.	474	.69	327
	May	1,221	.43	525
	June	1,547	.42	650
	July	592	.57	338
	Aug.	172	.77	132
	Sept.	112	.89	100
	Oct.	207	.98	203
	Nov.	190	.90	171
	Dec.	128	1.07	137
	TOTAL	5,129	.59	3,039
1950	Jan.	141	1.01	142
	Feb.	147	1.01	148
	Mar.	356	.90	321
	Apr.	620	.64	397
	May	1,026	.53	544
	June	1,567	.35	548
	July	734	.49	360
	Aug.	246	.63	155
	Sept.	149	.89	133
	Oct.	153	.96	147
	Nov.	166	.99	164
	Dec.	171	.96	164
	TOTAL	5,476	.59	3,223
1951	Jan.	113	1.13	128
	Feb.	167	.92	154
	Mar.	204	.93	190
	Apr.	372	.70	260
	May	882	.45	397
	June	1,309	.40	524
	July	627	.43	270
	Aug.	379	.69	261
	Sept.	178	.79	140
	Oct.	211	.99	209
	Nov.	164	1.05	172
	Dec.	132	1.07	142
	TOTAL	4,738	.60	2,847
1952	Jan.	135	1.01	136
	Feb.	140	.96	134
	Mar.	160	1.05	168
	Apr.	988	.88	869
	May	2,087	.48	1,002
	June	1,809	.36	651
	July	514	.60	309
	Aug.	315	.89	280
	Sept.	184	.96	177
	Oct.	129	1.09	140
	Nov.	122	1.24	151
	Dec.	129	1.20	155
	TOTAL	6,712	.62	4,172
1953	Jan.	140	1.05	147
	Feb.	141	1.04	147
	Mar.	217	1.00	217
	Apr.	221	.96	212
	May	454	.55	250
	June	1,167	.37	432
	July	376	.48	181
	Aug.	212	.84	178
	Sept.	87	.99	86
	Oct.	86	1.20	104
	Nov.	126	1.15	145
	Dec.	107	1.18	126
	TOTAL	3,334	.67	2,225
1954	Jan.	107	1.09	117
	Feb.	138	1.03	142
	Mar.	169	1.03	174
	Apr.	270	.75	202
	May	639	.38	243
	June	376	.45	169
	July	346	.46	159
	Aug.	120	.65	78
	Sept.	134	1.02	137
	Oct.	139	1.14	159
	Nov.	120	1.06	127
	Dec.	80	1.25	100
	TOTAL	2,638	.68	1,807
1955	Jan.	80	1.06	85
	Feb.	86	.92	79
	Mar.	237	.92	218
	Apr.	311	.77	239
	May	678	.39	264
	June	654	.36	236
	July	223	.46	102
	Aug.	161	.83	134
	Sept.	71	.93	66
	Oct.	77	1.08	83
	Nov.	86	1.13	97
	Dec.	127	1.02	130
	TOTAL	2,791	.62	1,733
1956	Jan.	155	0.91	141
	Feb	100	1.05	105
	Mar.	314	.81	255
	Apr.	460	.53	244
	May	995	.35	348
	June	1,207	.32	386
	July	294	.49	144
	Aug.	169	.67	113
	Sept.	72	.72	52
	Oct.	77	.94	73
	Nov.	99	1.02	101
	Dec.	79	1.05	83
	TOTAL	4,021	.51	2,045
1957	Jan.	83	0.95	79
	Feb.	100	.94	94
	Mar.	237	.89	210
	Apr.	290	.73	212
	May	913	.48	438
	June	1,871	.34	636
	July	1,164	.34	396
	Aug.	386	.79	305
	Sept.	202	.76	153
	Oct.	185	.94	174
	Nov.	228	.96	219
	Dec.	149	.97	144
	TOTAL	5,808	.53	3,060
1958	Jan.	128	0.93	119
	Feb.	184	.86	159
	Mar.	246	.92	227
	Apr.	432	.71	307
	May	1,311	.41	537
	June	1,174	.35	411
	July	224	.62	139
	Aug.	110	.82	91
	Sept.	96	1.07	103
	Oct.	91	1.01	92
	Nov.	102	1.10	113
	Dec.	114	1.09	124
	TOTAL	4,211	.57	2,421
1959	Jan.	97	1.13	110
	Feb.	114	.95	108
	Mar.	146	.94	137
	Apr.	219	.76	166
	May	480	.42	202
	June	763	.34	259
	July	346	.51	176
	Aug.	179	.90	161
	Sept.	104	.92	96
	Oct.	178	.86	153
	Nov.	152	.83	126
	Dec.	106	1.02	108
	TOTAL	2,884	.62	1,802
1960	Jan.	95	1.05	100
	Feb.	102	.95	97
	Mar.	320	.83	266
	Apr.	534	.51	272
	May	551	.39	215
	June	683	.33	225
	July	170	.52	88
	Aug.	69	.76	52
	Sept.	59	.93	55
	Oct.	96	1.00	96
	Nov.	105	.90	94
	Dec.	80	1.06	85
	TOTAL	2,864	.57	1,645
1961	Jan.	79	0.98	77
	Feb.	94	.87	82
	Mar.	136	.89	121
	Apr.	184	.79	145
	May	342	.41	140
	June	542	.31	168
	July	112	.49	55
	Aug.	80	.91	73
	Sept.	175	.99	173
	Oct.	234	.75	176
	Nov.	161	.80	129
	Dec.	126	.88	111
	TOTAL	2,265	.64	1,450
1962	Jan.	115	0.79	91
	Feb.	403	.72	290
	Mar.	401	.95	381
	Apr.	1,093	.56	612
	May	1,350	.36	486
	June	1,974	.38	408
	July	598	.41	245
	Aug.	177	.61	108
	Sept.	98	.98	96
	Oct.	126	1.37	173
	Nov.	94	1.15	108
	Dec.	72	1.10	79
	TOTAL	5,601	.55	3,077
1963	Jan.	71	1.04	74
	Feb.	120	.93	112
	Mar.	99	1.00	99
	Apr.	154	.68	105
	May	399	.40	160
	June	310	.42	130
	July	51	.77	39
	Aug.	72	1.77	127
	Sept.	95	1.57	149
	Oct.	47	1.32	62
	Nov.	74	1.26	93
	Dec.	84	1.08	91
	TOTAL	1,576	.79	1,241
1964	Jan.	109	0.76	83
	Feb.	114	.76	87
	Mar.	128	.87	111
	Apr.	190	.89	169
	May	634	.45	285
	June	725	.40	290
	July	344	.54	186
	Aug.	196	.93	182
	Sept.	139	.82	114
	Oct.	196	.78	153
	Nov.	200	.84	168
	Dec.	267	.81	216
	TOTAL	3,242	.63	2,044
1965	Jan.	300	0.73	219
	Feb.	303	.82	248
	Mar.	361	.88	318
	Apr.	518	.79	409
	May	819	.46	377
	June	1,207	.42	507
	July	546	.52	284
	Aug.	228	.94	214
	Sept.	189	.95	180
	Oct.	253	.85	215
	Nov.	239	.92	220
	Dec.	248	.89	221
	TOTAL	5,211	.65	3,412

To obtain mg/L multiply T/AF by 735.29

Table 6

Colorado River Basin

Historical Flow and Quality of Water Data

Green River at Green River, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	181	0.86	156
	Feb.	166	.80	133
	Mar.	393	.80	314
	Apr.	390	.66	257
	May	566	.48	272
	June	325	.55	179
	July	147	.85	125
	Aug.	147	.96	141
	Sept.	157	1.01	159
	Oct.	189	1.01	191
	Nov.	159	1.06	169
	Dec.	146	1.12	164
	TOTAL	2,966	.76	2,260
1967	Jan.	196	0.88	172
	Feb.	169	.90	152
	Mar.	256	.95	243
	Apr.	260	.77	200
	May	504	.54	272
	June	1,134	.52	590
	July	508	.63	320
	Aug.	247	.99	245
	Sept.	231	1.06	245
	Oct.	250	1.07	268
	Nov.	243	1.03	250
	Dec.	229	1.31	300
	TOTAL	4,227	.77	3,257
1968	Jan.	249	0.87	217
	Feb.	196	.91	178
	Mar.	241	1.05	253
	Apr.	275	.94	258
	May	708	.58	411
	June	1,248	.35	437
	July	426	.65	277
	Aug.	345	1.02	352
	Sept.	241	.93	224
	Oct.	230	.99	228
	Nov.	221	.93	206
	Dec.	209	.88	184
	TOTAL	4,589	.70	3,225
1969	Jan.	282	0.81	228
	Feb.	313	.82	257
	Mar.	354	.94	333
	Apr.	658	.69	454
	May	1,095	.45	493
	June	684	.54	369
	July	358	.59	211
	Aug.	270	.96	259
	Sept	246	.97	239
	Oct.	255	.95	242
	Nov.	236	.88	208
	Dec.	271	.83	225
	TOTAL	5,022	.70	3,518
1970	Jan.	191	0.84	160
	Feb.	175	.87	152
	Mar.	194	.89	173
	Apr.	249	.86	214
	May	867	.38	329
	June	1,019	.40	408
	July	420	.52	218
	Aug.	212	.80	170
	Sept.	179	.93	166
	Oct.	174	.94	164
	Nov.	159	1.12	178
	Dec.	145	.95	138
	TOTAL	3,984	.62	2,470
1971	Jan.	154	0.84	129
	Feb.	165	.80	132
	Mar.	202	.80	162
	Apr.	479	.54	259
	May	714	.38	272
	June	1,060	.29	311
	July	397	.46	183
	Aug.	197	.82	162
	Sept.	210	.92	193
	Oct.	211	.96	203
	Nov.	263	.92	241
	Dec.	267	.80	214
	TOTAL	4,319	.57	2,461
1972	Jan.	272	0.79	215
	Feb.	303	.73	222
	Mar.	323	.72	232
	Apr.	324	.63	204
	May	635	.43	273
	June	834	.35	292
	July	246	.60	148
	Aug	202	.73	147
	Sept.	123	.92	114
	Oct.	303	.90	274
	Nov.	340	.83	282
	Dec.	277	.81	223
	TOTAL	4,182	.63	2,626
1973	Jan.	264	0.77	202
	Feb.	265	.76	201
	Mar.	342	.96	330
	Apr.	303	.95	287
	May	1,168	.42	491
	June	1,069	.39	415
	July	521	.62	323
	Aug.	303	.80	242
	Sept.	233	.91	213
	Oct.	231	.94	217
	Nov.	255	.89	227
	Dec.	239	.85	204
	TOTAL	5,193	.65	3,352
1974	Jan.	231	0.84	195
	Feb.	150	.87	131
	Mar.	300	.87	262
	Apr.	357	.83	297
	May	1,179	.34	399
	June	892	.31	275
	July	269	.62	167
	Aug.	192	.83	159
	Sept.	173	.86	149
	Oct.	228	.94	215
	Nov.	233	.98	229
	Dec.	205	.96	196
	TOTAL	4,409	.61	2,674
1975	Jan.	256	0.84	216
	Feb.	258	.81	208
	Mar.	249	.91	226
	Apr.	224	.87	196
	May	652	.46	301
	June	1,253	.36	449
	July	899	.44	392
	Aug.	318	.76	242
	Sept.	171	.96	164
	Oct.	160	.96	154
	Nov.	205	.92	189
	Dec.	292	.83	243
	TOTAL	4,937	.60	2,980
1976	Jan.	259	0.80	207
	Feb.	249	.72	179
	Mar.	294	.85	250
	Apr.	310	.95	294
	May	765	.48	367
	June	658	.44	289
	July	281	.59	165
	Aug.	206	.81	166
	Sept.	185	.78	144
	Oct.	214	.78	168
	Nov.	219	.80	175
	Dec.	226	.75	169
	TOTAL	3,866	.67	2,573
1977	Jan.	237	0.75	176
	Feb.	199	.83	166
	Mar.	287	.78	222
	Apr.	266	.70	185
	May	347	.57	197
	June	262	.52	135
	July	183	.89	163
	Aug.	170	.89	151
	Sept.	140	.83	116
	Oct.	117	.90	105
	Nov.	116	.90	104
	Dec.	118	.92	108
	TOTAL	2,443	.75	1,829
1978	Jan.	126	0.84	106
	Feb.	125	.85	106
	Mar.	248	.91	227
	Apr.	374	.64	239
	May	686	.41	282
	June	1,074	.32	341
	July	483	.41	196
	Aug	173	.66	115
	Sept.	139	.82	114
	Oct.	141	.84	119
	Nov.	184	.93	172
	Dec.	177	.95	169
	TOTAL	3,930	.56	2,185
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 6

Colorado River Basin

Historical Flow and Quality of Water Data

Green River at Green River, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	4,608	.71	3,271	5684	522	2967
1942	4,622	.65	2,989	5701	476	2712
1943	4,294	.60	2,565	5297	439	2327
1944	4,417	.58	2,582	5448	430	2342
1945	4,260	.60	2,558	5255	442	2321
1946	3,519	.61	2,148	4341	449	1949
1947	5,523	.54	2,991	6813	398	2713
1948	3,928	.58	2,270	4845	425	2059
1949	5,129	.59	3,039	6327	436	2757
1950	5,476	.59	3,223	6754	433	2924
1951	4,738	.60	2,847	5844	442	2583
1952	6,712	.62	4,172	8279	457	3785
1953	3,334	.67	2,225	4112	491	2019
1954	2,638	.68	1,807	3254	504	1639
1955	2,791	.62	1,733	3443	457	1572
1956	4,021	.51	2,045	4960	374	1855
1957	5,808	.53	3,060	7164	387	2776
1958	4,212	.57	2,421	5195	423	2196
1959	2,884	.62	1,802	3557	460	1635
1960	2,864	.57	1,645	3533	422	1492
1961	2,265	.64	1,450	2794	471	1315
1962	5,601	.55	3,077	6909	404	2791
1963	1,576	.79	1,241	1944	579	1126
1964	3,242	.63	2,044	3999	464	1854
1965	5,211	.65	3,412	6428	481	3095
1966	2,966	.76	2,260	3659	560	2050
1967	4,227	.77	3,257	5214	567	2955
1968	4,589	.70	3,225	5660	517	2926
1969	5,022	.70	3,518	6194	515	3192
1970	3,984	.62	2,470	4914	456	2241
1971	4,319	.57	2,461	5327	419	2233
1972	4,182	.63	2,626	5158	462	2382
1973	5,193	.65	3,352	6405	475	3041
1974	4,409	.61	2,674	5438	446	2426
1975	4,937	.60	2,980	6090	444	2703
1976	3,866	.67	2,573	4769	489	2334
1977	2,443	.75	1,829	3013	551	1659
1978	3,930	.56	2,185	4843	409	1982
Total	157,740		98,027	194 569		88 928
Average	4,151	.63	2,580	5120	457	2340

Table 7

Colorado River Basin

Historical Flow and Quality of Water Data

San Rafael River near Green River, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	2	4.0	8
	Feb.	2	4.0	8
	Mar.	6	3.5	21
	Apr.	1	4.0	4
	May	50	1.2	62
	June	49	1.2	59
	July	7	2.9	20
	Aug.	6	3.3	20
	Sept.	2	4.5	9
	Oct.	5	4.0	20
	Nov.	5	4.2	21
	Dec.	4	4.0	16
	TOTAL	139	1.9	268
1942	Jan.	6	2.8	17
	Feb.	5	3.6	18
	Mar.	6	3.7	22
	Apr.	14	2.8	39
	May	34	1.4	49
	June	51	1.2	61
	July	6	3.0	18
	Aug.	6	3.2	19
	Sept.	1	5.0	5
	Oct.	2	5.0	10
	Nov.	3	4.7	14
	Dec.	3	4.7	14
	TOTAL	137	2.1	286
1943	Jan.	4	3.0	12
	Feb.	5	3.4	17
	Mar.	6	3.8	23
	Apr.	15	2.9	44
	May	13	2.1	27
	June	14	2.0	28
	July	2	3.5	7
	Aug.	6	3.2	19
	Sept.	1	5.0	5
	Oct.	2	5.0	10
	Nov.	2	5.0	10
	Dec.	3	3.7	11
	TOTAL	73	2.9	213
1944	Jan.	2	3.5	7
	Feb.	3	3.0	9
	Mar.	6	3.5	21
	Apr.	1	5.0	5
	May	40	1.3	53
	June	72	1.1	78
	July	9	2.9	26
	Aug.	7	3.1	22
	Sept	1	5.0	5
	Oct.	2	5.0	10
	Nov.	3	4.7	14
	Dec.	3	4.3	13
	TOTAL	149	1.8	263
1945	Jan.	3	3.3	10
	Feb.	3	4.0	12
	Mar.	6	3.5	21
	Apr.	1	6.0	6
	May	22	1.6	35
	June	27	1.5	41
	July	6	3.2	19
	Aug.	7	3.4	24
	Sept.	2	4.0	8
	Oct.	3	5.0	15
	Nov.	3	4.7	14
	Dec.	2	4.5	9
	TOTAL	85	2.5	214
1946	Jan.	2	4.0	8
	Feb.	4	3.3	13
	Mar.	6	3.7	22
	Apr.	11	3.2	35
	May	20	1.8	36
	June	8	2.4	19
	July	1	4.0	4
	Aug.	7	5.4	38
	Sept.	0	0	0
	Oct.	2	5.0	10
	Nov.	5	3.8	19
	Dec.	3	4.3	13
	TOTAL	69	3.1	217
1947	Jan.	2	4.5	9
	Feb.	5	3.0	15
	Mar.	4	3.8	15
	Apr.	3	4.3	13
	May	33	1.4	46
	June	26	1.8	47
	July	5	3.6	18
	Aug.	20	3.4	68
	Sept.	3	5.0	15
	Oct.	2	6.0	12
	Nov.	4	3.8	15
	Dec.	4	3.5	14
	TOTAL	111	2.6	287
1948	Jan.	3	3.7	11
	Feb.	6	3.0	18
	Mar.	7	3.6	25
	Apr.	4	3.5	14
	May	16	1.4	23
	June	13	2.2	29
	July	2	4.0	8
	Aug.	6	2.2	13
	Sept.	0	0	0
	Oct.	1	5.0	5
	Nov.	2	5.0	10
	Dec.	2	4.5	9
	TOTAL	62	2.7	165
1949	Jan.	2	4.0	8
	Feb.	2	4.0	8
	Mar.	9	3.3	30
	Apr.	10	2.2	22
	May	30	1.3	38
	June	52	1.2	64
	July	14	2.7	38
	Aug.	5	3.0	15
	Sept.	3	4.7	14
	Oct.	3	4.7	14
	Nov.	3	4.7	14
	Dec.	2	4.5	9
	TOTAL	135	2.0	274
1950	Jan.	2	4.5	9
	Feb.	6	3.3	20
	Mar.	5	4.0	20
	Apr.	3	4.7	14
	May	9	2.2	20
	June	11	2.2	24
	July	9	2.9	26
	Aug.	1	3.0	3
	Sept.	1	5.0	5
	Oct.	1	6.0	6
	Nov.	2	5.5	11
	Dec.	3	4.3	13
	TOTAL	53	3.2	171
1951	Jan.	2	5.0	10
	Feb.	3	3.7	11
	Mar.	2	5.0	10
	Apr.	1	6.0	6
	May	15	1.9	29
	June	23	1.7	40
	July	3	3.7	11
	Aug.	12	2.2	27
	Sept.	1	5.0	5
	Oct.	6	4.0	24
	Nov.	4	4.5	18
	Dec.	3	5.0	15
	TOTAL	75	2.7	206
1952	Jan.	3	3.7	11
	Feb.	5	3.6	18
	Mar.	14	3.1	44
	Apr.	24	2.4	58
	May	93	.8	78
	June	128	.9	114
	July	19	1.9	36
	Aug.	12	3.3	40
	Sept.	5	3.8	19
	Oct.	3	4.7	14
	Nov.	4	4.5	18
	Dec.	4	4.0	16
	TOTAL	314	1.5	466
1953	Jan.	6	2.8	17
	Feb.	7	3.1	22
	Mar.	6	3.2	19
	Apr.	3	4.3	13
	May	2	5.5	11
	June	31	1.5	47
	July	5	3.8	19
	Aug.	9	3.7	33
	Sept.	1	5.0	5
	Oct.	4	4.3	17
	Nov.	4	4.5	18
	Dec.	3	4.8	14
	TOTAL	81	2.9	235
1954	Jan.	3	4.0	12
	Feb.	5	3.8	19
	Mar.	4	3.8	15
	Apr.	3	4.3	13
	May	8	2.9	23
	June	1	5.0	5
	July	1	5.0	5
	Aug.	1	3.0	3
	Sept.	4	4.0	16
	Oct.	2	4.0	8
	Nov.	2	4.5	9
	Dec.	2	4.5	9
	TOTAL	36	3.8	137
1955	Jan.	2	4.0	8
	Feb.	2	3.5	7
	Mar.	6	3.5	21
	Apr.	3	3.7	11
	May	4	3.0	12
	June	6	2.8	17
	July	0	0	0
	Aug.	3	3.7	11
	Sept.	0	0	0
	Oct.	0	0	0
	Nov.	1	5.0	5
	Dec.	2	4.5	9
	TOTAL	29	3.5	101
1956	Jan.	3	3.7	11
	Feb.	3	3.3	10
	Mar.	3	3.3	10
	Apr.	1	5.0	5
	May	11	1.6	18
	June	8	2.0	16
	July	1	4.0	4
	Aug.	1	3.0	3
	Sept.	0	0	0
	Oct.	0	0	0
	Nov.	1	5.0	5
	Dec.	1	5.0	5
	TOTAL	33	2.6	87
1957	Jan.	2	3.0	6
	Feb.	4	3.0	12
	Mar.	2	5.0	10
	Apr.	1	5.0	5
	May	9	3.1	28
	June	96	.8	79
	July	24	1.5	37
	Aug.	13	2.8	36
	Sept.	4	3.5	14
	Oct.	10	3.3	33
	Nov.	21	2.5	53
	Dec.	5	3.4	17
	TOTAL	189	1.7	330
1958	Jan.	5	2.6	13
	Feb.	8	2.8	22
	Mar.	6	3.3	20
	Apr.	13	1.6	21
	May	66	.9	60
	June	57	.8	47
	July	2	4.0	8
	Aug.	4	4.5	18
	Sept.	4	4.3	17
	Oct.	1	5.0	5
	Nov.	2	4.0	8
	Dec.	4	3.3	13
	TOTAL	172	1.5	252
1959	Jan.	3	3.3	10
	Feb.	4	3.0	12
	Mar.	3	4.0	12
	Apr.	2	3.5	7
	May	1	5.0	5
	June	2	4.0	8
	July	0	0	0
	Aug.	1	3.0	3
	Sept.	1	5.0	5
	Oct.	1	4.0	4
	Nov.	2	4.0	8
	Dec.	1	7.0	7
	TOTAL	21	3.9	81
1960	Jan.	1	6.0	6
	Feb.	2	3.5	7
	Mar.	8	2.8	22
	Apr.	3	3.3	10
	May	8	1.9	15
	June	11	1.5	17
	July	0	0	0
	Aug.	0	0	0
	Sept.	1	4.0	4
	Oct.	8	2.5	20
	Nov.	2	4.5	9
	Dec.	2	4.0	8
	TOTAL	46	2.6	118
1961	Jan.	2	3.5	7
	Feb.	3	2.7	8
	Mar.	2	5.5	11
	Apr.	2	4.0	8
	May	3	3.0	9
	June	2	2.5	5
	July	0	0	0
	Aug.	7	2.9	20
	Sept.	18	2.9	53
	Oct.	3	4.0	12
	Nov.	4	3.5	14
	Dec.	2	4.5	9
	TOTAL	48	3.3	156
1962	Jan.	2	4.0	8
	Feb.	8	2.5	20
	Mar.	6	2.8	17
	Apr.	11	1.3	14
	May	29	1.1	31
	June	37	1.0	37
	July	7	2.6	18
	Aug.	1	4.0	4
	Sept.	3	3.0	9
	Oct.	4	4.5	18
	Nov.	2	5.5	11
	Dec.	2	5.5	11
	TOTAL	112	1.8	198
1963	Jan.	2	5.5	11
	Feb.	4	3.2	13
	Mar.	2	5.5	11
	Apr.	1	6.0	6
	May	6	2.3	14
	June	10	2.2	22
	July	1	2.0	2
	Aug.	9	3.8	34
	Sept.	6	4.3	26
	Oct.	1	6.0	6
	Nov.	2	4.5	9
	Dec.	2	4.5	9
	TOTAL	46	3.5	163
1964	Jan.	1	6.0	6
	Feb.	2	4.0	8
	Mar.	3	3.7	11
	Apr.	1	8.0	8
	May	15	1.9	29
	June	20	1.6	33
	July	4	3.8	15
	Aug.	6	3.7	22
	Sept.	1	4.0	4
	Oct.	0	0	0
	Nov.	1	7.0	7
	Dec.	3	4.7	14
	TOTAL	57	2.7	157
1965	Jan.	4	3.5	14
	Feb.	3	3.7	11
	Mar.	3	4.0	12
	Apr.	6	2.7	16
	May	18	1.6	28
	June	77	.9	70
	July	38	1.6	60
	Aug.	16	2.5	40
	Sept.	5	4.0	20
	Oct.	4	4.5	18
	Nov.	5	4.8	24
	Dec.	5	3.2	16
	TOTAL	184	1.8	329

To obtain mg/L multiply T/AF by 735.29

Table 7

Colorado River Basin

Historical Flow and Quality of Water Data

San Rafael River near Green River, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	3	3.7	11
	Feb.	3	3.7	11
	Mar.	8	3.5	28
	Apr.	4	3.0	12
	May	4	4.5	18
	June	2	4.0	8
	July	2	4.5	9
	Aug.	1	3.0	3
	Sept.	2	5.0	10
	Oct.	1	8.0	8
	Nov.	1	5.0	5
	Dec.	2	5.0	10
	TOTAL	33	4.0	133
1967	Jan.	1	4.8	5
	Feb.	2	3.8	8
	Mar.	2	4.6	9
	Apr.	1	5.8	6
	May	5	3.2	16
	June	22	2.0	44
	July	7	2.9	21
	Aug.	3	3.3	10
	Sept.	5	3.6	18
	Oct.	2	4.6	9
	Nov.	2	4.5	9
	Dec.	2	5.0	10
	TOTAL	54	3.1	165
1968	Jan.	2	5.0	10
	Feb.	3	4.1	12
	Mar.	3	5.2	16
	Apr.	2	4.8	10
	May	6	3.8	23
	June	25	1.3	33
	July	6	3.6	21
	Aug.	11	3.3	36
	Sept.	4	3.9	16
	Oct.	5	4.3	21
	Nov.	3	4.1	12
	Dec.	2	4.7	9
	TOTAL	72	3.0	219
1969	Jan.	3	4.0	12
	Feb.	3	3.3	10
	Mar.	9	3.6	32
	Apr.	13	1.8	23
	May	38	1.0	39
	June	32	1.4	44
	July	8	2.4	19
	Aug.	9	3.3	30
	Sept	6	3.8	23
	Oct.	4	4.2	17
	Nov.	4	3.0	12
	Dec.	4	3.3	13
	TOTAL	133	2.1	274
1970	Jan.	2	4.0	8
	Feb.	4	3.5	14
	Mar.	2	6.0	12
	Apr.	2	4.5	9
	May	14	1.5	21
	June	48	1.2	59
	July	9	2.9	26
	Aug.	4	4.0	16
	Sept.	4	4.0	16
	Oct.	3	5.0	15
	Nov.	3	4.7	14
	Dec.	3	4.7	14
	TOTAL	98	2.3	224
1971	Jan.	2	3.0	6
	Feb.	2	4.0	8
	Mar.	3	4.1	13
	Apr.	3	3.3	10
	May	4	4.0	16
	June	5	2.6	13
	July	6	3.2	19
	Aug.	4	4.0	16
	Sept.	2	5.0	10
	Oct.	5	5.3	28
	Nov.	4	4.5	18
	Dec.	2	4.5	9
	TOTAL	42	4.0	166
1972	Jan.	2	4.5	9
	Feb.	3	4.0	12
	Mar.	3	4.0	12
	Apr.	2	4.0	8
	May	2	5.0	10
	June	3	4.7	14
	July	1	6.0	6
	Aug.	1	5.0	5
	Sept.	1	4.0	4
	Oct.	9	3.0	27
	Nov.	4	5.0	20
	Dec.	1	7.0	7
	TOTAL	32	4.2	134
1973	Jan.	2	3.50	7
	Feb.	2	4.00	8
	Mar.	18	3.61	65
	Apr.	4	4.25	17
	May	29	1.00	29
	June	51	1.18	60
	July	10	3.00	30
	Aug.	4	4.00	16
	Sept.	4	3.75	15
	Oct.	5	3.40	17
	Nov.	3	5.33	16
	Dec.	3	4.00	12
	TOTAL	135	2.16	292
1974	Jan.	2	5.00	10
	Feb.	2	4.00	8
	Mar.	3	5.33	16
	Apr.	2	5.00	10
	May	3	5.00	15
	June	4	3.75	15
	July	5	4.00	20
	Aug.	3	3.33	10
	Sept.	2	4.50	9
	Oct.	5	4.40	22
	Nov.	4	5.75	23
	Dec.	2	5.00	10
	TOTAL	37	4.54	168
1975	Jan.	2	4.0	8
	Feb.	2	5.0	10
	Mar.	3	5.0	15
	Apr.	2	3.0	6
	May	3	4.3	13
	June	31	1.5	46
	July	28	1.4	38
	Aug.	5	2.8	14
	Sept.	5	3.2	16
	Oct.	4	3.2	13
	Nov.	3	4.6	14
	Dec.	2	4.5	9
	TOTAL	90	2.2	202
1976	Jan.	1	6.0	6
	Feb.	3	4.0	12
	Mar.	2	3.5	7
	Apr.	1	5.0	5
	May	2	6.0	12
	June	2	4.5	9
	July	2	4.0	8
	Aug.	1	6.0	6
	Sept.	2	4.0	8
	Oct.	2	4.5	9
	Nov.	2	4.0	8
	Dec.	1	6.0	6
	TOTAL	21	4.8	96
1977	Jan.	1	4.61	5
	Feb.	1	4.41	5
	Mar.	2	4.54	7
	Apr.	.4	4.75	2
	May	.2	6.47	1
	June	.1	6.78	.4
	July	3	5.21	13
	Aug.	2	3.48	8
	Sept.	1	4.39	4
	Oct.	.3	3.87	1
	Nov.	.3	5.24	2
	Dec.	1	5.83	4
	TOTAL	12	4.61	53
1978	Jan.	1	4.24	4
	Feb.	1	3.18	4
	Mar.	5	4.55	22
	Apr.	1	5.39	5
	May	1	5.24	7
	June	22	1.09	24
	July	8	1.78	15
	Aug.	1	3.64	3
	Sept.	.4	4.26	2
	Oct.	5	3.67	18
	Nov.	12	3.13	38
	Dec.	6	4.42	26
	TOTAL	59	2.63	149
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 7

Colorado River Basin

Historical Flow and Quality of Water Data

San Rafael River near Green River, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	139	1.9	268	171	1421	243
1942	137	2.1	286	169	1533	259
1943	73	2.9	213	90	2144	193
1944	149	1.8	263	184	1299	239
1945	85	2.5	214	105	1848	194
1946	69	3.1	217	85	2318	197
1947	111	2.6	287	137	1898	260
1948	62	2.7	165	76	1974	150
1949	135	2.0	274	167	1491	249
1950	53	3.2	171	65	2385	155
1951	75	2.7	206	93	2011	187
1952	314	1.5	466	387	1093	423
1953	81	2.9	235	100	2130	213
1954	36	3.8	137	44	2818	124
1955	29	3.5	101	36	2556	92
1956	33	2.6	87	41	1927	79
1957	189	1.7	330	233	1283	299
1958	172	1.5	252	212	1080	229
1959	21	3.9	81	26	2808	73
1960	46	2.6	118	57	1877	107
1961	48	3.3	156	59	2407	142
1962	112	1.8	198	138	1304	180
1963	46	3.5	163	57	2596	148
1964	57	2.7	157	70	2029	142
1965	184	1.8	329	227	1313	298
1966	33	4.0	133	41	2951	121
1967	54	3.1	165	67	2239	150
1968	72	3.0	219	89	2236	199
1969	133	2.1	274	164	1518	249
1970	98	2.3	224	121	1678	203
1971	42	4.0	166	52	2904	151
1972	32	4.2	134	39	3128	122
1973	135	2.2	292	167	1587	265
1974	37	4.5	168	46	3304	152
1975	90	2.2	202	111	1649	183
1976	21	4.8	96	26	3346	87
1977	12	4.6	53	14	3393	48
1978	59	2.6	149	73	1936	135
Total	3,274		7,649	4039		6940
Average	86	2.35	201	106	1727	183

Table 8

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Glenwood Springs, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	36	0.75	27
	Feb.	37	.59	22
	Mar.	51	.60	30
	Apr.	85	.47	40
	May	535	.22	118
	June	470	.19	90
	July	163	.37	60
	Aug.	84	.60	50
	Sept.	67	.60	40
	Oct.	78	.58	45
	Nov.	59	.63	37
	Dec.	48	.67	32
	TOTAL	1,713	.34	591
1942	Jan.	43	0.74	32
	Feb.	41	.68	28
	Mar.	46	.70	32
	Apr.	167	.42	70
	May	389	.24	93
	June	721	.16	116
	July	230	.27	62
	Aug.	78	.53	41
	Sept.	46	.78	36
	Oct.	53	.75	40
	Nov.	49	.76	37
	Dec.	40	.82	33
	TOTAL	1,903	.33	620
1943	Jan.	37	0.86	32
	Feb.	36	.78	28
	Mar.	48	.75	36
	Apr.	162	.34	55
	May	342	.23	79
	June	582	.18	105
	July	254	.28	71
	Aug.	109	.45	49
	Sept.	66	.64	42
	Oct.	60	.67	40
	Nov.	67	.54	36
	Dec.	64	.53	34
	TOTAL	1,827	.33	607
1944	Jan.	37	0.76	28
	Feb.	44	.66	29
	Mar.	50	.72	36
	Apr.	85	.51	43
	May	302	.26	78
	June	498	.16	80
	July	185	.29	54
	Aug.	72	.49	35
	Sept	45	.71	32
	Oct.	60	.65	39
	Nov.	57	.63	36
	Dec.	59	.56	33
	TOTAL	1,494	.35	523
1945	Jan.	41	0.71	29
	Feb.	37	.68	25
	Mar.	62	.50	31
	Apr.	72	.51	37
	May	347	.22	76
	June	461	.18	83
	July	268	.26	70
	Aug.	181	.33	60
	Sept.	73	.52	38
	Oct.	78	.49	38
	Nov.	73	.47	34
	Dec.	71	.45	32
	TOTAL	1,764	.31	553
1946	Jan.	67	0.48	32
	Feb.	54	.54	29
	Mar.	64	.55	35
	Apr.	197	.28	55
	May	284	.22	62
	June	362	.22	80
	July	164	.40	65
	Aug.	83	.51	42
	Sept.	59	.66	39
	Oct.	70	.61	43
	Nov.	61	.59	36
	Dec.	77	.40	31
	TOTAL	1,542	.36	549
1947	Jan.	52	0.60	31
	Feb.	54	.61	33
	Mar.	68	.53	36
	Apr.	123	.37	46
	May	486	.19	92
	June	606	.17	103
	July	438	.21	92
	Aug.	147	.38	56
	Sept.	79	.53	42
	Oct.	90	.47	42
	Nov.	80	.49	39
	Dec.	75	.48	36
	TOTAL	2,298	.28	648
1948	Jan.	76	0.45	34
	Feb.	72	.44	32
	Mar.	68	.50	34
	Apr.	162	.37	60
	May	542	.20	108
	June	470	.18	85
	July	156	.35	55
	Aug.	90	.51	46
	Sept.	57	.67	38
	Oct.	63	.65	41
	Nov.	66	.53	35
	Dec.	59	.61	36
	TOTAL	1,881	.32	604
1949	Jan.	67	0.54	36
	Feb.	56	.57	32
	Mar.	58	.59	34
	Apr.	132	.38	50
	May	364	.23	84
	June	654	.19	124
	July	356	.24	85
	Aug.	106	.45	48
	Sept.	69	.59	41
	Oct.	61	.70	43
	Nov.	55	.71	39
	Dec.	58	.62	36
	TOTAL	2,036	.32	652
1950	Jan.	56	0.63	35
	Feb.	54	.56	30
	Mar.	80	.44	35
	Apr.	141	.35	49
	May	259	.26	67
	June	429	.20	86
	July	137	.42	58
	Aug.	79	.50	40
	Sept.	66	.58	38
	Oct.	49	.80	39
	Nov.	53	.70	37
	Dec.	55	.61	34
	TOTAL	1,458	.38	548
1951	Jan.	59	0.56	33
	Feb.	58	.52	30
	Mar.	58	.55	32
	Apr.	104	.40	42
	May	381	.23	88
	June	536	.20	107
	July	285	.25	71
	Aug.	132	.43	57
	Sept.	77	.58	45
	Oct.	75	.61	46
	Nov.	63	.57	36
	Dec.	63	.51	32
	TOTAL	1,891	.33	619
1952	Jan.	53	0.60	32
	Feb.	47	.62	29
	Mar.	63	.51	32
	Apr.	194	.38	74
	May	597	.23	137
	June	785	.19	149
	July	245	.34	83
	Aug.	157	.51	80
	Sept.	99	.54	53
	Oct.	77	.58	45
	Nov.	66	.64	42
	Dec.	60	.58	35
	TOTAL	2,443	.32	791
1953	Jan.	64	0.59	38
	Feb.	53	.57	30
	Mar.	67	.54	37
	Apr.	103	.46	47
	May	229	.32	73
	June	509	.20	102
	July	171	.41	70
	Aug.	121	.50	60
	Sept.	69	.58	40
	Oct.	64	.63	40
	Nov.	55	.75	41
	Dec.	58	.66	38
	TOTAL	1,563	.39	616
1954	Jan.	62	0.58	36
	Feb.	48	.62	30
	Mar.	62	.58	36
	Apr.	86	.44	38
	May	146	.35	51
	June	89	.52	46
	July	83	.55	46
	Aug.	74	.58	43
	Sept.	59	.61	36
	Oct.	58	.66	38
	Nov.	48	.71	34
	Dec.	40	.90	36
	TOTAL	855	.55	470
1955	Jan.	38	0.79	30
	Feb.	34	.82	28
	Mar.	43	.79	34
	Apr.	90	.48	43
	May	206	.28	58
	June	217	.31	67
	July	99	.56	56
	Aug.	86	.66	57
	Sept.	67	.57	38
	Oct.	61	.62	38
	Nov.	55	.69	38
	Dec.	55	.60	33
	TOTAL	1,051	.49	520
1956	Jan.	52	0.60	31
	Feb.	48	.56	27
	Mar.	69	.59	41
	Apr.	120	.44	53
	May	421	.26	110
	June	329	.24	79
	July	104	.54	56
	Aug.	82	.61	50
	Sept.	73	.55	40
	Oct.	66	.55	36
	Nov.	50	.72	36
	Dec.	41	.78	32
	TOTAL	1,455	.41	591
1957	Jan.	46	0.72	33
	Feb.	44	.68	30
	Mar.	51	.67	34
	Apr.	92	.53	49
	May	350	.32	112
	June	834	.21	175
	July	571	.22	126
	Aug.	176	.37	65
	Sept.	88	.56	49
	Oct.	75	.60	45
	Nov.	72	.58	42
	Dec.	63	.59	37
	TOTAL	2,462	.32	797
1958	Jan.	62	0.55	34
	Feb.	58	.50	29
	Mar.	73	.52	38
	Apr.	102	.45	46
	May	546	.22	120
	June	439	.21	92
	July	104	.51	53
	Aug.	67	.59	40
	Sept.	62	.58	36
	Oct.	59	.63	37
	Nov.	54	.68	37
	Dec.	54	.63	34
	TOTAL	1,680	.35	596
1959	Jan.	63	0.54	34
	Feb.	54	.52	28
	Mar.	49	.65	32
	Apr.	81	.54	44
	May	252	.29	73
	June	342	.25	85
	July	126	.48	61
	Aug.	89	.61	54
	Sept.	73	.56	41
	Oct.	84	.55	46
	Nov.	69	.55	38
	Dec.	59	.53	31
	TOTAL	1,341	.42	567
1960	Jan.	67	0.49	33
	Feb.	55	.50	28
	Mar.	93	.47	44
	Apr.	166	.32	53
	May	288	.25	72
	June	357	.25	89
	July	122	.49	60
	Aug.	73	.60	44
	Sept.	67	.60	40
	Oct.	61	.62	38
	Nov.	56	.61	34
	Dec.	61	.54	33
	TOTAL	1,466	.39	568
1961	Jan.	65	0.52	34
	Feb.	56	.53	30
	Mar.	55	.59	32
	Apr.	66	.54	36
	May	297	.29	60
	June	203	.28	57
	July	82	.60	49
	Aug.	80	.59	47
	Sept.	109	.50	54
	Oct.	128	.43	55
	Nov.	81	.50	40
	Dec.	77	.47	36
	TOTAL	1,209	.44	530
1962	Jan.	80	0.44	35
	Feb.	91	.42	38
	Mar.	122	.39	48
	Apr.	347	.32	111
	May	539	.23	125
	June	455	.23	105
	July	288	.29	84
	Aug.	110	.50	55
	Sept.	74	.58	43
	Oct.	127	.42	53
	Nov.	102	.47	48
	Dec.	72	.57	41
	TOTAL	2,407	.33	786
1963	Jan.	55	0.67	37
	Feb.	53	.63	33
	Mar.	62	.58	36
	Apr.	81	.48	39
	May	175	.31	54
	June	122	.45	55
	July	66	.66	44
	Aug.	77	.60	46
	Sept.	76	.57	43
	Oct.	63	.61	38
	Nov.	54	.66	36
	Dec.	38	.82	31
	TOTAL	922	.53	492
1964	Jan	36	0.80	29
	Feb.	33	.78	26
	Mar.	39	.71	28
	Apr.	64	.61	39
	May	210	.32	67
	June	215	.31	67
	July	99	.63	62
	Aug.	87	.61	53
	Sept.	72	.60	43
	Oct.	65	.64	42
	Nov.	50	.72	36
	Dec.	51	.73	37
	TOTAL	1,021	.52	529
1965	Jan.	51	0.70	36
	Feb.	44	.72	32
	Mar.	49	.69	34
	Apr.	104	.50	52
	May	263	.30	79
	June	446	.26	116
	July	271	.31	84
	Aug.	172	.39	67
	Sept.	95	.50	48
	Oct.	95	.44	42
	Nov.	86	.46	39
	Dec.	88	.47	41
	TOTAL	1,764	.38	670

To obtain mg/L multiply T/AF by 735.29

Table 8

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Glenwood Springs, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	78	0.48	37
	Feb.	70	.45	32
	Mar.	91	.46	42
	Apr.	84	.47	39
	May	186	.30	56
	June	110	.45	50
	July	89	.51	45
	Aug.	77	.46	35
	Sept.	68	.51	35
	Oct.	72	.60	43
	Nov.	55	.66	36
	Dec.	44	.75	33
	TOTAL	1,024	.47	483
1967	Jan.	49	0.65	32
	Feb.	45	.62	28
	Mar.	67	.59	40
	Apr.	96	.45	43
	May	185	.31	57
	June	250	.28	70
	July	139	.47	65
	Aug.	90	.57	51
	Sept.	83	.59	49
	Oct.	78	.59	46
	Nov.	69	.57	39
	Dec.	59	.59	35
	TOTAL	1,210	.46	555
1968	Jan.	53	0.61	32
	Feb.	53	.55	29
	Mar.	62	.55	34
	Apr.	95	.46	44
	May	171	.36	62
	June	369	.25	92
	July	133	.46	61
	Aug.	125	.48	60
	Sept.	79	.53	42
	Oct.	77	.55	42
	Nov.	68	.54	37
	Dec.	65	.59	38
	TOTAL	1,350	.42	573
1969	Jan.	66	0.55	36
	Feb.	56	.57	32
	Mar.	63	.56	35
	Apr.	131	.41	54
	May	283	.28	51
	June	260	.31	81
	July	174	.38	66
	Aug.	93	.49	46
	Sept	78	.53	41
	Oct.	94	.55	52
	Nov.	79	.53	42
	Dec.	71	.52	37
	TOTAL	1,448	.40	573
1970	Jan.	62	.55	34
	Feb.	65	.52	34
	Mar.	72	.51	37
	Apr.	95	.43	41
	May	488	.20	99
	June	471	.21	99
	July	194	.35	68
	Aug.	109	.46	50
	Sept.	101	.50	50
	Oct.	108	.48	52
	Nov.	92	.50	46
	Dec.	68	.51	35
	TOTAL	1,925	.34	645
1971	Jan.	72	0.49	35
	Feb.	71	.49	35
	Mar.	105	.45	47
	Apr.	174	.32	55
	May	348	.22	77
	June	519	.19	99
	July	271	.31	84
	Aug.	121	.44	53
	Sept	109	.48	52
	Oct.	90	.50	45
	Nov.	86	.47	41
	Dec.	72	.52	37
	TOTAL	2,038	.32	660
1972	Jan.	67	0.52	35
	Feb.	62	.50	31
	Mar.	94	.45	42
	Apr.	116	.36	42
	May	255	.24	62
	June	355	.22	79
	July	128	.40	51
	Aug	97	.44	42
	Sept.	96	.46	44
	Oct.	92	.45	42
	Nov.	88	.42	37
	Dec.	74	.45	33
	TOTAL	1,524	.35	540
1973	Jan.	68	0.47	32
	Feb.	60	.45	27
	Mar.	73	.45	33
	Apr.	86	.45	39
	May	352	.21	73
	June	448	.19	83
	July	315	.23	74
	Aug.	138	.37	51
	Sept.	89	.44	39
	Oct.	97	.42	41
	Nov.	90	.42	38
	Dec.	69	.51	35
	TOTAL	1,885	.30	565
1974	Jan.	67	0.52	35
	Feb.	63	.51	32
	Mar.	93	.45	42
	Apr.	123	.37	46
	May	486	.17	84
	June	427	.20	84
	July	199	.36	72
	Aug.	113	.45	51
	Sept.	97	.45	44
	Oct.	91	.48	44
	Nov.	78	.51	40
	Dec.	64	.53	34
	TOTAL	1,901	.32	608
1975	Jan.	64	0.55	35
	Feb.	62	.53	33
	Mar.	74	.54	40
	Apr.	100	.44	44
	May	213	.27	58
	June	375	.22	83
	July	283	.27	75
	Aug.	121	.43	52
	Sept.	84	.48	40
	Oct.	78	.50	39
	Nov.	73	.48	35
	Dec.	63	.55	35
	TOTAL	1,580	.36	569
1976	Jan.	62	0.53	33
	Feb.	65	.52	34
	Mar.	84	.45	38
	Apr.	98	.45	44
	May	227	.26	59
	June	235	.26	61
	July	116	.47	55
	Aug.	93	.45	42
	Sept.	85	.43	37
	Oct.	74	.46	34
	Nov.	59	.49	29
	Dec.	52	.52	27
	TOTAL	1,250	.39	493
1977	Jan.	51	0.55	28
	Feb.	44	.58	25
	Mar.	44	.64	28
	Apr.	73	.45	33
	May	95	.40	38
	June	98	.40	39
	July	82	.46	38
	Aug.	83	.43	36
	Sept.	76	.45	34
	Oct.	62	.56	35
	Nov.	46	.65	30
	Dec.	49	.61	30
	TOTAL	803	.49	394
1978	Jan.	51	0.60	31
	Feb.	48	.58	28
	Mar.	57	.57	32
	Apr.	102	.42	42
	May	264	.25	66
	June	470	.19	90
	July	212	.31	66
	Aug	100	.46	46
	Sept.	89	.46	40
	Oct.	86	.50	44
	Nov.	83	.49	41
	Dec.	64	.57	37
	TOTAL	1,628	.35	563
	Jan.			
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	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 8

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Glenwood Springs, Colorado

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	1,713	.34	591	2113	254	536
1942	1,093	.33	620	2347	239	562
1943	1,827	.33	607	2254	244	551
1944	1,494	.35	523	1843	257	474
1945	1,764	.31	553	2176	231	502
1946	1,542	.36	549	1902	262	498
1947	2,298	.28	648	2835	207	588
1948	1,881	.32	604	2320	236	548
1949	2,036	.32	652	2511	235	591
1950	1,458	.38	548	1798	276	497
1951	1,891	.33	619	2333	241	562
1952	2,443	.32	791	3013	238	718
1953	1,563	.39	616	1928	290	559
1954	855	.55	470	1055	404	426
1955	1,051	.49	520	1296	364	472
1956	1,455	.41	591	1795	299	536
1957	2,462	.32	797	3037	238	723
1958	1,680	.35	596	2072	261	541
1959	1,341	.42	567	1654	311	514
1960	1,466	.39	568	1808	285	515
1961	1,209	.44	530	1491	323	481
1962	2,407	.33	786	2969	240	713
1963	922	.53	492	1137	392	446
1964	1,021	.52	529	1259	381	480
1965	1,764	.38	670	2176	279	608
1966	1,024	.47	483	1263	347	438
1967	1,210	.46	555	1493	337	503
1968	1,350	.42	573	1665	312	520
1969	1,448	.40	573	1786	291	520
1970	1,925	.34	645	2374	246	585
1971	2,038	.32	660	2514	238	599
1972	1,524	.35	540	1880	261	490
1973	1,885	.30	565	2325	221	513
1974	1,901	.32	608	2345	235	552
1975	1,580	.36	569	1949	265	516
1976	1,250	.39	493	1542	290	447
1977	803	.49	394	991	361	357
1978	1,628	.35	563	2008	254	511
Total	61,012		22,258	75 257		20 192
Average	1,606	.36	586	1980	268	531

Table 9

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cameo, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	65	1.23	80
	Feb.	67	1.15	77
	Mar.	82	1.11	91
	Apr.	133	.83	110
	May	948	.34	322
	June	803	.28	225
	July	315	.47	148
	Aug.	144	.91	131
	Sept.	122	.97	118
	Oct.	166	.88	146
	Nov.	124	.96	119
	Dec.	103	1.11	114
	TOTAL	3,072	.55	1,681
1942	Jan.	90	1.24	112
	Feb.	86	1.19	102
	Mar.	103	1.13	116
	Apr.	334	.62	207
	May	757	.41	310
	June	1,215	.24	292
	July	406	.44	179
	Aug.	139	.85	118
	Sept.	86	1.15	99
	Oct.	94	1.18	111
	Nov.	94	1.24	117
	Dec.	84	1.26	106
	TOTAL	3,488	.54	1,869
1943	Jan.	77	1.30	100
	Feb.	74	1.26	93
	Mar.	89	1.22	109
	Apr.	237	.56	133
	May	509	.32	163
	June	931	.23	214
	July	387	.39	151
	Aug.	192	.73	140
	Sept.	117	.89	104
	Oct.	111	1.00	111
	Nov.	115	.90	103
	Dec.	107	.93	100
	TOTAL	2,946	.52	1,521
1944	Jan.	74	1.24	92
	Feb.	76	1.11	84
	Mar.	81	1.11	90
	Apr.	118	.85	100
	May	564	.36	203
	June	890	.24	214
	July	378	.38	143
	Aug.	123	.80	98
	Sept	78	1.09	85
	Oct.	99	1.05	104
	Nov.	100	1.01	101
	Dec.	99	1.02	101
	TOTAL	2,680	.53	1,415
1945	Jan.	78	1.15	90
	Feb.	72	1.18	85
	Mar.	95	.99	94
	Apr.	115	.90	104
	May	601	.36	216
	June	794	.27	214
	July	499	.33	165
	Aug.	287	.52	149
	Sept.	118	.83	98
	Oct.	126	.79	100
	Nov.	125	.81	101
	Dec.	117	.89	104
	TOTAL	3,027	.50	1,520
1946	Jan.	109	0.90	98
	Feb.	91	.97	88
	Mar.	99	.94	93
	Apr.	285	.45	128
	May	449	.32	144
	June	689	.28	193
	July	267	.51	136
	Aug.	126	.85	107
	Sept.	92	1.01	93
	Oct.	122	.89	109
	Nov.	104	.92	96
	Dec.	121	.82	99
	TOTAL	2,554	.54	1,384
1947	Jan.	82	1.04	85
	Feb.	82	.99	81
	Mar.	107	.96	103
	Apr.	178	.63	112
	May	809	.28	227
	June	1,027	.25	257
	July	732	.27	198
	Aug.	240	.58	139
	Sept.	143	.78	111
	Oct.	153	.80	122
	Nov.	135	.77	104
	Dec.	118	.86	102
	TOTAL	3,806	.43	1,641
1948	Jan.	116	0.84	97
	Feb.	111	.81	90
	Mar.	115	.90	104
	Apr.	253	.59	149
	May	920	.30	276
	June	844	.26	219
	July	312	.47	146
	Aug.	161	.77	124
	Sept.	88	1.03	91
	Oct.	109	1.02	111
	Nov.	107	.96	103
	Dec.	90	1.04	94
	TOTAL	3,226	.50	1,604
1949	Jan.	99	0.96	95
	Feb.	84	.92	77
	Mar.	98	.98	96
	Apr.	201	.65	131
	May	572	.36	206
	June	1,080	.26	281
	July	594	.34	202
	Aug.	184	.69	127
	Sept.	122	.93	113
	Oct.	125	.98	123
	Nov.	108	1.01	109
	Dec.	101	1.05	106
	TOTAL	3,368	.49	1,666
1950	Jan.	91	1.04	95
	Feb.	88	.95	84
	Mar.	118	.87	103
	Apr.	212	.59	125
	May	418	.40	167
	June	787	.27	212
	July	273	.54	147
	Aug.	125	.87	109
	Sept.	111	.97	108
	Oct.	97	1.19	115
	Nov.	98	1.14	112
	Dec.	98	1.07	105
	TOTAL	2,516	.59	1,482
1951	Jan.	96	1.01	97
	Feb.	88	.95	84
	Mar.	99	1.01	100
	Apr.	151	.70	106
	May	537	.34	183
	June	858	.27	232
	July	471	.36	170
	Aug.	207	.68	141
	Sept.	111	.90	100
	Oct.	120	.92	110
	Nov.	104	.97	101
	Dec.	106	.96	102
	TOTAL	2,948	.52	1,526
1952	Jan.	96	1.01	97
	Feb.	84	1.06	89
	Mar.	113	.99	112
	Apr.	313	.60	188
	May	978	.36	352
	June	1,320	.26	343
	July	449	.44	197
	Aug.	276	.70	193
	Sept.	171	.78	133
	Oct.	123	.97	119
	Nov.	112	1.04	117
	Dec.	99	1.12	111
	TOTAL	4,134	.50	2,051
1953	Jan.	99	1.03	102
	Feb.	80	1.06	85
	Mar.	102	.96	98
	Apr.	136	.78	106
	May	346	.44	152
	June	887	.27	239
	July	294	.52	153
	Aug.	194	.72	140
	Sept.	101	.99	100
	Oct.	101	1.06	107
	Nov.	99	1.13	112
	Dec.	92	1.17	108
	TOTAL	2,531	.59	1,502
1954	Jan.	95	1.00	95
	Feb.	81	1.05	85
	Mar.	94	1.01	95
	Apr.	136	.78	106
	May	296	.48	142
	June	204	.60	123
	July	146	.81	118
	Aug.	105	.97	102
	Sept.	103	1.07	110
	Oct.	125	.97	121
	Nov.	98	1.07	105
	Dec.	82	1.23	101
	TOTAL	1,565	.83	1,303
1955	Jan.	74	1.23	91
	Feb.	67	1.25	84
	Mar.	86	1.13	97
	Apr.	142	.77	110
	May	384	.42	161
	June	448	.37	166
	July	214	.61	130
	Aug.	157	.87	137
	Sept.	100	.94	94
	Oct.	91	1.02	93
	Nov.	94	1.06	100
	Dec.	89	1.07	95
	TOTAL	1,946	.70	1,358
1956	Jan.	81	1.07	87
	Feb.	75	1.11	83
	Mar.	104	.98	102
	Apr.	184	.66	122
	May	685	.34	233
	June	637	.31	197
	July	173	.70	121
	Aug.	115	.95	109
	Sept.	88	.90	79
	Oct.	93	.95	88
	Nov.	83	1.07	89
	Dec.	73	1.21	88
	TOTAL	2,391	.59	1,398
1957	Jan.	80	1.10	88
	Feb.	77	1.10	85
	Mar.	83	1.16	96
	Apr.	151	.83	125
	May	591	.47	278
	June	1,415	.27	382
	July	1,072	.27	289
	Aug.	339	.50	170
	Sept.	157	.78	122
	Oct.	136	.89	121
	Nov.	123	.91	112
	Dec.	102	.96	98
	TOTAL	4,326	.45	1,966
1958	Jan.	92	0.93	86
	Feb.	95	.93	88
	Mar.	123	.89	110
	Apr.	171	.76	130
	May	847	.31	263
	June	808	.27	218
	July	193	.67	129
	Aug.	109	.97	106
	Sept.	103	1.03	106
	Oct.	99	1.09	108
	Nov.	94	1.09	102
	Dec.	86	1.12	96
	TOTAL	2,820	.55	1,542
1959	Jan.	94	1.02	96
	Feb.	86	1.01	87
	Mar.	83	1.09	90
	Apr.	118	.83	98
	May	392	.40	157
	June	684	.29	198
	July	215	.59	127
	Aug.	131	.87	114
	Sept.	105	.98	103
	Oct.	138	.81	112
	Nov.	116	.87	101
	Dec.	100	.98	98
	TOTAL	2,262	.61	1,381
1960	Jan.	100	0.89	89
	Feb.	91	.95	86
	Mar.	135	.78	105
	Apr.	246	.51	125
	May	432	.37	160
	June	668	.30	200
	July	217	.60	130
	Aug.	117	.89	104
	Sept.	102	.95	97
	Oct.	106	1.00	106
	Nov.	99	1.05	104
	Dec.	100	1.01	101
	TOTAL	2,413	.58	1,407
1961	Jan.	99	0.97	96
	Feb.	85	.94	80
	Mar.	86	1.06	91
	Apr.	103	.91	94
	May	354	.40	142
	June	426	.34	145
	July	138	.81	112
	Aug.	115	.89	102
	Sept.	175	.73	128
	Oct.	200	.59	118
	Nov.	131	.73	96
	Dec.	121	.78	94
	TOTAL	2,033	.64	1,298
1962	Jan.	115	0.78	90
	Feb.	135	.74	100
	Mar.	160	.69	110
	Apr.	513	.40	205
	May	892	.31	277
	June	882	.27	238
	July	545	.37	202
	Aug.	186	.72	134
	Sept.	121	.95	115
	Oct.	173	.74	128
	Nov.	148	.79	117
	Dec.	115	.99	114
	TOTAL	3,985	.46	1,830
1963	Jan.	95	1.11	105
	Feb.	87	.98	85
	Mar.	98	1.02	100
	Apr.	127	.79	100
	May	323	.40	129
	June	246	.53	130
	July	111	.91	101
	Aug.	115	.92	106
	Sept.	112	.89	100
	Oct.	96	.99	95
	Nov.	90	1.09	98
	Dec.	71	1.32	94
	TOTAL	1,571	.79	1,243
1964	Jan.	58	1.29	75
	Feb.	55	1.19	65
	Mar.	67	1.13	76
	Apr.	105	.92	97
	May	403	.41	165
	June	465	.35	163
	July	223	.62	138
	Aug.	153	.81	124
	Sept.	116	.86	100
	Oct.	104	1.01	105
	Nov.	94	1.11	104
	Dec.	91	1.08	98
	TOTAL	1,934	.68	1,310
1965	Jan.	92	1.10	101
	Feb.	78	1.09	85
	Mar.	85	1.15	98
	Apr.	161	.69	111
	May	477	.39	186
	June	920	.28	258
	July	605	.34	206
	Aug.	273	.56	153
	Sept.	172	.75	129
	Oct.	167	.75	125
	Nov.	137	.75	103
	Dec.	138	.75	103
	TOTAL	3,305	.50	1,658

To obtain mg/L multiply T/AF by 735.29

Table 9

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cameo, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	114	0.82	93
	Feb.	99	.81	80
	Mar.	133	.77	102
	Apr.	141	.66	93
	May	373	.40	149
	June	277	.48	133
	July	157	.73	115
	Aug.	119	.87	104
	Sept.	101	.94	95
	Oct.	108	.98	106
	Nov.	93	1.05	98
	Dec.	85	1.22	104
	TOTAL	1,800	.71	1,272
1967	Jan.	86	1.11	95
	Feb.	74	1.06	78
	Mar.	106	.93	99
	Apr.	137	.72	99
	May	328	.43	141
	June	543	.31	168
	July	289	.53	153
	Aug.	137	.83	114
	Sept.	125	.90	112
	Oct.	115	.92	106
	Nov.	104	.95	99
	Dec.	100	1.00	100
	TOTAL	2,144	.64	1,364
1968	Jan.	89	1.12	100
	Feb.	87	.98	85
	Mar.	96	1.01	97
	Apr.	133	.77	102
	May	326	.43	140
	June	757	.27	204
	July	257	.57	146
	Aug.	224	.67	150
	Sept.	125	.86	108
	Oct.	128	.91	116
	Nov.	113	.95	107
	Dec.	104	.99	103
	TOTAL	2,439	.60	1,458
1969	Jan.	106	0.94	100
	Feb.	86	.99	85
	Mar.	96	.95	91
	Apr.	241	.58	140
	May	561	.34	191
	June	502	.40	201
	July	355	.52	185
	Aug.	152	.79	120
	Sept	131	.88	115
	Oct.	173	.79	137
	Nov.	131	.85	112
	Dec.	121	1.05	127
	TOTAL	2,655	.60	1,604
1970	Jan.	105	0.96	101
	Feb.	95	.92	87
	Mar.	116	.84	97
	Apr.	154	.64	99
	May	850	.26	224
	June	834	.27	222
	July	363	.45	165
	Aug.	167	.77	128
	Sept.	182	.74	134
	Oct.	171	.78	133
	Nov.	155	.79	122
	Dec.	140	.86	120
	TOTAL	3,332	.49	1,632
1971	Jan.	138	0.82	113
	Feb.	112	.84	94
	Mar.	149	.74	110
	Apr.	293	.48	140
	May	521	.32	165
	June	885	.24	215
	July	451	.41	184
	Aug.	179	.72	129
	Sept.	170	.76	130
	Oct.	150	.78	118
	Nov.	137	.78	108
	Dec.	129	.79	102
	TOTAL	3,314	.49	1,608
1972	Jan.	127	0.79	100
	Feb.	119	.87	104
	Mar.	151	.81	122
	Apr.	175	.66	115
	May	394	.39	155
	June	664	.29	192
	July	219	.60	132
	Aug.	143	.85	122
	Sept.	150	.81	121
	Oct.	164	.77	126
	Nov.	152	.74	113
	Dec.	128	.81	103
	TOTAL	2,586	.58	1,505
1973	Jan.	116	0.86	100
	Feb.	105	.82	86
	Mar.	125	.82	103
	Apr.	121	.82	99
	May	592	.32	189
	June	829	.27	222
	July	565	.31	174
	Aug.	207	.61	126
	Sept.	143	.81	116
	Oct.	149	.81	120
	Nov.	141	.80	113
	Dec.	126	.87	110
	TOTAL	3,219	.48	1,558
1974	Jan.	122	0.80	97
	Feb.	109	.83	91
	Mar.	152	.79	120
	Apr.	185	.66	122
	May	709	.25	176
	June	658	.28	184
	July	286	.53	151
	Aug.	161	.73	118
	Sept.	128	.84	107
	Oct.	136	.85	116
	Nov.	127	.87	111
	Dec.	115	.97	111
	TOTAL	2,888	.52	1,504
1975	Jan.	109	0.89	97
	Feb.	98	.88	86
	Mar.	124	.92	114
	Apr.	154	.77	118
	May	389	.43	168
	June	739	.28	208
	July	561	.35	198
	Aug.	199	.63	126
	Sept.	141	.80	113
	Oct.	141	.83	117
	Nov.	133	.80	106
	Dec.	120	.83	100
	TOTAL	2,908	.53	1,551
1976	Jan.	115	0.82	94
	Feb.	114	.82	95
	Mar.	139	.85	118
	Apr.	161	.70	112
	May	401	.40	161
	June	450	.33	149
	July	213	.58	123
	Aug.	149	.83	123
	Sept.	136	.82	112
	Oct.	139	.83	115
	Nov.	116	.88	102
	Dec.	112	1.10	122
	TOTAL	2,245	.64	1,426
1977	Jan.	105	0.94	99
	Feb.	86	.97	83
	Mar.	80	1.09	87
	Apr.	110	.84	92
	May	156	.64	100
	June	176	.61	107
	July	112	.75	84
	Aug.	108	.79	85
	Sept.	103	.82	85
	Oct.	98	.93	91
	Nov.	83	1.09	90
	Dec.	86	1.01	87
	TOTAL	1,303	.84	1,091
1978	Jan.	80	0.94	75
	Feb.	74	.88	64
	Mar.	96	.88	85
	Apr.	172	.62	107
	May	431	.44	191
	June	846	.27	229
	July	360	.41	146
	Aug	135	.71	96
	Sept.	109	.82	89
	Oct.	108	.83	90
	Nov.	111	.84	93
	Dec.	92	.96	89
	TOTAL	2,615	.52	1,354
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 9

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cameo, Colorado

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	3,072	.55	1,681	3789	402	1525
1942	3,488	.54	1,869	4302	394	1696
1943	2,946	.52	1,521	3634	380	1380
1944	2,680	.53	1,415	3306	388	1284
1945	3,027	.50	1,520	3734	369	1379
1946	2,554	.54	1,384	3150	399	1256
1947	3,806	.43	1,641	4695	317	1489
1948	3,226	.50	1,604	3979	366	1455
1949	3,368	.49	1,666	4154	364	1511
1950	2,516	.59	1,482	3103	433	1344
1951	2,948	.52	1,526	3636	381	1384
1952	4,134	.50	2,051	5099	365	1861
1953	2,531	.59	1,502	3122	437	1363
1954	1,565	.83	1,303	1930	612	1182
1955	1,946	.70	1,358	2400	513	1232
1956	2,391	.59	1,398	2949	430	1268
1957	4,326	.45	1,966	5336	334	1784
1958	2,820	.55	1,542	3478	402	1399
1959	2,262	.61	1,381	2790	449	1253
1960	2,413	.58	1,407	2976	429	1276
1961	2,033	.64	1,298	2508	470	1178
1962	3,985	.46	1,830	4915	338	1660
1963	1,571	.79	1,243	1938	582	1128
1964	1,934	.68	1,310	2386	498	1188
1965	3,305	.55	1,658	4077	369	1504
1966	1,800	.71	1,272	2220	520	1154
1967	2,144	.64	1,364	2645	468	1237
1968	2,439	.60	1,458	3009	440	1323
1969	2,655	.60	1,604	3275	444	1455
1970	3,332	.49	1,632	4110	360	1481
1971	3,314	.49	1,608	4088	357	1459
1972	2,586	.58	1,505	3190	428	1365
1973	3,219	.48	1,558	3971	356	1413
1974	2,888	.52	1,504	3562	383	1364
1975	2,908	.53	1,551	3587	392	1407
1976	2,245	.64	1,426	2769	467	1294
1977	1,303	.84	1,091	1608	616	990
1978	2,615	.52	1,354	3225	381	1228
Total	104,295		57,483	128 645		52 149
Average	2,745	.55	1,513	3385	405	1372

Table 10

Colorado River Basin

Historical Flow and Quality of Water Data

Gunnison River near Grand Junction, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	51	1.90	97
	Feb.	51	1.82	93
	Mar.	63	1.67	105
	Apr.	123	1.00	123
	May	871	.40	349
	June	563	.46	259
	July	192	.94	180
	Aug.	95	1.41	134
	Sept.	81	2.11	171
	Oct.	198	1.35	267
	Nov.	121	1.33	161
	Dec.	84	1.58	133
	TOTAL	2,493	.83	2,072
1942	Jan.	71	1.59	113
	Feb.	62	1.66	103
	Mar.	76	1.64	125
	Apr.	546	.52	284
	May	760	.47	357
	June	688	.38	261
	July	167	.93	156
	Aug.	68	2.18	148
	Sept.	56	2.36	132
	Oct.	57	2.58	147
	Nov.	65	1.92	125
	Dec.	58	1.83	106
	TOTAL	2,674	.77	2,057
1943	Jan.	57	1.72	98
	Feb.	48	1.60	77
	Mar.	56	1.55	87
	Apr.	279	.44	123
	May	389	.48	187
	June	397	.46	183
	July	113	1.08	122
	Aug.	153	1.43	219
	Sept.	87	1.59	138
	Oct.	69	1.84	127
	Nov.	75	1.59	119
	Dec.	61	1.57	96
	TOTAL	1,784	.88	1,576
1944	Jan.	51	1.65	84
	Feb.	48	1.44	69
	Mar.	53	1.42	75
	Apr.	102	.97	99
	May	758	.32	242
	June	694	.33	229
	July	230	.69	159
	Aug.	51	1.94	99
	Sept	45	2.44	110
	Oct.	58	2.31	134
	Nov.	71	1.86	132
	Dec.	64	1.73	111
	TOTAL	2,225	.69	1,543
1945	Jan.	55	1.58	87
	Feb.	47	1.62	76
	Mar.	52	1.48	77
	Apr.	91	1.00	91
	May	628	.35	220
	June	407	.46	187
	July	163	.85	139
	Aug.	122	1.22	149
	Sept.	46	2.39	110
	Oct.	76	2.00	152
	Nov.	73	1.63	119
	Dec.	58	1.59	92
	TOTAL	1,818	.82	1,499
1946	Jan.	58	1.55	90
	Feb.	48	1.44	69
	Mar.	58	1.28	74
	Apr.	182	.59	108
	May	228	.59	135
	June	321	.52	167
	July	64	1.62	104
	Aug.	56	2.16	121
	Sept.	54	2.31	125
	Oct.	69	2.06	142
	Nov.	67	1.70	114
	Dec.	56	1.55	87
	TOTAL	1,261	1.06	1,336
1947	Jan.	45	1.67	75
	Feb.	47	1.49	70
	Mar.	55	1.27	70
	Apr.	96	.82	79
	May	455	.39	177
	June	502	.46	231
	July	242	.64	155
	Aug.	120	1.50	180
	Sept.	96	1.63	155
	Oct.	114	1.60	183
	Nov.	96	1.35	130
	Dec.	70	1.41	99
	TOTAL	1,938	.83	1,695
1948	Jan.	58	1.38	80
	Feb.	65	1.43	93
	Mar.	76	1.38	105
	Apr.	324	.51	165
	May	835	.30	251
	June	546	.40	218
	July	141	.92	129
	Aug.	71	1.84	131
	Sept.	48	2.25	108
	Oct.	57	2.09	119
	Nov.	70	1.84	129
	Dec.	70	1.64	115
	TOTAL	2,361	.70	1,643
1949	Jan.	51	1.49	76
	Feb.	52	1.48	77
	Mar.	69	1.42	98
	Apr.	236	.57	134
	May	481	.38	183
	June	651	.42	273
	July	265	.65	172
	Aug.	65	1.80	117
	Sept.	53	2.15	114
	Oct.	70	2.09	146
	Nov.	74	1.58	117
	Dec.	54	1.74	94
	TOTAL	2,121	.76	1,601
1950	Jan.	54	1.57	85
	Feb.	57	2.00	114
	Mar.	60	1.33	80
	Apr.	219	.50	110
	May	309	.45	139
	June	319	.50	160
	July	88	1.43	126
	Aug.	37	2.16	80
	Sept.	46	2.61	120
	Oct.	37	2.65	98
	Nov.	49	2.12	104
	Dec.	60	1.73	104
	TOTAL	1,335	.99	1,320
1951	Jan.	47	1.64	77
	Feb.	46	1.59	73
	Mar.	55	1.27	70
	Apr.	62	.97	60
	May	265	.51	135
	June	323	.52	168
	July	93	1.06	99
	Aug.	53	1.72	91
	Sept.	37	2.30	85
	Oct.	49	2.41	118
	Nov.	60	1.88	113
	Dec.	46	1.65	76
	TOTAL	1,136	1.03	1,165
1952	Jan.	53	1.53	81
	Feb.	47	1.48	71
	Mar.	53	1.41	75
	Apr.	342	.46	157
	May	818	.33	270
	June	759	.35	266
	July	200	.79	158
	Aug.	121	1.54	187
	Sept.	76	1.86	141
	Oct.	67	1.90	127
	Nov.	64	2.00	128
	Dec.	72	1.68	121
	TOTAL	2,672	.67	1,781
1953	Jan.	65	1.51	98
	Feb.	50	1.48	74
	Mar.	61	1.26	77
	Apr.	86	1.01	87
	May	230	.57	131
	June	437	.43	188
	July	86	1.13	97
	Aug.	67	1.75	117
	Sept.	46	2.28	105
	Oct.	58	2.40	139
	Nov.	74	1.78	132
	Dec.	52	1.83	95
	TOTAL	1,312	1.02	1,340
1954	Jan.	49	1.75	86
	Feb.	45	1.58	71
	Mar.	45	1.49	67
	Apr.	70	.84	59
	May	110	.85	93
	June	39	1.92	75
	July	40	2.10	84
	Aug.	31	2.64	82
	Sept.	52	2.50	130
	Oct.	64	1.94	124
	Nov.	51	1.92	98
	Dec.	49	1.90	93
	TOTAL	645	1.65	1,062
1955	Jan.	46	1.70	78
	Feb.	40	1.67	67
	Mar.	59	1.47	87
	Apr.	108	.74	80
	May	262	.52	136
	June	219	.63	138
	July	46	1.74	80
	Aug.	52	1.86	97
	Sept.	36	2.48	89
	Oct.	38	2.47	94
	Nov.	54	2.08	112
	Dec.	57	1.65	94
	TOTAL	1,017	1.13	1,152
1956	Jan.	50	1.64	82
	Feb.	44	1.59	70
	Mar.	56	1.30	73
	Apr.	142	.60	85
	May	324	.45	146
	June	262	.53	139
	July	37	1.92	71
	Aug.	29	2.07	60
	Sept.	20	3.15	63
	Oct.	35	2.94	103
	Nov.	55	1.95	107
	Dec.	47	.87	88
	TOTAL	1,101	.99	1,087
1957	Jan.	52	1.73	90
	Feb.	55	1.69	93
	Mar.	56	1.36	76
	Apr.	136	.67	91
	May	554	.44	244
	June	1,168	.32	374
	July	719	.39	281
	Aug.	224	.83	186
	Sept.	108	1.47	159
	Oct.	106	1.92	204
	Nov.	111	1.33	148
	Dec.	92	1.26	116
	TOTAL	3,381	.61	2,062
1958	Jan.	66	1.40	92
	Feb.	70	1.50	105
	Mar.	82	1.24	102
	Apr.	254	.57	145
	May	873	.32	279
	June	570	.42	239
	July	65	1.52	99
	Aug.	43	1.74	75
	Sept.	51	2.31	118
	Oct.	52	2.42	126
	Nov.	71	1.82	129
	Dec.	65	1.60	104
	TOTAL	2,262	.71	1,613
1959	Jan.	57	1.58	90
	Feb.	50	1.51	75
	Mar.	52	1.34	70
	Apr.	55	1.10	61
	May	167	.75	125
	June	256	.66	169
	July	34	2.39	81
	Aug.	51	2.01	103
	Sept.	41	2.46	101
	Oct.	96	1.45	139
	Nov.	72	1.39	100
	Dec.	50	1.54	77
	TOTAL	981	1.21	1,191
1960	Jan.	49	1.46	72
	Feb.	41	1.48	61
	Mar.	87	1.26	110
	Apr.	270	.45	122
	May	249	.45	117
	June	336	.46	155
	July	58	1.33	77
	Aug.	34	2.08	71
	Sept.	38	2.22	84
	Oct.	51	2.34	119
	Nov.	58	1.69	98
	Dec.	51	1.59	81
	TOTAL	1,332	.88	1,167
1961	Jan.	41	1.65	68
	Feb.	40	1.55	62
	Mar.	55	1.29	71
	Apr.	67	1.05	70
	May	266	.50	133
	June	209	.62	130
	July	34	2.09	71
	Aug.	44	2.07	91
	Sept.	100	1.66	166
	Oct.	107	1.20	128
	Nov.	86	1.20	103
	Dec.	57	1.37	78
	TOTAL	1,106	1.06	1,171
1962	Jan.	52	1.37	71
	Feb.	58	1.35	78
	Mar.	53	1.22	65
	Apr.	395	.37	146
	May	574	.32	184
	June	477	.37	176
	July	219	.67	147
	Aug.	52	1.72	89
	Sept.	63	1.97	124
	Oct.	70	1.84	129
	Nov.	68	1.62	110
	Dec.	54	1.70	92
	TOTAL	2,135	.66	1,411
1963	Jan.	48	1.67	80
	Feb.	70	1.51	106
	Mar.	82	1.11	91
	Apr.	102	.72	73
	May	188	.53	100
	June	92	1.02	94
	July	37	2.11	78
	Aug.	52	1.99	104
	Sept.	51	2.28	116
	Oct.	55	2.52	139
	Nov.	66	1.70	112
	Dec.	49	1.69	83
	TOTAL	892	1.32	1,176
1964	Jan.	43	1.58	68
	Feb.	45	1.51	68
	Mar.	43	1.52	65
	Apr.	78	1.00	78
	May	418	.41	171
	June	316	.50	158
	July	83	1.20	100
	Aug.	93	1.61	150
	Sept.	59	1.99	117
	Oct.	53	2.20	117
	Nov.	65	1.85	120
	Dec.	59	1.46	86
	TOTAL	1,355	.96	1,298
1965	Jan.	55	1.37	75
	Feb.	45	1.28	58
	Mar.	52	1.33	69
	Apr.	228	.52	119
	May	582	.36	210
	June	681	.37	252
	July	472	.47	222
	Aug.	158	.98	155
	Sept.	166	1.29	208
	Oct.	116	1.35	157
	Nov.	63	1.93	122
	Dec.	60	1.58	95
	TOTAL	2,673	.65	1,742

To obtain mg/L multiply T/AF by 735.29

Table 10

Colorado River Basin

Historical Flow and Quality of Water Data

Gunnison River near Grand Junction, Colorado

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	52	1.67	87
	Feb.	37	1.86	69
	Mar.	68	1.30	88
	Apr.	166	.65	108
	May	211	.67	141
	June	125	1.03	129
	July	51	1.75	89
	Aug.	38	2.09	79
	Sept.	58	1.99	115
	Oct.	65	2.03	132
	Nov.	45	2.34	105
	Dec.	55	1.76	97
	TOTAL	971	1.28	1,239
1967	Jan.	47	1.63	77
	Feb.	42	1.62	68
	Mar.	62	1.16	72
	Apr.	86	.73	63
	May	143	.81	116
	June	152	1.03	157
	July	60	1.78	107
	Aug.	59	1.93	114
	Sept.	70	1.88	132
	Oct.	65	1.88	122
	Nov.	106	1.16	123
	Dec.	165	.73	120
	TOTAL	1,057	1.20	1,271
1968	Jan.	119	0.95	113
	Feb.	96	1.03	99
	Mar.	65	1.20	78
	Apr.	68	.97	66
	May	268	.57	153
	June	258	.56	144
	July	59	1.62	96
	Aug.	107	1.56	167
	Sept.	68	1.86	126
	Oct.	87	1.72	150
	Nov.	133	1.08	144
	Dec.	149	.77	115
	TOTAL	1,477	.98	1,451
1969	Jan.	146	0.80	117
	Feb.	75	1.03	77
	Mar.	145	.70	101
	Apr.	304	.43	131
	May	332	.49	162
	June	194	1.03	200
	July	100	1.37	137
	Aug.	91	1.40	128
	Sept	119	1.43	170
	Oct.	155	1.27	197
	Nov.	143	.98	140
	Dec.	128	.88	113
	TOTAL	1,932	.87	1,673
1970	Jan.	129	0.78	100
	Feb.	122	.70	85
	Mar.	149	.68	101
	Apr.	137	.69	95
	May	404	.42	169
	June	415	.50	208
	July	174	.79	137
	Aug.	101	1.27	128
	Sept.	196	1.07	209
	Oct.	188	1.13	212
	Nov.	170	.78	133
	Dec.	181	.65	117
	TOTAL	2,366	.72	1,694
1971	Jan.	196	0.54	107
	Feb.	201	.45	90
	Mar.	239	.44	106
	Apr.	266	.40	105
	May	209	.66	139
	June	212	.72	152
	July	114	1.07	122
	Aug.	114	.95	108
	Sept.	133	1.08	144
	Oct.	120	1.22	146
	Nov.	132	.88	116
	Dec.	144	.76	109
	TOTAL	2,080	.69	1,444
1972	Jan.	126	0.61	77
	Feb.	110	.61	68
	Mar.	109	.65	71
	Apr.	67	.87	58
	May	115	.86	99
	June	118	.91	107
	July	36	1.86	66
	Aug.	38	1.73	66
	Sept.	84	1.42	120
	Oct.	104	1.38	143
	Nov.	125	.89	111
	Dec.	157	.61	95
	TOTAL	1,189	.91	1,081
1973	Jan.	155	0.52	80
	Feb.	75	.84	63
	Mar.	83	.93	77
	Apr.	93	.77	72
	May	456	.34	155
	June	414	.46	191
	July	164	.82	134
	Aug.	148	.96	142
	Sept.	109	1.07	117
	Oct.	125	.98	122
	Nov.	89	.99	88
	Dec.	170	.68	115
	TOTAL	2,081	.65	1,356
1974	Jan.	216	0.45	97
	Feb.	214	.51	109
	Mar.	204	.83	170
	Apr.	141	.74	105
	May	261	.61	159
	June	121	1.53	185
	July	51	2.82	144
	Aug.	42	2.00	84
	Sept.	65	1.94	126
	Oct.	84	1.75	147
	Nov.	117	1.12	131
	Dec.	111	.99	110
	TOTAL	1,627	.96	1,567
1975	Jan.	114	0.82	93
	Feb.	96	.91	87
	Mar.	99	.90	89
	Apr.	158	.67	106
	May	398	.38	151
	June	336	.59	198
	July	165	.93	153
	Aug.	63	1.72	108
	Sept.	76	1.53	116
	Oct.	110	1.21	133
	Nov.	141	.87	122
	Dec.	152	.80	127
	TOTAL	1,908	.77	1,477
1976	Jan.	134	0.72	96
	Feb.	95	1.05	100
	Mar.	87	.90	78
	Apr.	83	.83	69
	May	207	1.29	268
	June	128	.92	118
	July	54	1.69	91
	Aug.	50	1.80	90
	Sept.	73	1.64	120
	Oct.	91	1.33	121
	Nov.	105	1.09	115
	Dec.	120	.80	96
	TOTAL	1,227	1.11	1,362
1977	Jan.	116	0.93	108
	Feb.	69	1.04	71
	Mar.	48	1.19	57
	Apr.	35	1.30	45
	May	43	1.62	70
	June	37	1.82	67
	July	38	1.93	73
	Aug.	36	1.74	63
	Sept.	36	1.84	66
	Oct.	50	1.71	85
	Nov.	51	1.65	84
	Dec.	43	1.51	65
	TOTAL	600	1.42	853
1978	Jan.	49	1.19	59
	Feb.	46	1.08	49
	Mar.	52	.94	49
	Apr.	133	.69	92
	May	292	.51	148
	June	314	.42	131
	July	143	.83	119
	Aug.	59	1.00	58
	Sept.	86	1.08	92
	Oct.	68	1.19	81
	Nov.	86	1.20	103
	Dec.	134	.67	90
	TOTAL	1,461	.73	1,072
	Jan.			
	Feb.			
	Mar.			
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	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 10

Colorado River Basin

Historical Flow and Quality of Water Data

Gunnison River near Grand Junction, Colorado

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	2,493	.83	2,072	3075	611	1880
1942	2,674	.77	2,057	3298	566	1866
1943	1,784	.88	1,576	2201	650	1430
1944	2,225	.69	1,543	2745	510	1400
1945	1,818	.82	1,499	2243	606	1360
1946	1,261	1.06	1,336	1555	779	1212
1947	1,938	.83	1,605	2391	609	1456
1948	2,361	.70	1,643	2912	512	1491
1949	2,121	.76	1,601	2616	555	1452
1950	1,335	.99	1,320	1647	727	1198
1951	1,136	1.03	1,165	1401	754	1057
1952	2,672	.67	1,781	3296	490	1616
1953	1,312	1.02	1,340	1618	752	1216
1954	645	1.65	1,062	796	1210	963
1955	1,017	1.13	1,152	1254	833	1045
1956	1,101	.99	1,087	1358	726	986
1957	3,381	.61	2,062	4170	449	1871
1958	2,262	.71	1,613	2790	524	1463
1959	981	1.21	1,191	1210	893	1080
1960	1,332	.88	1,167	1643	645	1059
1961	1,106	1.06	1,171	1364	779	1062
1962	2,135	.66	1,411	2634	486	1280
1963	892	1.32	1,176	1100	970	1067
1964	1,355	.96	1,298	1671	705	1178
1965	2,673	.65	1,742	3297	479	1580
1966	971	1.28	1,239	1198	938	1124
1967	1,057	1.20	1,271	1304	884	1153
1968	1,477	.98	1,451	1822	722	1316
1969	1,932	.87	1,673	2383	637	1518
1970	2,366	.72	1,694	2918	527	1537
1971	2,080	.69	1,444	2566	511	1310
1972	1,189	.91	1,081	1467	669	981
1973	2,081	.65	1,356	2567	479	1230
1974	1,627	.96	1,567	2007	709	1422
1975	1,908	.77	1,477	2354	569	1340
1976	1,227	1.11	1,362	1513	817	1236
1977	600	1.42	853	741	1045	774
1978	1,461	.73	1,072	1802	540	972
Total	63,986		54,210	78 927		49 181
Average	1,684	.85	1,427	2077	623	1294

Table II

Colorado River Basin

Historical Flow and Quality of Water Data

Dolores River near Cisco, Utah

Calendar Year	Month	Flow 1000 (A F)	Concen- tration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	14	2.79	39
	Feb.	20	2.35	47
	Mar.	41	1.41	58
	Apr.	175	.46	80
	May	615	.20	125
	June	248	.26	65
	July	98	.59	58
	Aug.	31	1.42	44
	Sept.	32	1.31	42
	Oct.	197	.52	102
	Nov.	61	1.33	81
	Dec.	34	1.82	62
	TOTAL	1,566	.51	803
1942	Jan.	26	2.19	57
	Feb.	22	2.23	49
	Mar.	50	1.26	63
	Apr.	516	.25	129
	May	387	.25	98
	June	213	.27	58
	July	46	.89	41
	Aug.	17	1.76	30
	Sept.	8	2.63	21
	Oct.	9	3.00	27
	Nov.	10	3.10	31
	Dec.	12	3.00	36
	TOTAL	1,316	.49	640
1943	Jan.	12	3.00	36
	Feb.	14	2.79	39
	Mar.	20	2.20	44
	Apr.	212	.41	87
	May	133	.42	56
	June	98	.45	44
	July	24	1.25	30
	Aug.	34	1.35	46
	Sept.	19	1.68	32
	Oct.	11	2.64	29
	Nov.	9	3.22	29
	Dec.	10	3.20	32
	TOTAL	596	.85	504
1944	Jan.	9	3.33	30
	Feb.	12	3.00	36
	Mar.	17	2.47	42
	Apr.	97	.63	61
	May	463	.23	108
	June	267	.25	67
	July	73	.70	51
	Aug.	14	1.93	27
	Sept	5	3.40	17
	Oct.	8	3.13	25
	Nov.	12	2.83	34
	Dec.	11	3.09	34
	TOTAL	988	.54	532
1945	Jan.	12	3.00	36
	Feb.	16	2.63	42
	Mar.	14	2.79	39
	Apr.	134	.52	70
	May	296	.29	85
	June	88	.47	41
	July	32	1.06	34
	Aug.	29	1.45	42
	Sept.	6	3.17	19
	Oct.	15	2.20	33
	Nov.	10	3.10	31
	Dec.	9	3.44	31
	TOTAL	661	.76	503
1946	Jan.	11	3.09	34
	Feb.	10	3.30	33
	Mar.	16	2.56	41
	Apr.	72	.74	53
	May	53	.66	35
	June	59	.59	35
	July	16	1.50	24
	Aug.	18	1.78	32
	Sept.	10	2.40	24
	Oct.	9	3.00	27
	Nov.	11	2.91	32
	Dec.	10	3.20	32
	TOTAL	295	1.36	402
1947	Jan.	8	3.50	28
	Feb.	11	3.18	35
	Mar.	15	2.67	40
	Apr.	49	.92	45
	May	172	.38	65
	June	111	.41	46
	July	48	.85	41
	Aug.	37	1.30	48
	Sept.	30	1.33	40
	Oct.	37	1.43	53
	Nov.	19	1.58	30
	Dec.	16	2.19	35
	TOTAL	553	.92	506
1948	Jan.	14	2.79	39
	Feb.	26	2.12	55
	Mar.	26	2.00	52
	Apr.	250	.44	109
	May	271	.31	84
	June	133	.32	43
	July	33	.91	30
	Aug.	18	1.61	29
	Sept.	5	3.80	19
	Oct.	8	3.63	29
	Nov.	8	4.25	34
	Dec.	9	3.89	35
	TOTAL	801	.70	558
1949	Jan.	12	3.17	38
	Feb.	17	2.96	47
	Mar.	24	2.21	53
	Apr.	189	.59	112
	May	233	.32	75
	June	222	.33	73
	July	71	.75	53
	Aug.	20	2.20	44
	Sept.	5	5.40	27
	Oct.	9	3.78	34
	Nov.	10	3.70	37
	Dec.	10	3.80	38
	TOTAL	822	.77	631
1950	Jan.	12	3.08	37
	Feb.	16	2.50	40
	Mar.	18	2.44	44
	Apr.	128	.45	58
	May	78	.45	35
	June	67	.48	32
	July	22	1.32	29
	Aug.	4	3.50	14
	Sept.	5	4.20	21
	Oct.	5	3.60	18
	Nov.	5	4.40	22
	Dec.	6	4.50	27
	TOTAL	366	1.03	377
1951	Jan.	9	3.78	34
	Feb.	9	3.78	34
	Mar.	8	3.50	28
	Apr.	7	3.71	26
	May	38	.92	35
	June	48	.58	28
	July	12	1.58	19
	Aug.	11	1.73	19
	Sept.	4	2.50	10
	Oct.	4	3.75	15
	Nov.	6	3.33	20
	Dec.	7	3.14	22
	TOTAL	163	1.78	290
1952	Jan.	14	2.36	33
	Feb.	10	2.40	24
	Mar.	15	2.33	35
	Apr.	324	.38	123
	May	365	.27	97
	June	243	.26	62
	July	67	.63	42
	Aug.	21	1.48	31
	Sept.	11	2.64	29
	Oct.	8	2.88	23
	Nov.	7	3.57	25
	Dec.	10	3.20	32
	TOTAL	1,095	.51	556
1953	Jan.	12	2.83	34
	Feb.	9	3.67	33
	Mar.	12	3.25	39
	Apr.	39	1.00	39
	May	64	.59	38
	June	88	.41	36
	July	18	1.44	26
	Aug	20	1.75	35
	Sept.	4	3.25	13
	Oct.	16	2.38	38
	Nov.	11	3.00	33
	Dec.	8	3.63	29
	TOTAL	301	1.31	393
1954	Jan.	9	3.44	31
	Feb.	9	3.00	27
	Mar.	10	3.20	32
	Apr.	43	.84	36
	May	53	.58	31
	June	18	1.22	22
	July	10	1.80	18
	Aug.	7	2.14	15
	Sept.	13	2.15	28
	Oct.	20	1.55	31
	Nov.	9	3.00	27
	Dec.	7	4.43	31
	TOTAL	208	1.58	329
1955	Jan.	6	3.50	21
	Feb.	7	2.86	20
	Mar.	32	1.47	47
	Apr.	65	.63	41
	May	116	.42	49
	June	66	.52	34
	July	12	1.83	22
	Aug.	17	2.06	35
	Sept.	3	5.00	15
	Oct.	4	4.50	18
	Nov.	6	4.67	28
	Dec.	9	3.78	34
	TOTAL	343	1.06	364
1956	Jan.	8	4.38	35
	Feb.	9	3.67	33
	Mar.	16	2.25	36
	Apr.	56	.59	33
	May	84	.51	43
	June	63	.51	32
	July	8	2.38	19
	Aug.	7	2.71	19
	Sept.	1	6.00	6
	Oct.	2	8.50	17
	Nov.	6	4.33	26
	Dec.	5	4.60	23
	TOTAL	265	1.22	322
1957	Jan.	6	3.83	23
	Feb.	13	2.62	34
	Mar.	13	2.77	36
	Apr.	114	.60	68
	May	296	.35	103
	June	352	.28	98
	July	157	.43	67
	Aug.	78	.76	59
	Sept.	43	.91	39
	Oct.	31	1.77	55
	Nov.	27	2.33	63
	Dec.	20	2.40	48
	TOTAL	1,150	.60	693
1958	Jan.	13	3.38	44
	Feb.	32	1.94	62
	Mar.	35	1.77	62
	Apr.	341	.42	144
	May	368	.27	100
	June	164	.36	59
	July	20	1.75	35
	Aug.	8	3.63	29
	Sept.	9	3.00	27
	Oct.	8	3.75	30
	Nov.	9	3.78	34
	Dec.	9	4.00	36
	TOTAL	1,016	.65	662
1959	Jan.	10	3.40	34
	Feb.	10	3.00	30
	Mar.	11	3.27	36
	Apr.	25	1.48	37
	May	33	.94	31
	June	32	.78	25
	July	7	1.57	11
	Aug.	13	1.69	22
	Sept.	3	3.67	11
	Oct.	10	2.20	22
	Nov.	9	2.67	24
	Dec.	6	3.33	20
	TOTAL	169	1.79	303
1960	Jan.	8	2.63	21
	Feb.	9	3.33	30
	Mar.	44	1.48	65
	Apr.	156	.47	73
	May	111	.41	46
	June	104	.37	38
	July	20	1.25	25
	Aug.	5	2.60	13
	Sept.	4	3.75	15
	Oct.	5	3.80	19
	Nov.	7	2.86	20
	Dec.	7	3.14	22
	TOTAL	480	.81	387
1961	Jan.	6	4.17	25
	Feb.	7	4.14	29
	Mar.	12	2.83	34
	Apr.	58	.72	42
	May	131	.37	49
	June	70	.44	31
	July	11	1.73	19
	Aug.	14	2.36	33
	Sept.	19	1.42	27
	Oct.	18	1.61	29
	Nov.	12	2.63	34
	Dec.	9	3.67	33
	TOTAL	367	1.05	385
1962	Jan.	8	3.63	29
	Feb.	25	1.32	33
	Mar.	17	2.59	44
	Apr.	190	.37	71
	May	134	.39	52
	June	80	.48	38
	July	33	1.00	33
	Aug.	8	2.38	19
	Sept.	6	3.83	23
	Oct.	12	2.50	30
	Nov.	9	3.67	33
	Dec.	8	4.63	37
	TOTAL	530	.83	442
1963	Jan.	6	3.33	20
	Feb.	17	2.82	48
	Mar.	36	1.56	56
	Apr.	51	.76	39
	May	57	.60	34
	June	18	1.56	28
	July	8	2.13	17
	Aug.	15	1.93	29
	Sept.	10	1.70	17
	Oct.	5	3.60	18
	Nov.	8	2.38	19
	Dec.	6	3.17	19
	TOTAL	237	1.45	344
1964	Jan.	5	4.60	23
	Feb.	6	6.50	39
	Mar.	7	5.00	35
	Apr.	37	1.32	49
	May	117	.43	50
	June	56	.50	28
	July	14	1.71	24
	Aug.	28	1.82	51
	Sept.	8	3.00	24
	Oct.	7	3.43	24
	Nov.	6	4.17	25
	Dec.	9	3.22	29
	TOTAL	300	1.34	401
1965	Jan.	11	3.00	33
	Feb.	9	3.44	31
	Mar.	9	4.00	36
	Apr.	174	.43	74
	May	243	.32	78
	June	165	.34	56
	July	96	.57	55
	Aug.	42	1.07	45
	Sept.	27	1.37	37
	Oct.	30	1.63	49
	Nov.	21	2.24	47
	Dec.	22	2.14	47
	TOTAL	849	.69	588

To obtain mg/L multiply T/AF by 735.29

Table II

Colorado River Basin

Historical Flow and Quality of Water Data

Dolores River near Cisco, Utah

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	23	2.39	55
	Feb.	14	2.14	30
	Mar.	67	1.00	67
	Apr.	130	.44	57
	May	133	.50	67
	June	44	.82	36
	July	14	2.00	28
	Aug.	5	2.00	10
	Sept.	4	3.25	13
	Oct.	6	3.33	20
	Nov.	7	3.57	25
	Dec.	17	2.35	40
	TOTAL	464	.97	448
1967	Jan.	8	3.38	27
	Feb.	10	3.60	36
	Mar.	20	1.85	37
	Apr.	19	1.58	30
	May	58	.76	44
	June	45	.93	42
	July	17	1.82	31
	Aug.	23	1.83	42
	Sept.	9	2.33	21
	Oct.	6	3.00	18
	Nov.	6	3.50	21
	Dec.	7	4.14	29
	TOTAL	228	1.66	378
1968	Jan.	8	3.00	24
	Feb.	11	3.55	39
	Mar.	10	3.90	39
	Apr.	54	.94	51
	May	168	.40	68
	June	158	.37	58
	July	27	1.41	38
	Aug.	40	1.15	46
	Sept.	5	4.00	20
	Oct.	6	5.33	32
	Nov.	8	4.13	33
	Dec.	6	4.67	28
	TOTAL	501	.95	476
1969	Jan.	11	3.18	35
	Feb.	10	3.90	39
	Mar.	13	2.92	38
	Apr.	213	.42	90
	May	168	.33	56
	June	75	.56	42
	July	39	1.05	41
	Aug.	13	2.15	28
	Sept	14	2.36	33
	Oct.	15	2.06	30
	Nov.	14	1.96	29
	Dec.	14	2.24	32
	TOTAL	599	.82	493
1970	Jan.	13	2.99	38
	Feb.	11	2.41	27
	Mar.	11	3.32	37
	Apr.	51	.97	50
	May	229	.31	71
	June	89	.48	42
	July	28	1.24	35
	Aug.	18	1.63	29
	Sept.	64	.88	56
	Oct.	16	2.10	34
	Nov.	15	2.16	32
	Dec.	15	2.40	36
	TOTAL	560	.87	487
1971	Jan.	16	2.22	36
	Feb.	15	2.20	33
	Mar.	42	1.13	48
	Apr.	81	.49	40
	May	109	.47	51
	June	104	.39	40
	July	25	1.09	27
	Aug.	17	2.68	46
	Sept.	8	2.23	18
	Oct.	16	2.28	37
	Nov.	10	3.12	31
	Dec.	14	2.10	29
	TOTAL	457	.95	436
1972	Jan.	13	3.19	42
	Feb.	12	3.33	40
	Mar.	34	1.19	40
	Apr.	28	1.26	35
	May	39	1.00	39
	June	47	.65	31
	July	7	2.21	16
	Aug.	2	4.48	9
	Sept.	6	3.07	18
	Oct.	40	1.16	46
	Nov.	23	1.68	39
	Dec.	18	2.25	41
	TOTAL	269	1.47	396
1973	Jan.	18	1.94	35
	Feb.	18	1.83	33
	Mar.	33	1.71	56
	Apr.	194	.50	97
	May	546	.30	164
	June	321	.32	103
	July	109	.67	73
	Aug.	13	2.62	34
	Sept.	8	3.70	29
	Oct.	8	4.31	35
	Nov.	8	4.17	33
	Dec.	13	3.97	51
	TOTAL	1,289	.58	743
1974	Jan.	10	3.50	35
	Feb.	10	2.50	25
	Mar.	24	2.14	51
	Apr.	77	.87	67
	May	130	.38	49
	June	37	.93	34
	July	15	1.90	28
	Aug.	4	2.61	10
	Sept.	1	6.19	6
	Oct.	5	4.65	23
	Nov.	8	3.47	28
	Dec.	7	4.44	31
	TOTAL	328	1.18	387
1975	Jan.	7	4.27	30
	Feb.	9	3.60	32
	Mar.	13	3.19	42
	Apr.	150	.95	140
	May	315	.27	86
	June	218	.28	60
	July	130	.43	56
	Aug.	16	2.05	33
	Sept.	9	3.43	30
	Oct.	8	4.36	35
	Nov.	8	4.70	37
	Dec.	8	4.37	35
	TOTAL	891	.69	616
1976	Jan.	10	3.95	39
	Feb.	13	3.75	49
	Mar.	13	3.82	49
	Apr.	80	.56	45
	May	132	.40	53
	June	76	.54	41
	July	15	1.98	30
	Aug.	8	2.54	20
	Sept.	8	2.12	17
	Oct.	8	3.13	25
	Nov.	6	5.00	30
	Dec.	4	6.50	26
	TOTAL	373	1.14	424
1977	Jan.	5	6.92	36
	Feb.	7	5.51	41
	Mar.	6	5.81	36
	Apr.	8	2.83	23
	May	6	4.48	26
	June	10	2.32	23
	July	19	2.23	43
	Aug.	15	1.70	25
	Sept.	5	2.63	14
	Oct.	10	2.31	24
	Nov.	6	3.25	19
	Dec.	6	4.81	29
	TOTAL	104	3.26	338
1978	Jan.	9	3.81	32
	Feb.	8	4.04	32
	Mar.	16	2.52	40
	Apr.	236	.34	80
	May	247	.28	68
	June	160	.26	41
	July	33	.87	29
	Aug.	5	2.40	12
	Sept.	2	5.15	9
	Oct.	4	5.12	20
	Nov.	10	2.50	25
	Dec.	6	4.10	26
	TOTAL	735	.56	415
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table II

Colorado River Basin

Historical Flow and Quality of Water Data

Dolores River near Cisco, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	1,566	.51	803	1932	377	728
1942	1,316	.49	640	1623	358	581
1943	596	.85	504	735	622	457
1944	988	.54	532	1219	396	483
1945	661	.76	503	815	560	456
1946	295	1.36	402	364	1003	365
1947	553	.92	506	682	673	459
1948	801	.70	558	988	512	506
1949	822	.77	631	1014	564	572
1950	366	1.03	377	451	758	342
1951	163	1.78	290	201	1308	263
1952	1,095	.51	556	1351	373	504
1953	301	1.31	393	371	962	357
1954	208	1.58	329	257	1160	298
1955	343	1.06	364	423	780	330
1956	265	1.22	322	327	893	292
1957	1,150	.60	693	1419	443	629
1958	1,016	.65	662	1253	480	601
1959	169	1.79	303	208	1322	275
1960	480	.81	387	592	593	351
1961	367	1.05	385	453	770	349
1962	530	.83	442	654	613	401
1963	237	1.45	344	292	1068	312
1964	300	1.34	401	370	984	364
1965	849	.69	588	1047	509	533
1966	464	.97	448	572	710	406
1967	228	1.66	378	281	1221	343
1968	501	.95	476	618	699	432
1969	599	.82	493	739	605	447
1970	560	.87	487	691	640	442
1971	457	.95	436	564	702	396
1972	269	1.47	396	332	1081	359
1973	1,289	.58	743	1590	424	674
1974	328	1.18	387	405	867	351
1975	891	.69	616	1099	509	559
1976	373	1.14	424	460	837	385
1977	104	3.26	338	128	2395	306
1978	735	.56	415	906	415	376
Total	22,235		17,952	27 426		16 284
Average	585	.81	472	722	593	429

Table 12

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cisco, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	139	1.86	259
	Feb.	153	1.78	272
	Mar.	207	1.64	339
	Apr.	445	1.00	445
	May	2,355	.42	989
	June	1,582	.46	728
	July	579	.73	423
	Aug.	251	1.67	419
	Sept.	237	1.81	429
	Oct.	579	1.10	637
	Nov.	311	1.18	367
	Dec.	229	1.51	346
	TOTAL	7,067	.80	5,653
1942	Jan.	181	1.67	302
	Feb.	165	1.73	285
	Mar.	228	1.52	347
	Apr.	1,344	.61	820
	May	1,809	.45	814
	June	1,961	.37	725
	July	579	.78	451
	Aug.	185	1.84	340
	Sept.	134	2.46	329
	Oct.	162	2.33	378
	Nov.	186	1.99	370
	Dec.	164	1.96	322
	TOTAL	7,098	.77	5,483
1943	Jan.	153	1.90	291
	Feb.	146	1.85	270
	Mar.	174	1.77	308
	Apr.	709	.64	454
	May	996	.46	458
	June	1,365	.38	518
	July	502	.78	392
	Aug.	368	1.26	463
	Sept.	212	1.85	392
	Oct.	184	1.84	339
	Nov.	215	1.47	317
	Dec.	190	1.56	296
	TOTAL	5,214	.86	4,498
1944	Jan.	140	1.77	248
	Feb.	152	1.56	237
	Mar.	166	1.51	251
	Apr.	304	1.09	331
	May	1,784	.41	723
	June	1,843	.35	645
	July	677	.61	413
	Aug.	149	1.62	241
	Sept	99	2.54	252
	Oct.	159	2.18	347
	Nov.	196	1.78	348
	Dec.	171	1.70	291
	TOTAL	5,840	.74	4,336
1945	Jan.	149	1.73	258
	Feb.	151	1.74	263
	Mar.	178	1.56	277
	Apr.	328	.88	289
	May	1,495	.36	538
	June	1,311	.37	485
	July	676	.67	453
	Aug.	446	1.01	451
	Sept.	146	1.85	270
	Oct.	217	1.75	380
	Nov.	224	1.41	316
	Dec.	183	1.26	230
	TOTAL	5,504	.76	4,210
1946	Jan.	174	1.37	239
	Feb.	155	1.27	197
	Mar.	191	1.24	236
	Apr.	525	.61	320
	May	726	.49	356
	June	1,027	.42	432
	July	309	.98	303
	Aug.	196	1.66	325
	Sept.	135	2.10	283
	Oct.	206	1.85	382
	Nov.	206	1.56	322
	Dec.	208	1.37	285
	TOTAL	4,058	.91	3,680
1947	Jan.	145	1.58	229
	Feb.	150	1.44	216
	Mar.	189	1.39	263
	Apr.	316	.85	268
	May	1,423	.40	569
	June	1,594	.39	621
	July	985	.47	463
	Aug.	369	1.21	447
	Sept.	259	1.44	373
	Oct.	328	1.47	483
	Nov.	277	1.24	343
	Dec.	223	1.40	312
	TOTAL	6,258	.73	4,587
1948	Jan.	191	1.34	256
	Feb.	210	1.33	280
	Mar.	245	1.36	333
	Apr.	830	.64	531
	May	1,959	.36	705
	June	1,499	.39	585
	July	446	.86	384
	Aug.	225	1.52	342
	Sept.	121	1.88	228
	Oct.	175	1.96	343
	Nov.	204	1.67	341
	Dec.	186	1.66	308
	TOTAL	6,291	.74	4,636
1949	Jan.	188	1.54	289
	Feb.	187	1.35	253
	Mar.	243	1.40	340
	Apr.	615	.67	412
	May	1,289	.41	529
	June	1,910	.37	707
	July	908	.55	499
	Aug.	224	1.58	354
	Sept.	158	1.08	328
	Oct.	226	1.83	414
	Nov.	210	1.71	359
	Dec.	180	1.66	299
	TOTAL	6,338	.75	4,783
1950	Jan.	199	1.52	302
	Feb.	201	1.44	289
	Mar.	209	1.31	274
	Apr.	541	.61	330
	May	764	.51	389
	June	1,113	.42	467
	July	347	1.03	357
	Aug.	109	2.02	220
	Sept.	138	2.12	292
	Oct.	125	2.35	294
	Nov.	161	1.96	316
	Dec.	167	1.75	293
	TOTAL	4,074	.94	3,823
1951	Jan.	153	1.69	258
	Feb.	151	1.51	228
	Mar.	161	1.46	236
	Apr.	173	1.21	209
	May	758	.54	409
	June	1,173	.43	505
	July	529	.68	360
	Aug.	238	1.47	350
	Sept.	131	2.06	270
	Oct.	169	1.99	336
	Nov.	178	1.74	310
	Dec.	172	1.67	287
	TOTAL	3,986	.94	3,758
1952	Jan.	191	1.59	303
	Feb.	155	1.65	256
	Mar.	194	1.48	287
	Apr.	969	.53	514
	May	2,152	.35	753
	June	2,314	.33	764
	July	641	.72	462
	Aug.	358	1.18	422
	Sept.	213	1.58	337
	Oct.	166	1.92	318
	Nov.	177	1.89	334
	Dec.	188	1.66	313
	TOTAL	7,718	.66	5,063
1953	Jan.	185	1.65	306
	Feb.	143	1.63	233
	Mar.	187	1.52	284
	Apr.	250	1.00	250
	May	606	.60	364
	June	1,399	.41	574
	July	353	.95	335
	Aug	256	1.23	315
	Sept.	128	2.22	284
	Oct.	177	1.89	334
	Nov.	207	1.77	366
	Dec.	171	1.75	299
	TOTAL	4,062	.97	3,944
1954	Jan.	177	1.76	312
	Feb.	143	1.65	236
	Mar.	161	1.46	235
	Apr.	221	.98	217
	May	436	.74	323
	June	217	1.17	254
	July	150	1.69	253
	Aug.	98	2.30	225
	Sept	171	2.09	358
	Oct.	215	1.59	342
	Nov.	164	1.70	278
	Dec.	140	1.90	266
	TOTAL	2,293	1.44	3,299
1955	Jan.	134	1.84	247
	Feb.	121	1.78	215
	Mar.	198	1.33	263
	Apr.	320	.82	262
	May	752	.50	376
	June	689	.55	379
	July	214	1.21	259
	Aug.	185	1.66	307
	Sept.	108	2.16	233
	Oct.	119	2.19	261
	Nov.	169	1.89	319
	Dec.	176	1.70	299
	TOTAL	3,185	1.07	3,420
1956	Jan.	155	1.69	262
	Feb.	141	1.70	239
	Mar.	187	1.50	281
	Apr.	356	.72	256
	May	1,005	.45	452
	June	924	.44	406
	July	172	1.47	253
	Aug.	119	1.97	234
	Sept.	81	2.38	193
	Oct.	121	2.22	269
	Nov.	165	1.87	308
	Dec.	142	1.94	275
	TOTAL	3,568	.96	3,428
1957	Jan.	164	1.80	296
	Feb.	168	1.55	260
	Mar.	167	1.56	260
	Apr.	398	.86	342
	May	1,375	.44	605
	June	2,859	.29	829
	July	1,952	.37	722
	Aug.	661	.83	549
	Sept.	314	1.21	380
	Oct.	292	1.78	520
	Nov.	299	1.44	431
	Dec.	239	1.71	408
	TOTAL	8,888	.63	5,602
1958	Jan.	200	1.52	304
	Feb.	225	1.34	302
	Mar.	254	1.29	328
	Apr.	756	.53	401
	May	2,032	.31	630
	June	1,560	.40	624
	July	234	1.22	285
	Aug.	109	2.17	236
	Sept.	153	2.14	328
	Oct.	155	1.99	308
	Nov.	190	1.66	315
	Dec.	176	1.63	287
	TOTAL	6,044	.72	4,348
1959	Jan.	168	1.71	287
	Feb.	153	1.41	216
	Mar.	150	1.60	240
	Apr.	163	1.39	227
	May	535	.65	348
	June	924	.50	462
	July	214	1.15	246
	Aug.	160	1.91	306
	Sept.	124	2.14	265
	Oct.	250	1.43	358
	Nov.	210	1.31	275
	Dec.	163	1.54	251
	TOTAL	3,214	1.08	3,481
1960	Jan.	164	1.51	248
	Feb.	143	1.51	216
	Mar.	273	1.22	333
	Apr.	629	.51	321
	May	758	.49	371
	June	1,068	.42	448
	July	250	1.04	260
	Aug.	105	1.96	206
	Sept.	117	2.16	253
	Oct.	153	1.94	297
	Nov.	177	1.67	296
	Dec.	165	1.48	244
	TOTAL	4,002	.87	3,493
1961	Jan.	156	1.43	223
	Feb.	140	1.52	213
	Mar.	162	1.44	233
	Apr.	206	1.14	235
	May	677	.57	386
	June	664	.51	339
	July	130	1.62	211
	Aug.	138	2.01	277
	Sept.	316	1.49	471
	Oct.	357	1.07	382
	Nov.	252	1.23	310
	Dec.	197	1.40	276
	TOTAL	3,395	1.05	3,556
1962	Jan.	182	1.29	235
	Feb.	261	1.12	292
	Mar.	246	1.05	258
	Apr.	1,054	.44	464
	May	1,603	.38	609
	June	1,400	.38	532
	July	765	.58	444
	Aug.	206	1.42	293
	Sept.	173	1.99	344
	Oct.	263	1.43	376
	Nov.	243	1.31	318
	Dec.	180	1.77	319
	TOTAL	6,576	.68	4,483
1963	Jan.	163	1.52	248
	Feb.	193	1.51	292
	Mar.	219	1.30	285
	Apr.	245	.91	223
	May	517	.62	320
	June	332	.93	309
	July	114	1.94	221
	Aug.	168	1.94	326
	Sept.	183	1.80	329
	Oct.	134	2.14	287
	Nov.	179	1.62	290
	Dec.	138	1.84	254
	TOTAL	2,585	1.31	3,384
1964	Jan.	132	1.85	244
	Feb.	121	1.79	217
	Mar.	128	1.87	239
	Apr.	214	1.11	238
	May	861	.50	430
	June	780	.50	390
	July	276	1.07	295
	Aug.	241	1.51	364
	Sept.	153	1.88	288
	Oct.	164	1.93	317
	Nov.	182	1.81	329
	Dec.	181	1.59	288
	TOTAL	3,433	1.06	3,639
1965	Jan.	162	1.55	251
	Feb.	140	1.63	228
	Mar.	154	1.59	245
	Apr.	562	.68	382
	May	1,272	.39	496
	June	1,654	.38	629
	July	1,116	.52	580
	Aug.	447	.94	420
	Sept.	369	1.21	446
	Oct.	360	1.32	475
	Nov.	249	1.65	411
	Dec.	237	1.39	329
	TOTAL	6,722	.73	4,892

To obtain mg/L multiply T/AF by 735.29

Table 12

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cisco, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	200	1.38	276
	Feb.	169	1.34	226
	Mar.	278	.96	267
	Apr.	438	.61	267
	May	697	.53	369
	June	429	.83	356
	July	185	1.50	278
	Aug.	120	1.89	227
	Sept.	145	2.01	291
	Oct.	175	1.87	327
	Nov.	153	1.89	289
	Dec.	174	1.71	298
	TOTAL	3,163	1.10	3,471
1967	Jan.	146	1.77	258
	Feb.	136	1.71	233
	Mar.	185	1.30	240
	Apr.	198	1.31	259
	May	462	.76	351
	June	713	.65	463
	July	327	1.09	356
	Aug.	175	1.76	308
	Sept.	178	1.77	315
	Oct.	174	1.39	242
	Nov.	211	1.39	293
	Dec.	241	1.18	284
	TOTAL	3,146	1.14	3,602
1968	Jan.	205	1.18	242
	Feb.	193	1.20	232
	Mar.	171	1.41	241
	Apr.	230	.99	228
	May	667	.60	400
	June	1,171	.44	515
	July	306	1.08	330
	Aug.	365	1.23	449
	Sept.	159	1.72	273
	Oct.	213	1.63	347
	Nov.	257	1.28	329
	Dec.	248	1.14	283
	TOTAL	4,185	.92	3,869
1969	Jan.	259	1.04	270
	Feb.	189	1.19	224
	Mar.	250	.97	242
	Apr.	714	.56	400
	May	987	.24	239
	June	731	.60	439
	July	472	.82	387
	Aug.	199	1.44	287
	Sept	240	1.47	353
	Oct.	324	1.12	364
	Nov.	289	1.06	305
	Dec.	252	1.06	267
	TOTAL	4,906	.77	3,777
1970	Jan.	236	1.06	251
	Feb.	220	.95	208
	Mar.	277	.87	241
	Apr.	327	.82	267
	May	1,384	.37	518
	June	1,339	.39	518
	July	537	.68	366
	Aug.	245	1.20	294
	Sept.	407	1.06	432
	Oct.	360	.99	357
	Nov.	338	.90	305
	Dec.	317	.87	275
	TOTAL	5,987	.67	4,032
1971	Jan.	332	0.78	258
	Feb.	321	.68	216
	Mar.	413	.63	262
	Apr.	580	.50	288
	May	768	.52	398
	June	1,141	.40	457
	July	535	.65	349
	Aug.	246	1.16	286
	Sept.	282	1.13	320
	Oct.	280	1.28	357
	Nov.	276	1.12	308
	Dec.	284	1.06	302
	TOTAL	5,458	.70	3,801
1972	Jan.	267	1.02	273
	Feb.	227	1.03	233
	Mar.	279	1.07	299
	Apr.	202	.98	198
	May	453	.71	320
	June	759	.50	377
	July	192	1.19	229
	Aug.	119	1.66	198
	Sept.	201	1.54	309
	Oct.	302	1.13	342
	Nov.	281	1.13	317
	Dec.	267	.98	263
	TOTAL	3,549	.95	3,358
1973	Jan.	283	0.96	273
	Feb.	211	1.15	242
	Mar.	240	1.23	295
	Apr.	388	.96	372
	May	1,557	.43	670
	June	1,557	.41	640
	July	799	.60	480
	Aug.	331	1.04	344
	Sept.	220	1.37	302
	Oct.	251	1.34	337
	Nov.	247	1.23	305
	Dec.	290	.93	271
	TOTAL	6,374	.71	4,531
1974	Jan.	312	0.86	267
	Feb.	294	.81	237
	Mar.	363	.84	304
	Apr.	361	.81	291
	May	1,016	.39	400
	June	747	.50	373
	July	313	1.01	315
	Aug.	161	1.48	238
	Sept.	158	1.66	263
	Oct.	206	1.58	326
	Nov.	259	1.27	329
	Dec.	232	1.20	279
	TOTAL	4,422	.82	3,622
1975	Jan.	236	1.11	263
	Feb.	207	1.08	223
	Mar.	241	1.09	263
	Apr.	377	.85	319
	May	1,007	.47	472
	June	1,243	.42	524
	July	807	.53	425
	Aug.	226	1.20	272
	Sept.	185	1.50	278
	Oct.	233	1.44	336
	Nov.	279	1.16	324
	Dec.	262	1.08	283
	TOTAL	5,303	.75	3,982
1976	Jan.	230	1.07	247
	Feb.	206	1.18	244
	Mar.	220	1.11	244
	Apr.	277	1.15	319
	May	639	.61	390
	June	592	.63	371
	July	231	1.20	278
	Aug.	150	1.58	237
	Sept.	176	1.46	257
	Oct.	219	1.28	280
	Nov.	220	1.20	264
	Dec.	219	1.04	229
	TOTAL	3,379	.99	3,360
1977	Jan.	206	1.15	238
	Feb.	146	1.38	201
	Mar.	124	1.56	192
	Apr.	97	1.52	148
	May	143	1.28	183
	June	168	1.23	207
	July	127	1.89	240
	Aug.	109	1.92	209
	Sept.	127	1.68	214
	Oct.	141	1.61	227
	Nov.	142	1.58	225
	Dec.	130	1.46	189
	TOTAL	1,660	1.49	2,472
1978	Jan.	137	1.34	183
	Feb.	138	1.27	176
	Mar.	191	1.19	228
	Apr.	477	.72	343
	May	957	.49	470
	June	1,343	.36	483
	July	535	.62	333
	Aug.	159	1.35	215
	Sept.	182	1.36	248
	Oct.	200	1.37	273
	Nov.	249	1.15	287
	Dec.	244	1.06	259
	TOTAL	4,813	.73	3,498
	Jan.			
	Feb.			
	Mar.			
	Apr.			
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	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 12

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cisco, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	7,067	.80	5,653	8717	588	5128
1942	7,098	.77	5,483	8755	568	4974
1943	5,214	.86	4,498	6431	635	4081
1944	5,840	.74	4,336	7204	546	3934
1945	5,504	.76	4,210	6789	563	3819
1946	4,058	.91	3,680	5006	667	3338
1947	6,258	.73	4,587	7719	539	4161
1948	6,291	.74	4,636	7760	542	4206
1949	6,338	.75	4,783	7818	555	4339
1950	4,074	.94	3,823	5025	690	3468
1951	3,986	.94	3,758	4917	693	3409
1952	7,718	.66	5,063	9520	482	4593
1953	4,062	.97	3,944	5010	714	3578
1954	2,293	1.44	3,299	2828	1058	2993
1955	3,185	1.07	3,420	3929	790	3103
1956	3,568	.96	3,428	4401	707	3110
1957	8,888	.63	5,602	10 963	464	5082
1958	6,044	.72	4,348	7455	529	3945
1959	3,214	1.08	3,481	3964	797	3158
1960	4,002	.87	3,493	4936	642	3169
1961	3,395	1.05	3,556	4188	770	3226
1962	6,576	.68	4,484	8111	502	4068
1963	2,585	1.31	3,384	3189	963	3070
1964	3,433	1.06	3,639	4235	779	3301
1965	6,722	.73	4,892	8292	535	4438
1966	3,163	1.10	3,471	3902	807	3149
1967	3,146	1.14	3,602	3881	842	3268
1968	4,185	.92	3,869	5162	680	3510
1969	4,906	.77	3,777	6052	566	3426
1970	5,987	.67	4,032	7385	495	3658
1971	5,458	.70	3,801	6732	512	3448
1972	3,549	.95	3,358	4378	696	3046
1973	6,374	.71	4,531	7862	523	4111
1974	4,422	.82	3,622	5452	602	3286
1975	5,303	.75	3,982	6541	552	3612
1976	3,379	.99	3,360	4168	731	3048
1977	1,660	1.49	2,472	2047	1095	2242
1978	4,813	.73	3,498	5937	535	3173
Total	183,758		152,855	226 661		138 668
Average	4,836	.83	4,022	5965	612	3649

Table 13

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Archuletta, New Mexico

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	22	0.41	9
	Feb.	46	.35	16
	Mar.	98	.38	37
	Apr.	251	.21	53
	May	709	.16	110
	June	560	.12	68
	July	324	.14	46
	Aug.	84	.19	16
	Sept.	68	.24	16
	Oct.	273	.12	33
	Nov.	87	.17	15
	Dec.	52	.21	11
	TOTAL	2,574	.17	430
1942	Jan.	45	0.33	15
	Feb.	48	.25	12
	Mar.	54	.42	23
	Apr.	383	.21	82
	May	320	.15	48
	June	310	.12	38
	July	76	.18	14
	Aug.	41	.22	9
	Sept.	28	.25	7
	Oct.	23	.26	6
	Nov.	22	.27	6
	Dec.	16	.38	6
	TOTAL	1,366	.19	266
1943	Jan.	16	0.44	7
	Feb.	26	.35	9
	Mar.	55	.38	21
	Apr.	198	.19	37
	May	184	.16	30
	June	134	.15	20
	July	51	.24	12
	Aug.	48	.21	10
	Sept.	28	.25	7
	Oct.	35	.20	7
	Nov.	24	.29	7
	Dec.	19	.32	6
	TOTAL	818	.21	173
1944	Jan.	16	0.38	6
	Feb.	19	.32	6
	Mar.	34	.47	16
	Apr.	131	.21	27
	May	371	.16	61
	June	382	.13	49
	July	134	.16	22
	Aug.	45	.20	9
	Sept	43	.23	10
	Oct.	41	.22	9
	Nov.	21	.29	6
	Dec.	14	.43	6
	TOTAL	1,251	.18	227
1945	Jan.	14	.43	6
	Feb.	22	.45	10
	Mar.	35	.49	17
	Apr.	143	.20	28
	May	278	.16	44
	June	209	.13	28
	July	68	.21	14
	Aug.	40	.22	9
	Sept.	21	.24	5
	Oct.	30	.37	11
	Nov.	19	.37	7
	Dec.	12	.50	6
	TOTAL	891	.21	185
1946	Jan.	14	0.43	6
	Feb.	17	.47	8
	Mar.	22	.50	11
	Apr.	66	.23	15
	May	73	.18	13
	June	87	.18	16
	July	27	.33	9
	Aug.	40	.35	14
	Sept.	29	.31	9
	Oct.	36	.31	11
	Nov.	26	.35	9
	Dec.	19	.32	6
	TOTAL	456	.28	127
1947	Jan.	15	0.40	6
	Feb.	24	.38	9
	Mar.	32	.34	11
	Apr.	50	.24	12
	May	186	.17	32
	June	140	.13	18
	July	43	.28	12
	Aug.	73	.30	22
	Sept.	56	.23	13
	Oct.	77	.21	16
	Nov.	37	.22	8
	Dec.	27	.26	7
	TOTAL	760	.22	166
1948	Jan.	27	0.26	7
	Feb.	39	.33	13
	Mar.	43	.35	15
	Apr.	246	.20	49
	May	306	.14	43
	June	338	.12	40
	July	79	.16	13
	Aug.	49	.24	12
	Sept.	22	.32	7
	Oct.	23	.35	8
	Nov.	18	.39	7
	Dec.	13	.46	6
	TOTAL	1,203	.18	220
1949	Jan.	16	0.44	7
	Feb.	25	.36	9
	Mar.	73	.37	27
	Apr.	228	.24	55
	May	318	.15	48
	June	406	.13	53
	July	199	.15	30
	Aug.	57	.24	14
	Sept.	33	.27	9
	Oct.	30	.30	9
	Nov.	21	.38	8
	Dec.	14	.50	7
	TOTAL	1,420	.19	276
1950	Jan.	16	.37	6
	Feb.	29	.41	12
	Mar.	31	.42	13
	Apr.	116	.19	22
	May	126	.15	19
	June	112	.16	18
	July	44	.27	12
	Aug.	20	.35	7
	Sept.	24	.38	9
	Oct.	20	.35	7
	Nov.	14	.50	7
	Dec.	12	.50	6
	TOTAL	564	.24	138
1951	Jan.	10	0.50	5
	Feb.	11	.45	5
	Mar.	20	.45	9
	Apr.	35	.29	10
	May	117	.18	21
	June	94	.17	16
	July	21	.38	8
	Aug.	33	.36	12
	Sept.	22	.36	8
	Oct.	17	.47	8
	Nov.	15	.47	7
	Dec.	18	.44	8
	TOTAL	413	.28	117
1952	Jan.	19	0.53	10
	Feb.	19	.53	10
	Mar.	47	.49	23
	Apr.	326	.26	85
	May	396	.16	63
	June	454	.13	59
	July	136	.18	24
	Aug.	66	.26	17
	Sept.	33	.27	9
	Oct.	22	.32	7
	Nov.	16	.44	7
	Dec.	18	.39	7
	TOTAL	1,552	.21	321
1953	Jan.	18	0.39	7
	Feb.	18	.39	7
	Mar.	37	.41	15
	Apr.	75	.24	18
	May	117	.19	22
	June	148	.15	22
	July	41	.32	13
	Aug.	33	.33	11
	Sept.	16	.44	7
	Oct.	23	.43	10
	Nov.	23	.43	10
	Dec.	14	.50	7
	TOTAL	563	.26	149
1954	Jan.	11	0.45	5
	Feb.	21	.48	10
	Mar.	28	.46	13
	Apr.	90	.21	19
	May	143	.18	26
	June	67	.19	13
	July	37	.41	15
	Aug.	45	.29	13
	Sept.	30	.43	13
	Oct.	42	.24	10
	Nov.	18	.39	7
	Dec.	13	.46	6
	TOTAL	545	.28	150
1955	Jan.	12	0.42	5
	Feb.	13	.31	4
	Mar.	27	.37	10
	Apr.	45	.24	11
	May	132	.18	24
	June	119	.16	19
	July	42	.29	12
	Aug.	67	.28	19
	Sept.	28	.29	8
	Oct.	20	.30	6
	Nov.	17	.35	6
	Dec.	15	.40	6
	TOTAL	537	.24	130
1956	Jan.	16	0.38	6
	Feb.	15	.40	6
	Mar.	48	.33	16
	Apr.	79	.20	16
	May	173	.14	24
	June	117	.15	18
	July	25	.32	8
	Aug.	23	.35	8
	Sept.	11	.36	4
	Oct.	12	.42	5
	Nov.	11	.45	5
	Dec.	9	.44	4
	TOTAL	539	.22	120
1957	Jan.	13	0.46	6
	Feb.	30	.47	14
	Mar.	46	.43	20
	Apr.	120	.28	34
	May	222	.19	42
	June	480	.13	62
	July	326	.16	52
	Aug.	164	.22	36
	Sept.	67	.19	13
	Oct.	67	.30	20
	Nov.	68	.26	18
	Dec.	44	.30	13
	TOTAL	1,647	.20	330
1958	Jan.	22	0.16	8
	Feb.	51	.43	22
	Mar.	77	.42	32
	Apr.	279	.30	84
	May	460	.17	78
	June	270	.13	35
	July	42	.26	11
	Aug.	35	.31	11
	Sept.	40	.30	12
	Oct.	25	.36	9
	Nov.	17	.41	7
	Dec.	14	.43	6
	TOTAL	1,332	.24	315
1959	Jan.	11	0.46	5
	Feb.	14	.44	6
	Mar.	18	.42	8
	Apr.	37	.30	11
	May	87	.18	16
	June	84	.16	13
	July	18	.32	6
	Aug.	34	.33	11
	Sept.	15	.34	5
	Oct.	60	.30	18
	Nov.	39	.30	12
	Dec.	19	.37	7
	TOTAL	436	.27	118
1960	Jan.	14	0.43	6
	Feb.	16	.42	7
	Mar.	175	.34	60
	Apr.	240	.19	46
	May	193	.17	33
	June	232	.13	30
	July	55	.23	13
	Aug.	25	.29	7
	Sept.	23	.31	7
	Oct.	26	.37	10
	Nov.	16	.42	7
	Dec.	14	.54	7
	TOTAL	1,029	.23	233
1961	Jan.	12	0.45	5
	Feb.	16	.43	7
	Mar.	43	.44	19
	Apr.	113	.26	29
	May	192	.15	29
	June	122	.16	19
	July	38	.28	11
	Aug.	52	.28	15
	Sept.	58	.25	15
	Oct.	52	.24	12
	Nov.	34	.28	10
	Dec.	18	.31	6
	TOTAL	750	.24	177
1962	Jan.	15	0.37	6
	Feb.	42	.38	16
	Mar.	51	.38	20
	Apr.	242	.20	48
	May	228	.14	32
	June	165	.14	23
	July	39	.19	7
	Aug.	29	.25	7
	Sept.	19	.25	5
	Oct.	18	.31	6
	Nov.	14	.33	5
	Dec.	10	.37	4
	TOTAL	872	.21	179
1963	Jan.	7	0.39	3
	Feb.	8	.43	4
	Mar.	14	.39	6
	Apr.	31	.38	12
	May	19	.26	5
	June	19	.19	4
	July	20	.18	4
	Aug.	21	.19	4
	Sept.	20	.20	4
	Oct.	24	.23	6
	Nov.	24	.24	6
	Dec.	24	.28	7
	TOTAL	232	.28	65
1964	Jan	17	0.32	6
	Feb.	13	.31	4
	Mar.	13	.32	4
	Apr.	15	.32	5
	May	34	.31	10
	June	82	.28	23
	July	108	.25	27
	Aug.	48	.23	11
	Sept.	26	.22	6
	Oct.	28	.23	6
	Nov.	21	.27	6
	Dec.	32	.28	9
	TOTAL	437	.27	117
.965	Jan.	90	0.29	26
	Feb.	92	.30	28
	Mar.	52	.36	19
	Apr.	85	.35	30
	May	138	.29	40
	June	215	.20	43
	July	102	.18	18
	Aug.	136	.17	23
	Sept.	112	.17	19
	Oct.	131	.13	17
	Nov.	180	.16	29
	Dec.	178	.18	32
	TOTAL	1,511	.21	324

To obtain mg/L multiply T/AF by 735.29

Table 13

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Archuletta, New Mexico

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
	Jan.	168	0.21	35
	Feb.	94	.26	24
	Mar.	114	.29	33
	Apr.	181	.28	51
	May	130	.26	34
	June	27	.22	6
1966	July	28	.17	5
	Aug.	29	.18	5
	Sept.	27	.17	5
	Oct.	91	.18	16
	Nov.	47	.20	9
	Dec.	25	.24	6
	TOTAL	961	.24	229
	Jan.	25	0.26	6
	Feb.	45	.26	12
	Mar.	70	.26	18
	Apr.	23	.27	6
	May	17	.31	5
	June	18	.35	6
1967	July	20	.34	7
	Aug.	62	.29	18
	Sept.	59	.26	15
	Oct.	21	.23	5
	Nov.	21	.26	5
	Dec.	21	.28	6
	TOTAL	402	.27	109
	Jan.	19	0.29	6
	Feb.	20	.26	5
	Mar.	18	.29	5
	Apr.	60	.27	16
	May	49	.26	13
	June	28	.26	7
1968	July	30	.28	8
	Aug.	39	.27	11
	Sept.	47	.25	12
	Oct.	35	.25	9
	Nov.	23	.24	6
	Dec.	24	.23	6
	TOTAL	392	.27	104
	Jan.	40	0.22	9
	Feb.	110	.23	25
	Mar.	94	.20	19
	Apr.	110	.25	27
	May	117	.22	26
	June	118	.22	26
1969	July	98	.22	22
	Aug.	72	.21	15
	Sept	76	.21	16
	Oct.	96	.20	19
	Nov.	81	.21	17
	Dec.	90	.21	19
	TOTAL	1,102	.22	240
	Jan.	51	0.22	11
	Feb.	110	.19	21
	Mar.	91	.20	18
	Apr.	26	.23	6
1970	May	29	.24	7
	June	30	.23	7
	July	31	.19	6
	Aug.	39	.18	7
	Sept.	78	.19	15
	Oct.	110	.22	24
	Nov.	104	.22	23
	Dec.	120	.22	26
	TOTAL	819	.21	171
	Jan.	141	0.23	32
	Feb.	120	.24	29
	Mar.	68	.22	15
	Apr.	30	.23	7
	May	31	.22	7
	June	29	.24	7
1971	July	31	.22	7
	Aug.	30	.21	6
	Sept.	30	.22	7
	Oct.	25	.26	6
	Nov.	18	.29	5
	Dec.	65	.21	14
	TOTAL	618	.23	142
	Jan.	93	0.22	20
	Feb.	84	.26	22
	Mar.	93	.28	26
	Apr.	49	.28	14
	May	31	.24	7
	June	30	.28	9
1972	July	31	.30	9
	Aug	38	.24	9
	Sep	37	.27	10
	Oct.	32	.29	9
	Nov.	30	.27	8
	Dec.	62	.27	17
	TOTAL	610	.26	160
	Jan.	71	0.27	19
	Feb.	97	.26	25
	Mar.	29	.31	9
	Apr.	30	.30	9
	May	133	.31	41
	June	182	.28	51
1973	July	266	.28	75
	Aug.	216	.22	47
	Sept.	159	.22	35
	Oct.	120	.20	24
	Nov.	117	.21	24
	Dec.	120	.21	25
	TOTAL	1,540	.25	384
	Jan.	103	0.20	21
	Feb.	65	.23	15
	Mar.	63	.22	14
	Apr.	59	.25	15
	May	57	.25	14
	June	38	.24	9
1974	July	36	.25	9
	Aug.	43	.26	11
	Sept.	42	.24	10
	Oct.	32	.28	9
	Nov.	28	.29	8
	Dec.	30	.30	9
	TOTAL	596	.24	144
	Jan.	32	0.28	9
	Feb.	27	.27	7
	Mar.	31	.29	9
	Apr.	82	.27	22
	May	148	.27	40
	June	144	.27	39
1975	July	151	.26	39
	Aug.	113	.26	29
	Sept.	92	.25	23
	Oct.	90	.24	21
	Nov.	85	.23	20
	Dec.	96	.22	21
	TOTAL	1,091	.26	279
	Jan.	77	0.22	17
	Feb.	54	.22	12
	Mar.	56	.21	12
	Apr.	42	.24	10
	May	88	.23	20
	June	82	.23	19
1976	July	33	.24	8
	Aug.	37	.24	9
	Sept.	40	.23	9
	Oct.	29	.24	7
	Nov.	28	.26	7
	Dec.	73	.23	17
	TOTAL	639	.23	147
	Jan.	75	0.23	17
	Feb.	37	.24	9
	Mar.	32	.24	8
	Apr.	31	.25	7
	May	34	.24	8
	June	36	.24	9
1977	July	34	.24	8
	Aug.	35	.24	8
	Sept.	31	.25	8
	Oct.	33	.25	8
	Nov.	30	.25	8
	Dec.	29	.26	7
	TOTAL	437	.24	105
	Jan.	31	0.27	8
	Feb.	29	.26	7
	Mar.	30	.28	8
	Apr.	31	.28	9
	May	32	.28	9
	June	28	.30	8
1978	July	30	.27	8
	Aug	34	.27	9
	Sept.	38	.27	10
	Oct.	30	.28	8
	Nov.	30	.28	9
	Dec.	31	.28	9
	TOTAL	375	.28	104
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 13

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Archuletta, New Mexico

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	2,574	.17	430	3175	123	390
1942	1,366	.19	266	1685	143	241
1943	818	.21	173	1009	156	157
1944	1,251	.18	227	1543	134	206
1945	891	.21	185	1099	153	168
1946	456	.28	127	562	205	115
1947	760	.22	166	937	161	151
1948	1,203	.18	220	1484	135	200
1949	1,420	.19	276	1752	143	250
1950	564	.24	138	696	180	125
1951	413	.28	117	509	208	106
1952	1,552	.21	321	1914	152	291
1953	563	.26	149	694	195	135
1954	545	.28	150	672	202	136
1955	537	.24	130	662	178	118
1956	539	.22	120	665	164	109
1957	1,647	.20	330	2032	147	299
1958	1,332	.24	315	1643	174	286
1959	436	.27	118	538	199	107
1960	1,029	.23	233	1269	166	211
1961	750	.24	177	925	174	161
1962	872	.21	179	1076	151	162
1963	232	.28	65	286	206	59
1964	437	.27	117	539	197	106
1965	1,511	.21	324	1864	158	294
1966	961	.24	229	1185	176	208
1967	402	.27	109	496	200	99
1968	392	.27	104	484	194	94
1969	1,102	.22	240	1359	160	218
1970	819	.21	171	1010	153	155
1971	618	.23	142	762	169	129
1972	610	.26	160	752	193	145
1973	1,540	.25	384	1900	183	348
1974	596	.24	144	735	178	131
1975	1,091	.26	279	1346	188	253
1976	639	.23	147	788	169	133
1977	437	.24	105	539	177	96
1978	375	.28	104	462	203	94
Total	33,280		7,371	41 048		6686
Average	876	.22	194	1080	163	176

Table 14

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Bluff, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	78	1.01	79
	Feb.	127	.98	124
	Mar.	211	.78	165
	Apr.	392	.62	243
	May	1,323	.50	662
	June	915	.30	275
	July	526	.30	158
	Aug.	174	.70	122
	Sept.	202	.87	176
	Oct.	655	.64	419
	Nov.	191	.61	117
	Dec.	105	.81	85
	TOTAL	4,899	.54	2,625
1942	Jan.	81	0.93	75
	Feb.	68	.93	63
	Mar.	126	.95	120
	Apr.	602	.51	307
	May	479	.38	182
	June	533	.26	139
	July	150	.48	72
	Aug.	51	.82	42
	Sept.	38	1.00	38
	Oct.	37	1.22	45
	Nov.	39	1.23	48
	Dec.	43	1.26	54
	TOTAL	2,247	.53	1,185
1943	Jan.	43	1.26	54
	Feb.	49	1.19	58
	Mar.	95	1.09	104
	Apr.	294	.47	138
	May	332	.39	129
	June	254	.38	96
	July	106	.57	60
	Aug.	91	1.01	92
	Sept.	62	.90	56
	Oct.	58	1.00	58
	Nov.	59	.97	57
	Dec.	51	1.12	57
	TOTAL	1,494	.64	959
1944	Jan.	37	1.16	43
	Feb.	49	1.14	56
	Mar.	76	1.06	81
	Apr.	204	.62	126
	May	640	.36	230
	June	705	.25	176
	July	283	.35	99
	Aug.	61	.85	52
	Sept	66	.92	61
	Oct.	75	.91	68
	Nov.	52	1.12	58
	Dec.	43	1.19	51
	TOTAL	2,291	.48	1,101
1945	Jan.	41	1.22	50
	Feb.	63	1.13	71
	Mar.	72	1.03	74
	Apr.	196	.61	120
	May	456	.35	160
	June	377	.29	109
	July	128	.50	64
	Aug.	96	1.13	108
	Sept.	21	1.18	25
	Oct.	62	1.10	68
	Nov.	46	1.04	48
	Dec.	30	1.27	38
	TOTAL	1,588	.59	935
1946	Jan.	37	1.14	42
	Feb.	36	1.19	43
	Mar.	47	1.04	49
	Apr.	95	.66	63
	May	125	.49	61
	June	204	.40	82
	July	63	.86	54
	Aug.	75	1.12	84
	Sept.	44	.93	41
	Oct.	55	.98	54
	Nov.	60	1.02	61
	Dec.	46	1.02	47
	TOTAL	887	.77	681
1947	Jan.	31	1.13	35
	Feb.	45	1.07	48
	Mar.	51	.90	46
	Apr.	68	.63	43
	May	329	.38	125
	June	276	.30	83
	July	110	.41	45
	Aug.	294	1.01	296
	Sept.	124	.73	91
	Oct.	207	.79	163
	Nov.	77	.73	56
	Dec.	65	.86	56
	TOTAL	1,677	.65	1,087
1948	Jan.	52	0.83	43
	Feb.	79	.84	66
	Mar.	89	.83	74
	Apr.	358	.37	133
	May	519	.27	140
	June	603	.28	169
	July	147	.41	60
	Aug.	86	.78	67
	Sept.	36	1.11	40
	Oct.	75	1.05	79
	Nov.	55	1.07	59
	Dec.	41	1.12	46
	TOTAL	2,140	.46	976
1949	Jan.	63	1.11	70
	Feb.	74	.99	73
	Mar.	152	.81	123
	Apr.	338	.45	152
	May	503	.31	156
	June	748	.31	232
	July	342	.33	113
	Aug.	90	.66	59
	Sept.	41	1.05	43
	Oct.	56	1.00	56
	Nov.	45	1.07	48
	Dec.	35	1.23	43
	TOTAL	2,487	.47	1,168
1950	Jan.	41	1.12	46
	Feb.	49	1.08	53
	Mar.	56	.93	52
	Apr.	136	.46	62
	May	169	.40	68
	June	191	.38	73
	July	68	.72	49
	Aug.	15	1.13	17
	Sept.	42	1.14	48
	Oct.	30	1.07	32
	Nov.	25	1.44	36
	Dec.	32	1.34	43
	TOTAL	854	.68	579
1951	Jan.	30	1.30	39
	Feb.	29	1.41	41
	Mar.	34	1.15	39
	Apr.	34	.85	29
	May	142	.51	72
	June	188	.36	68
	July	30	.80	24
	Aug.	49	1.06	52
	Sept.	45	1.07	48
	Oct.	35	1.23	43
	Nov.	39	1.10	43
	Dec.	36	1.28	46
	TOTAL	691	.79	544
1952	Jan.	88	1.16	102
	Feb.	40	1.20	48
	Mar.	87	1.03	90
	Apr.	453	.42	190
	May	618	.30	185
	June	769	.24	185
	July	238	.42	100
	Aug.	83	.69	57
	Sept.	56	.93	52
	Oct.	38	1.05	40
	Nov.	41	1.29	53
	Dec.	43	1.26	54
	TOTAL	2,554	.45	1,156
1953	Jan.	42	1.24	52
	Feb.	36	1.17	42
	Mar.	56	1.02	57
	Apr.	107	.64	68
	May	156	.44	69
	June	267	.27	72
	July	77	.84	65
	Aug	71	1.15	82
	Sept.	12	1.50	18
	Oct.	54	1.28	69
	Nov.	55	1.13	62
	Dec.	34	1.31	45
	TOTAL	967	.73	701
1954	Jan.	32	1.34	43
	Feb.	36	1.17	42
	Mar.	48	1.02	49
	Apr.	113	.53	60
	May	218	.39	85
	June	120	.48	58
	July	120	1.03	123
	Aug.	66	.86	57
	Sept.	89	1.19	106
	Oct.	95	.75	71
	Nov.	39	1.05	41
	Dec.	35	1.26	44
	TOTAL	1,011	.77	779
1955	Jan.	31	1.26	39
	Feb.	34	1.12	38
	Mar.	63	1.00	63
	Apr.	62	.74	46
	May	186	.38	71
	June	208	.32	67
	July	65	.88	57
	Aug.	142	1.07	152
	Sept.	28	.82	23
	Oct.	25	1.00	25
	Nov.	31	1.26	39
	Dec.	35	1.34	47
	TOTAL	910	.73	667
1956	Jan.	40	1.22	49
	Feb.	34	1.29	44
	Mar.	74	.83	61
	Apr.	107	.50	54
	May	241	.35	84
	June	203	.31	63
	July	31	1.10	34
	Aug.	36	1.33	48
	Sept.	4	1.50	6
	Oct.	13	1.54	20
	Nov.	30	1.23	37
	Dec.	25	1.40	35
	TOTAL	838	.64	535
1957	Jan.	38	1.26	48
	Feb.	64	1.05	67
	Mar.	71	.97	69
	Apr.	171	.55	94
	May	327	.48	157
	June	787	.28	220
	July	566	.38	215
	Aug.	364	.63	229
	Sept.	142	.68	97
	Oct.	150	.86	129
	Nov.	141	.72	102
	Dec.	88	.81	71
	TOTAL	2,909	.51	1,498
1958	Jan.	53	1.02	54
	Feb.	119	.92	109
	Mar.	159	.87	139
	Apr.	413	.48	198
	May	743	.26	193
	June	507	.25	126
	July	74	.65	48
	Aug.	43	1.02	43
	Sept.	61	.95	58
	Oct.	47	1.04	49
	Nov.	43	1.23	53
	Dec.	36	1.28	46
	TOTAL	2,298	.49	1,116
1959	Jan.	30	1.39	42
	Feb.	31	1.36	42
	Mar.	32	1.27	41
	Apr.	39	.94	37
	May	111	.52	58
	June	156	.39	61
	July	18	.81	15
	Aug.	64	1.13	72
	Sept.	11	1.53	17
	Oct.	92	.86	79
	Nov.	82	.82	67
	Dec.	46	1.02	47
	TOTAL	712	.81	578
1960	Jan.	37	1.26	47
	Feb.	43	1.09	47
	Mar.	260	.73	190
	Apr.	336	.32	108
	May	285	.34	97
	June	382	.27	103
	July	92	.53	49
	Aug.	18	1.11	20
	Sept.	17	1.24	21
	Oct.	58	1.13	66
	Nov.	39	1.22	48
	Dec.	40	1.27	51
	TOTAL	1,607	.53	847
1961	Jan.	35	1.33	47
	Feb.	41	1.31	54
	Mar.	66	1.02	67
	Apr.	157	.56	88
	May	285	.32	91
	June	227	.31	70
	July	43	.83	36
	Aug.	87	1.05	91
	Sept.	109	.88	96
	Oct.	98	.77	75
	Nov.	72	.93	67
	Dec.	44	1.22	54
	TOTAL	1,264	.66	836
1962	Jan.	36	1.24	45
	Feb.	94	.95	89
	Mar.	73	.99	72
	Apr.	315	.37	117
	May	346	.30	104
	June	297	.32	95
	July	88	.59	52
	Aug.	23	1.02	23
	Sept.	26	1.41	37
	Oct.	104	1.32	137
	Nov.	45	1.34	60
	Dec.	33	1.40	46
	TOTAL	1,480	.59	877
1963	Jan.	25	1.66	42
	Feb.	39	1.44	56
	Mar.	40	1.25	50
	Apr.	64	.78	50
	May	95	.72	68
	June	47	.82	39
	July	15	1.60	24
	Aug.	48	1.57	75
	Sept.	70	1.09	76
	Oct.	41	1.32	54
	Nov.	47	1.10	52
	Dec.	48	1.03	49
	TOTAL	579	1.10	635
1964	Jan.	44	1.14	50
	Feb.	30	1.27	38
	Mar.	28	1.46	41
	Apr.	30	1.40	42
	May	103	.57	59
	June	121	.58	70
	July	113	.76	86
	Aug.	131	1.07	140
	Sept.	56	1.36	76
	Oct.	37	1.26	47
	Nov.	42	1.43	60
	Dec.	60	1.20	72
	TOTAL	795	.98	781
1965	Jan.	122	0.77	94
	Feb.	120	.70	84
	Mar.	85	.93	79
	Apr.	165	.62	102
	May	288	.45	130
	June	419	.38	159
	July	295	.45	133
	Aug.	218	.65	142
	Sept.	177	.56	99
	Oct.	190	.60	114
	Nov.	232	.50	116
	Dec.	235	.54	127
	TOTAL	2,546	.54	1,379

To obtain mg/L multiply T/AF by 735.29

Table 14

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Bluff, Utah

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	198	0.54	107
	Feb.	129	.65	84
	Mar.	199	.68	135
	Apr.	252	.48	121
	May	267	.42	112
	June	127	.56	71
	July	54	1.01	55
	Aug.	44	1.30	57
	Sept.	42	1.25	52
	Oct.	94	.66	62
	Nov.	70	.86	60
	Dec.	72	1.11	80
	TOTAL	1,548	.64	996
1967	Jan.	58	1.07	62
	Feb.	64	.92	59
	Mar.	79	.71	56
	Apr.	31	1.15	36
	May	78	.76	59
	June	89	.91	81
	July	39	1.35	53
	Aug.	151	1.29	195
	Sept.	94	.96	90
	Oct.	31	1.46	45
	Nov.	38	1.26	48
	Dec.	39	1.20	47
	TOTAL	791	1.05	831
1968	Jan.	36	1.22	44
	Feb.	54	1.29	70
	Mar.	50	1.25	62
	Apr.	83	.75	62
	May	148	.54	80
	June	240	.37	89
	July	82	.93	76
	Aug.	176	1.04	183
	Sept.	41	1.00	41
	Oct.	56	1.09	61
	Nov.	49	1.18	58
	Dec.	45	1.07	48
	TOTAL	1,060	.82	874
1969	Jan.	83	1.04	86
	Feb.	131	.61	80
	Mar.	143	.73	104
	Apr.	216	.54	117
	May	271	.40	108
	June	238	.45	107
	July	202	.57	115
	Aug.	101	.88	89
	Sept	118	.76	90
	Oct.	208	.83	173
	Nov.	118	.64	75
	Dec.	109	.65	71
	TOTAL	1,938	.63	1,215
1970	Jan.	75	0.77	58
	Feb.	130	.49	64
	Mar.	116	.57	66
	Apr.	49	.96	47
	May	140	.45	63
	June	138	.49	67
	July	74	.73	54
	Aug.	66	1.09	72
	Sept.	308	.71	219
	Oct.	142	.59	84
	Nov.	137	.58	80
	Dec.	149	.54	80
	TOTAL	1,524	.63	954
1971	Jan.	164	0.48	79
	Feb.	144	.48	69
	Mar.	101	.57	57
	Apr.	69	.74	51
	May	86	.77	67
	June	123	.49	61
	July	66	.83	54
	Aug.	108	1.36	146
	Sept.	52	1.12	58
	Oct.	100	1.14	113
	Nov.	59	1.12	66
	Dec.	110	.77	85
	TOTAL	1,182	.77	906
1972	Jan.	119	0.61	72
	Feb.	109	.61	67
	Mar.	119	.54	64
	Apr.	65	.69	44
	May	81	.69	56
	June	118	.61	72
	July	17	1.14	19
	Aug.	31	1.44	44
	Sept.	56	.99	56
	Oct.	339	1.03	349
	Nov.	96	.98	94
	Dec.	100	.79	79
	TOTAL	1,250	.81	1,016
1973	Jan.	109	0.76	83
	Feb.	178	.75	134
	Mar.	177	1.16	205
	Apr.	260	.95	248
	May	486	.49	237
	June	464	.40	187
	July	398	.41	162
	Aug.	222	.49	108
	Sept.	195	.54	106
	Oct.	133	.59	79
	Nov.	134	.59	79
	Dec.	141	.57	81
	TOTAL	2,897	.59	1,709
1974	Jan.	133	0.59	78
	Feb.	92	.72	66
	Mar.	103	.98	101
	Apr.	65	.78	51
	May	106	.57	60
	June	69	.64	44
	July	39	1.13	44
	Aug.	25	1.12	28
	Sept.	25	1.08	27
	Oct.	73	.99	72
	Nov.	71	1.11	79
	Dec.	55	1.04	57
	TOTAL	856	.83	707
1975	Jan.	59	0.88	52
	Feb.	50	1.08	54
	Mar.	112	1.11	124
	Apr.	159	.67	107
	May	295	.42	124
	June	397	.31	123
	July	361	.35	125
	Aug.	147	.52	76
	Sept.	129	.60	78
	Oct.	107	.59	63
	Nov.	102	.58	59
	Dec.	116	.57	66
	TOTAL	2,034	.52	1,051
1976	Jan.	97	0.71	69
	Feb.	81	.75	61
	Mar.	79	.84	66
	Apr.	53	.75	40
	May	179	.45	81
	June	180	.54	98
	July	52	.77	40
	Aug.	48	.77	37
	Sept.	66	.86	57
	Oct.	51	.94	48
	Nov.	47	1.06	50
	Dec.	82	.76	62
	TOTAL	1,015	.70	709
1977	Jan.	84	0.72	60
	Feb.	55	.93	51
	Mar.	42	.77	32
	Apr.	24	.95	23
	May	21	1.30	27
	June	33	1.13	37
	July	58	1.50	86
	Aug.	81	1.19	97
	Sept.	33	1.11	37
	Oct.	39	1.12	43
	Nov.	51	1.05	54
	Dec.	49	1.01	49
	TOTAL	569	1.05	597
1978	Jan.	58	1.05	61
	Feb.	61	1.16	71
	Mar.	101	1.22	123
	Apr.	110	.74	81
	May	155	.63	98
	June	203	.40	81
	July	63	.73	46
	Aug.	15	.93	14
	Sept.	30	.95	28
	Oct.	40	.96	39
	Nov.	76	.89	70
	Dec.	75	1.02	77
	TOTAL	991	.80	789
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
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	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 14

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Bluff, Utah

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	4,899	.54	2,625	6043	394	2381
1942	2,247	.53	1,185	2772	388	1075
1943	1,494	.64	959	1843	472	870
1944	2,291	.48	1,101	2826	354	999
1945	1,588	.59	935	1959	433	848
1946	887	.77	681	1094	565	618
1947	1,677	.65	1,087	2069	477	986
1948	2,140	.46	976	2640	335	885
1949	2,487	.47	1,168	3068	346	1060
1950	854	.68	579	1053	499	525
1951	691	.79	544	852	580	494
1952	2,554	.45	1,156	3150	333	1049
1953	967	.73	701	1193	533	636
1954	1,011	.77	779	1247	567	707
1955	910	.73	667	1122	539	605
1956	838	.64	535	1034	469	485
1957	2,909	.51	1,498	3588	379	1359
1958	2,298	.49	1,116	2835	357	1012
1959	712	.81	578	878	597	524
1960	1,607	.53	847	1982	387	768
1961	1,264	.66	836	1559	486	758
1962	1,480	.59	877	1826	436	796
1963	579	1.10	635	714	807	576
1964	795	.98	781	981	723	709
1965	2,546	.54	1,379	3140	398	1251
1966	1,548	.64	996	1909	474	904
1967	791	1.05	831	976	773	754
1968	1,060	.82	874	1308	606	793
1969	1,938	.63	1,215	2391	461	1102
1970	1,524	.63	954	1880	460	865
1971	1,182	.77	906	1458	564	822
1972	1,250	.81	1,016	1542	598	922
1973	2,897	.59	1,709	3573	434	1550
1974	857	.83	707	1056	607	641
1975	2,034	.52	1,051	2509	380	953
1976	1,015	.70	709	1252	514	643
1977	569	1.05	597	702	771	541
1978	991	.80	789	1222	585	716
Total	59,381		36,579	73 246		33 182
Average	1,563	.62	963	1928	453	873

Table 15

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Lees Ferry, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	348	1.36	474
	Feb.	423	1.29	546
	Mar.	669	1.12	749
	Apr.	1,091	.79	862
	May	4,974	.45	2,239
	June	4,004	.38	1,522
	July	1,666	.51	850
	Aug.	798	1.16	925
	Sept.	608	1.35	821
	Oct.	1,797	1.09	1,959
	Nov.	903	.94	849
	Dec.	576	1.19	685
	TOTAL	17,857	.70	12,481
1942	Jan.	407	1.34	545
	Feb.	396	1.28	507
	Mar.	630	1.16	731
	Apr.	2,844	.55	1,564
	May	3,209	.46	1,476
	June	4,202	.29	1,219
	July	1,317	.57	751
	Aug.	454	1.08	490
	Sept.	275	1.59	438
	Oct.	334	1.58	528
	Nov.	368	1.58	582
	Dec.	357	1.54	550
	TOTAL	14,793	.63	9,381
1943	Jan.	330	1.50	494
	Feb.	332	1.41	469
	Mar.	516	1.19	614
	Apr.	1,450	.67	971
	May	2,158	.43	928
	June	2,729	.40	1,092
	July	1,429	.47	672
	Aug.	793	1.09	864
	Sept.	447	1.15	514
	Oct.	378	1.60	604
	Nov.	456	1.35	616
	Dec.	395	1.36	537
	TOTAL	11,413	.73	8,375
1944	Jan.	278	1.50	418
	Feb.	344	1.32	454
	Mar.	509	1.31	668
	Apr.	1,027	.89	914
	May	3,251	.47	1,528
	June	4,136	.32	1,323
	July	1,782	.45	802
	Aug.	417	1.07	446
	Sept	229	1.50	343
	Oct.	342	1.66	567
	Nov.	384	1.51	579
	Dec.	320	1.51	483
	TOTAL	13,019	.65	8,525
1945	Jan.	325	1.48	481
	Feb.	352	1.39	489
	Mar.	437	1.28	559
	Apr.	755	.99	748
	May	2,805	.44	1,234
	June	2,761	.37	1,021
	July	1,668	.47	784
	Aug.	1,011	.89	900
	Sept.	370	1.28	474
	Oct.	505	1.51	763
	Nov.	443	1.34	594
	Dec.	337	1.35	454
	TOTAL	11,769	.72	8,501
1946	Jan.	366	1.28	468
	Feb.	319	1.24	396
	Mar.	496	1.15	570
	Apr.	1,013	.83	841
	May	1,732	.47	814
	June	1,993	.43	857
	July	730	.73	533
	Aug.	478	1.28	612
	Sept.	310	1.62	502
	Oct.	403	1.50	604
	Nov.	466	1.30	607
	Dec.	445	1.22	542
	TOTAL	8,751	.84	7,346
1947	Jan.	277	1.40	388
	Feb.	357	1.29	462
	Mar.	654	1.09	713
	Apr.	780	.78	608
	May	3,121	.39	1,217
	June	3,275	.40	1,310
	July	1,926	.43	828
	Aug.	1,203	.98	1,179
	Sept.	584	1.13	660
	Oct.	818	1.17	958
	Nov.	585	1.07	626
	Dec.	466	1.21	564
	TOTAL	14,046	.68	9,513
1948	Jan.	406	1.18	479
	Feb.	458	1.14	522
	Mar.	645	1.14	735
	Apr.	1,703	.64	1,090
	May	3,507	.38	1,333
	June	3,339	.34	1,135
	July	980	.65	637
	Aug.	531	1.23	653
	Sept.	230	1.40	322
	Oct.	331	1.65	545
	Nov.	408	1.46	595
	Dec.	347	1.40	485
	TOTAL	12,885	.66	8,531
1949	Jan.	337	1.39	469
	Feb.	361	1.25	451
	Mar.	706	1.18	834
	Apr.	1,307	.78	1,020
	May	3,098	.43	1,332
	June	4,419	.41	1,812
	July	2,137	.52	1,111
	Aug.	576	1.00	576
	Sept.	313	1.51	473
	Oct.	509	1.48	753
	Nov.	473	1.31	619
	Dec.	368	1.37	504
	TOTAL	14,604	.68	9,954
1950	Jan.	350	1.41	493
	Feb.	399	1.23	490
	Mar.	650	1.11	721
	Apr.	1,217	.74	900
	May	1,971	.49	966
	June	2,979	.37	1,102
	July	1,377	.67	923
	Aug.	422	1.02	430
	Sept.	330	1.47	485
	Oct.	342	1.47	502
	Nov.	350	1.55	542
	Dec.	415	1.31	544
	TOTAL	10,802	.75	8,098
1951	Jan.	315	1.43	451
	Feb.	361	1.25	451
	Mar.	418	1.19	497
	Apr.	531	1.00	531
	May	1,645	.57	938
	June	2,886	.41	1,184
	July	1,357	.48	651
	Aug.	787	1.11	874
	Sept.	411	1.32	542
	Oct.	412	1.47	606
	Nov.	445	1.41	628
	Dec.	333	1.44	480
	TOTAL	9,901	.79	7,833
1952	Jan.	476	1.23	586
	Feb.	379	1.26	478
	Mar.	440	1.31	576
	Apr.	2,267	.74	1,677
	May	5,081	.41	2,083
	June	5,192	.36	1,869
	July	1,573	.55	865
	Aug.	821	1.06	870
	Sept.	542	1.31	710
	Oct.	368	1.43	527
	Nov.	386	1.55	599
	Dec.	378	1.47	556
	TOTAL	17,903	.64	11,396
1953	Jan.	393	1.36	534
	Feb.	365	1.30	475
	Mar.	458	1.22	558
	Apr.	529	1.07	566
	May	1,047	.69	723
	June	2,992	.38	1,137
	July	950	.64	608
	Aug	661	1.19	787
	Sept.	258	1.59	410
	Oct.	321	1.77	568
	Nov.	414	1.50	621
	Dec.	341	1.46	498
	TOTAL	8,729	.86	7,485
1954	Jan.	319	1.46	466
	Feb.	342	1.30	444
	Mar.	393	1.24	487
	Apr.	546	1.00	546
	May	1,277	.56	715
	June	792	.63	499
	July	647	.87	563
	Aug.	321	1.19	382
	Sept.	389	1.66	645
	Oct.	512	1.43	733
	Nov.	349	1.39	485
	Dec.	278	1.51	421
	TOTAL	6,165	1.04	6,386
1955	Jan.	244	1.58	386
	Feb.	243	1.39	338
	Mar.	580	1.29	748
	Apr.	617	1.05	649
	May	1,570	.56	879
	June	1,586	.49	777
	July	571	.70	399
	Aug.	510	1.40	713
	Sept.	230	1.60	368
	Oct.	214	1.70	363
	Nov.	275	1.67	458
	Dec.	326	1.44	470
	TOTAL	6,966	.94	6,548
1956	Jan.	373	1.28	477
	Feb.	280	1.39	390
	Mar.	511	1.16	592
	Apr.	898	.75	673
	May	2,190	.48	1,051
	June	2,594	.39	1,012
	July	557	.75	418
	Aug.	356	1.33	473
	Sept.	166	1.48	246
	Oct.	186	1.74	324
	Nov.	300	1.58	474
	Dec.	247	1.55	383
	TOTAL	8,658	.75	6,513
1957	Jan.	284	1.46	415
	Feb.	323	1.34	433
	Mar.	498	1.23	613
	Apr.	828	.90	745
	May	2,569	.56	1,439
	June	5,645	.39	2,201
	July	4,015	.43	1,727
	Aug.	1,604	.78	1,251
	Sept.	822	1.03	847
	Oct.	748	1.54	1,150
	Nov.	848	1.39	1,179
	Dec.	516	1.25	646
	TOTAL	18,700	.68	12,646
1958	Jan.	397	1.27	504
	Feb.	536	1.18	632
	Mar.	696	1.10	766
	Apr.	1,574	.64	1,007
	May	3,992	.46	1,836
	June	3,678	.40	1,471
	July	628	.74	465
	Aug.	286	1.43	409
	Sept.	319	1.69	540
	Oct.	310	1.63	505
	Nov.	357	1.65	589
	Dec.	366	1.52	556
	TOTAL	13,139	.71	9,280
1959	Jan.	315	1.48	466
	Feb.	315	1.36	428
	Mar.	344	1.37	471
	Apr.	420	1.16	487
	May	1,025	.70	718
	June	1,836	.48	881
	July	782	.63	493
	Aug.	425	1.43	608
	Sept.	246	1.68	413
	Oct.	502	1.41	708
	Nov.	499	1.21	604
	Dec.	352	1.39	489
	TOTAL	7,061	.96	6,766
1960	Jan.	305	1.54	470
	Feb.	318	1.34	426
	Mar.	745	1.18	879
	Apr.	1,610	.62	998
	May	1,564	.51	798
	June	2,239	.43	963
	July	647	.69	446
	Aug.	208	1.38	287
	Sept.	193	1.90	367
	Oct.	341	1.67	569
	Nov.	345	1.47	507
	Dec.	275	1.39	382
	TOTAL	8,790	.81	7,092
1961	Jan.	266	1.48	394
	Feb.	331	1.34	444
	Mar.	362	1.34	485
	Apr.	567	1.02	578
	May	1,153	.59	680
	June	1,588	.45	715
	July	369	.89	328
	Aug.	336	1.65	554
	Sept.	710	1.61	1,143
	Oct.	725	1.01	732
	Nov.	527	1.04	548
	Dec.	380	1.22	464
	TOTAL	7,314	.97	7,065
1962	Jan.	349	1.24	433
	Feb.	791	1.03	815
	Mar.	598	1.13	676
	Apr.	2,391	.71	1,698
	May	3,633	.44	1,599
	June	2,876	.45	1,294
	July	1,717	.57	979
	Aug.	469	1.02	478
	Sept.	315	1.61	507
	Oct.	539	1.52	819
	Nov.	428	1.28	548
	Dec.	333	1.42	473
	TOTAL	14,439	.71	10,319
1963	Jan.	169	1.69	286
	Feb.	369	1.35	498
	Mar.	188	1.35	254
	Apr.	60	1.44	86
	May	62	1.30	81
	June	140	1.13	158
	July	90	.95	86
	Aug.	62	.96	60
	Sept.	60	.90	54
	Oct.	61	.88	54
	Nov.	60	.95	57
	Dec.	63	1.34	84
	TOTAL	1,384	1.27	1,758
1964	Jan.	71	1.33	94
	Feb.	231	1.33	307
	Mar.	388	1.29	500
	Apr.	771	1.24	956
	May	319	1.22	389
	June	60	1.24	74
	July	60	1.25	75
	Aug.	174	1.24	216
	Sept.	156	.69	108
	Oct.	268	.63	169
	Nov.	347	.84	292
	Dec.	398	1.00	398
	TOTAL	3,243	1.10	3,578
1965	Jan.	558	0.98	547
	Feb.	515	1.02	525
	Mar.	556	1.01	562
	Apr.	1,222	1.03	1,259
	May	2,284	.95	2,170
	June	2,323	.88	2,044
	July	727	.48	349
	Aug.	871	.41	357
	Sept.	750	.40	300
	Oct.	659	.43	283
	Nov.	589	.47	277
	Dec.	531	.63	335
	TOTAL	11,585	.78	9,008

To obtain mg/L multiply T/AF by 735.29

Table 15

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Lees Ferry, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	451	0.73	329
	Feb.	483	.76	367
	Mar.	622	.76	473
	Apr.	825	.77	635
	May	978	.72	704
	June	754	.71	535
	July	658	.66	434
	Aug.	682	.65	443
	Sept.	622	.66	411
	Oct.	551	.65	358
	Nov.	584	.66	385
	Dec.	529	.69	365
	TOTAL	7,739	.70	5,439
1967	Jan.	614	0.76	467
	Feb.	534	.79	422
	Mar.	690	.89	614
	Apr.	788	1.03	812
	May	879	.93	817
	June	698	.99	691
	July	641	.81	519
	Aug.	693	.71	492
	Sept.	596	.75	447
	Oct.	415	.73	303
	Nov.	460	.76	350
	Dec.	552	.82	453
	TOTAL	7,560	.84	6,387
1968	Jan.	633	0.93	589
	Feb.	464	.97	450
	Mar.	858	1.02	875
	Apr.	968	1.02	987
	May	943	1.05	990
	June	894	1.00	894
	July	827	.81	670
	Aug.	685	.70	480
	Sept.	635	.70	444
	Oct.	620	.69	428
	Nov.	616	.67	413
	Dec.	639	.79	505
	TOTAL	8,782	.88	7,725
1969	Jan.	570	0.92	524
	Feb.	461	.94	434
	Mar.	708	.99	698
	Apr.	871	1.06	920
	May	763	.98	744
	June	875	.91	798
	July	956	.88	837
	Aug.	930	.76	710
	Sept	794	.72	570
	Oct.	630	.77	487
	Nov.	706	.80	562
	Dec.	814	.77	623
	TOTAL	9,078	.87	7,907
1970	Jan.	706	0.84	593
	Feb.	445	.90	401
	Mar.	486	.96	466
	Apr.	942	.94	888
	May	900	.92	824
	June	800	.86	690
	July	769	.86	658
	Aug.	773	.79	608
	Sept.	701	.77	542
	Oct.	498	.76	380
	Nov.	459	.80	365
	Dec.	670	.81	545
	TOTAL	8,149	.85	6,960
1971	Jan.	492	0.75	369
	Feb.	416	.85	354
	Mar.	640	.91	581
	Apr.	1,011	.90	908
	May	926	.87	803
	June	894	.79	705
	July	943	.77	724
	Aug.	876	.75	660
	Sept.	776	.68	525
	Oct.	584	.71	415
	Nov.	764	.71	539
	Dec.	937	.71	662
	TOTAL	9,259	.78	7,245
1972	Jan.	806	0.74	594
	Feb.	444	.74	331
	Mar.	378	.85	321
	Apr.	782	.88	686
	May	902	.82	741
	June	863	.78	676
	July	915	.75	684
	Aug.	1,005	.75	755
	Sept.	931	.71	663
	Oct.	631	.73	459
	Nov.	671	.74	499
	Dec.	1,017	.79	799
	TOTAL	9,345	.77	7,208
1973	Jan.	1,207	0.73	887
	Feb.	764	.75	572
	Mar.	1,095	.83	912
	Apr.	1,678	.86	1,443
	May	648	.86	558
	June	751	.83	624
	July	656	.84	552
	Aug.	566	.78	444
	Sept.	424	.79	334
	Oct.	510	.76	387
	Nov.	412	.76	314
	Dec.	333	.69	230
	TOTAL	9,044	.80	7,257
1974	Jan.	846	0.69	585
	Feb.	299	.68	203
	Mar.	389	.80	313
	Apr.	495	.84	418
	May	804	.81	653
	June	914	.77	702
	July	1,226	.75	921
	Aug.	1,213	.74	897
	Sept.	826	.72	597
	Oct.	602	.71	425
	Nov.	710	.70	495
	Dec.	564	.68	381
	TOTAL	8,888	.74	6,590
1975	Jan.	768	0.70	539
	Feb.	556	.73	406
	Mar.	508	.79	402
	Apr.	459	.81	373
	May	892	.83	740
	June	987	.78	771
	July	1,221	.76	934
	Aug.	1,022	.73	751
	Sept.	966	.74	717
	Oct.	637	.70	449
	Nov.	425	.73	311
	Dec.	520	.71	369
	TOTAL	8,961	.75	6,762
1976	Jan.	692	0.70	485
	Feb.	742	.78	581
	Mar.	676	.84	570
	Apr.	660	.84	557
	May	1,046	.81	843
	June	756	.77	585
	July	766	.75	572
	Aug.	720	.73	524
	Sept.	842	.72	610
	Oct.	792	.70	556
	Nov.	898	.73	655
	Dec.	811	.71	577
	TOTAL	9,401	.76	7,115
1977	Jan.	994	0.74	731
	Feb.	471	.79	372
	Mar.	458	.83	380
	Apr.	164	.82	135
	May	205	.84	172
	June	466	.81	376
	July	847	.80	675
	Aug.	1,178	.81	956
	Sept.	977	.79	774
	Oct.	379	.77	290
	Nov.	390	.77	299
	Dec.	823	.75	617
	TOTAL	7,352	.79	5,777
1978	Jan.	947	0.80	758
	Feb.	601	.80	482
	Mar.	579	.83	482
	Apr.	492	.88	431
	May	647	.90	582
	June	758	.89	675
	July	702	.88	615
	Aug.	1,065	.88	936
	Sept.	968	.87	844
	Oct.	681	.84	575
	Nov.	671	.81	546
	Dec.	889	.77	687
	TOTAL	9,001	.85	7,612
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
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	TOTAL			
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	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 15

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Lees Ferry, Arizona

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	17,857	.70	12,481	22 027	514	11 323
1942	14,793	.63	9,381	18 247	466	8510
1943	11,413	.73	8,375	14 078	540	7598
1944	13,019	.65	8,525	16 059	482	7734
1945	11,769	.72	8,501	14 517	531	7712
1946	8,751	.84	7,346	10 794	617	6664
1947	14,046	.68	9,513	17 326	498	8630
1948	12,885	.66	8,531	15 894	487	7739
1949	14,604	.68	9,954	18 014	501	9030
1950	10,802	.75	8,098	13 324	551	7347
1951	9,901	.79	7,833	12 213	582	7106
1952	17,903	.64	11,396	22 083	468	10 338
1953	8,729	.86	7,485	10 767	631	6790
1954	6,165	1.04	6,386	7604	762	5793
1955	6,966	.94	6,548	8593	691	5940
1956	8,658	.75	6,513	10 680	553	5909
1957	18,700	.68	12,646	23 066	497	11 472
1958	13,139	.71	9,280	16 207	519	8419
1959	7,061	.96	6,766	8710	705	6138
1960	8,790	.81	7,092	10 842	593	6434
1961	7,314	.97	7,065	9022	710	6409
1962	14,439	.71	10,319	17 811	526	9361
1963	1,384	1.27	1,758	1707	934	1595
1964	3,243	1.10	3,578	4000	812	3246
1965	11,585	.78	9,008	14 290	572	8172
1966	7,739	.70	5,439	9546	517	4934
1967	7,560	.84	6,387	9325	621	5794
1968	8,803	.88	7,738	10 859	646	7020
1969	9,078	.87	7,907	11 198	641	7173
1970	8,139	.85	6,954	10 039	628	6309
1971	9,259	.78	7,245	11 421	576	6573
1972	9,345	.77	7,208	11 527	567	6539
1973	9,044	.80	7,257	11 156	596	6584
1974	8,888	.74	6,590	10 963	545	5978
1975	8,961	.75	6,762	11 053	555	6134
1976	9,401	.76	7,115	11 596	557	6455
1977	7,352	.79	5,777	9065	578	5241
1978	9,001	.85	7,612	11 103	622	6905
Total	386,486		294,369	476 726		267 048
Average	10,171	.76	7,747	12 545	560	7028

Table 16

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Grand Canyon, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	434	1.42	616
	Feb.	515	1.31	675
	Mar.	838	1.17	980
	Apr.	1,209	.87	1,052
	May	4,976	.50	2,488
	June	4,100	.45	1,845
	July	1,753	.55	964
	Aug.	861	1.29	1,111
	Sept.	659	1.43	942
	Oct.	1,904	1.14	2,171
	Nov.	953	.98	934
	Dec.	594	1.22	725
	TOTAL	18,796	.77	14,503
1942	Jan.	430	1.40	602
	Feb.	435	1.33	579
	Mar.	653	1.25	816
	Apr.	2,763	.60	1,658
	May	3,163	.49	1,550
	June	4,241	.32	1,357
	July	1,345	.59	794
	Aug.	486	1.15	559
	Sept.	294	1.67	491
	Oct.	356	1.67	575
	Nov.	386	1.67	645
	Dec.	373	1.50	560
	TOTAL	14,925	.68	10,186
1943	Jan.	347	1.49	517
	Feb.	351	1.48	519
	Mar.	580	1.26	731
	Apr.	1,417	.83	1,176
	May	2,161	.57	1,232
	June	2,676	.49	1,311
	July	1,459	.60	875
	Aug.	834	1.17	976
	Sept.	494	1.40	692
	Oct.	408	1.69	690
	Nov.	477	1.47	701
	Dec.	420	1.46	613
	TOTAL	11,624	.86	10,033
1944	Jan.	298	1.61	480
	Feb.	363	1.23	446
	Mar.	551	1.41	777
	Apr.	1,099	.95	1,044
	May	3,206	.55	1,763
	June	4,144	.41	1,699
	July	1,854	.52	964
	Aug.	456	1.14	520
	Sept	251	1.61	404
	Oct.	362	1.78	644
	Nov.	401	1.64	658
	Dec.	345	1.59	549
	TOTAL	13,330	.75	9,948
1945	Jan.	356	1.55	552
	Feb.	381	1.48	564
	Mar.	472	1.41	666
	Apr.	804	1.01	812
	May	2,803	.52	1,458
	June	2,754	.48	1,322
	July	1,732	.56	970
	Aug.	1,071	1.05	1,125
	Sept.	394	1.38	544
	Oct.	524	1.63	854
	Nov.	465	1.51	702
	Dec.	359	1.47	528
	TOTAL	12,115	.83	10,097
1946	Jan.	384	1.41	541
	Feb.	333	1.38	460
	Mar.	514	1.29	663
	Apr.	1,016	.94	955
	May	1,775	.53	941
	June	1,995	.54	1,077
	July	784	.82	643
	Aug.	567	1.50	850
	Sept.	372	1.71	636
	Oct.	419	1.62	679
	Nov.	492	1.36	684
	Dec.	468	1.31	613
	TOTAL	9,119	.96	8,742
1947	Jan.	303	1.50	455
	Feb.	371	1.38	512
	Mar.	653	1.18	771
	Apr.	785	.92	722
	May	3,088	.48	1,482
	June	3,233	.48	1,552
	July	1,953	.50	976
	Aug.	1,329	1.17	1,555
	Sept.	640	1.26	806
	Oct.	894	1.28	1,144
	Nov.	608	1.14	693
	Dec.	490	1.28	627
	TOTAL	14,347	.79	11,295
1948	Jan.	427	1.27	542
	Feb.	458	1.28	586
	Mar.	669	1.25	836
	Apr.	1,732	.74	1,282
	May	3,392	.45	1,526
	June	3,358	.40	1,343
	July	1,009	.73	737
	Aug.	587	1.33	781
	Sept.	242	1.65	399
	Oct.	336	1.82	612
	Nov.	434	1.61	699
	Dec.	365	1.25	456
	TOTAL	13,009	.75	9,799
1949	Jan.	363	1.51	548
	Feb.	374	1.36	509
	Mar.	796	1.20	955
	Apr.	1,337	.92	1,230
	May	2,959	.48	1,420
	June	4,303	.48	2,065
	July	2,128	.58	1,234
	Aug.	632	1.12	708
	Sept.	340	1.65	561
	Oct.	521	1.58	823
	Nov.	488	1.36	664
	Dec.	381	1.41	537
	TOTAL	14,622	.77	11,254
1950	Jan.	358	1.56	558
	Feb.	414	1.35	559
	Mar.	670	1.21	811
	Apr.	1,192	.88	1,049
	May	1,941	.59	1,145
	June	2,925	.47	1,375
	July	1,401	.76	1,065
	Aug.	444	1.13	502
	Sept.	343	1.56	535
	Oct.	359	1.67	600
	Nov.	355	1.75	621
	Dec.	434	1.48	642
	TOTAL	10,836	.87	9,462
1951	Jan.	326	1.59	518
	Feb.	366	1.45	531
	Mar.	429	1.35	579
	Apr.	535	1.17	626
	May	1,552	.67	1,040
	June	2,800	.49	1,372
	July	1,397	.57	796
	Aug.	833	1.18	983
	Sept.	452	1.46	660
	Oct.	425	1.67	710
	Nov.	466	1.61	750
	Dec.	353	1.61	568
	TOTAL	9,934	.92	9,133
1952	Jan.	593	1.28	759
	Feb.	396	1.42	562
	Mar.	435	1.46	635
	Apr.	2,209	.84	1,855
	May	5,062	.52	2,632
	June	5,203	.46	2,393
	July	1,590	.65	1,033
	Aug.	833	1.18	983
	Sept.	596	1.43	852
	Oct.	393	1.52	597
	Nov.	396	1.64	649
	Dec.	400	1.58	632
	TOTAL	18,106	.75	13,582
1953	Jan.	408	1.46	596
	Feb.	378	1.42	537
	Mar.	478	1.35	645
	Apr.	533	1.21	645
	May	989	.87	860
	June	2,932	.47	1,378
	July	980	.76	745
	Aug.	703	1.30	914
	Sept.	290	1.73	502
	Oct.	325	1.88	611
	Nov.	428	1.63	698
	Dec.	360	1.56	562
	TOTAL	8,804	.99	8,693
1954	Jan.	333	1.58	526
	Feb.	353	1.40	494
	Mar.	424	1.34	568
	Apr.	566	1.11	628
	May	1,211	.68	823
	June	798	.68	543
	July	669	.95	636
	Aug.	349	1.32	461
	Sept.	415	1.67	693
	Oct.	526	1.52	800
	Nov.	360	1.47	529
	Dec.	296	1.60	474
	TOTAL	6,300	1.14	7,175
1955	Jan.	261	1.70	444
	Feb.	269	1.50	404
	Mar.	586	1.35	791
	Apr.	621	1.15	714
	May	1,515	.59	894
	June	1,596	.55	878
	July	618	.77	476
	Aug.	668	1.39	929
	Sept.	265	1.63	432
	Oct.	236	1.84	434
	Nov.	298	1.88	560
	Dec.	354	1.52	538
	TOTAL	7,287	1.03	7,494
1956	Jan.	398	1.42	565
	Feb.	310	1.30	403
	Mar.	511	1.21	618
	Apr.	878	.82	720
	May	2,125	.49	1,041
	June	2,584	.45	1,163
	July	598	.82	490
	Aug.	383	1.31	502
	Sept.	185	1.58	292
	Oct.	202	1.86	376
	Nov.	325	1.69	549
	Dec.	274	1.66	455
	TOTAL	8,773	.82	7,174
1957	Jan.	343	1.45	497
	Feb.	370	1.37	507
	Mar.	541	1.26	682
	Apr.	812	.93	755
	May	2,501	.57	1,426
	June	5,541	.40	2,216
	July	4,033	.40	1,613
	Aug.	1,672	.88	1,471
	Sept.	884	1.13	999
	Oct.	784	1.46	1,144
	Nov.	892	1.42	1,266
	Dec.	537	1.28	687
	TOTAL	18,910	.79	13,263
1958	Jan.	415	1.31	544
	Feb.	536	1.24	665
	Mar.	749	1.13	846
	Apr.	1,580	.77	1,220
	May	3,900	.45	1,755
	June	3,763	.41	1,542
	July	683	.91	622
	Aug.	337	1.31	440
	Sept.	379	1.32	500
	Oct.	346	1.53	530
	Nov.	385	1.53	590
	Dec.	388	1.55	600
	TOTAL	13,461	.73	9,854
1959	Jan.	334	1.56	520
	Feb.	326	1.53	500
	Mar.	365	1.53	560
	Apr.	423	1.27	537
	May	1,011	.78	789
	June	1,804	.53	956
	July	795	.69	549
	Aug.	488	1.50	731
	Sept.	271	1.82	493
	Oct.	528	1.47	777
	Nov.	569	1.25	712
	Dec.	394	1.33	524
	TOTAL	7,308	1.05	7,648
1960	Jan.	348	1.41	490
	Feb.	353	1.40	495
	Mar.	820	1.15	942
	Apr.	1,650	.63	1,036
	May	1,580	.55	870
	June	2,212	.46	1,011
	July	678	.73	497
	Aug.	233	1.42	331
	Sept.	218	1.92	418
	Oct.	382	1.81	692
	Nov.	380	1.59	603
	Dec.	300	1.49	448
	TOTAL	9,154	.86	7,833
1961	Jan.	291	1.58	460
	Feb.	353	1.39	490
	Mar.	379	1.40	530
	Apr.	587	1.04	608
	May	1,147	.66	760
	June	1,692	.47	788
	July	417	.98	409
	Aug.	374	1.76	658
	Sept.	748	1.82	1,360
	Oct.	772	1.23	949
	Nov.	570	1.23	701
	Dec.	409	1.32	539
	TOTAL	7,739	1.07	8,252
1962	Jan.	369	1.35	498
	Feb.	832	1.02	847
	Mar.	610	1.19	726
	Apr.	2,467	.70	1,730
	May	3,716	.45	1,654
	June	2,850	.46	1,318
	July	1,821	.57	1,031
	Aug.	512	1.03	526
	Sept.	318	1.58	502
	Oct.	557	1.57	877
	Nov.	443	1.34	592
	Dec.	344	1.50	516
	TOTAL	14,839	.73	10,817
1963	Jan.	182	1.84	334
	Feb.	374	1.37	496
	Mar.	203	1.37	279
	Apr.	72	1.56	112
	May	79	1.49	118
	June	148	1.09	162
	July	108	1.14	123
	Aug.	112	1.29	145
	Sept.	122	1.43	175
	Oct.	77	1.39	107
	Nov.	76	1.39	106
	Dec.	77	1.74	134
	TOTAL	1,630	1.41	2,291
1964	Jan.	79	1.75	138
	Feb.	245	1.52	373
	Mar.	382	1.47	562
	Apr.	796	1.33	1,058
	May	356	1.36	485
	June	77	1.65	127
	July	84	1.75	147
	Aug.	287	1.31	376
	Sept.	191	1.05	200
	Oct.	298	.77	230
	Nov.	371	.87	323
	Dec.	416	1.04	431
	TOTAL	3,582	1.24	4,450
1965	Jan.	608	1.06	644
	Feb.	539	1.09	588
	Mar.	568	1.09	619
	Apr.	1,251	1.04	1,301
	May	2,282	1.03	2,350
	June	2,282	.89	2,038
	July	724	.59	427
	Aug.	879	.86	755
	Sept.	767	.51	391
	Oct.	675	.51	344
	Nov.	612	.53	322
	Dec.	586	.69	406
	TOTAL	11,773	.86	10,185

To obtain mg/L multiply T/AF by 735.29

Table 16

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Grand Canyon, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	529	0.79	418
	Feb.	524	.87	455
	Mar.	718	.81	582
	Apr.	865	.81	700
	May	1,011	.79	799
	June	789	.77	609
	July	698	.75	523
	Aug.	694	.68	471
	Sept.	623	.75	468
	Oct.	567	.74	419
	Nov.	589	.71	418
	Dec.	620	.76	471
	TOTAL	8,227	.77	6,333
1967	Jan.	648	0.84	544
	Feb.	564	.86	485
	Mar.	704	.97	683
	Apr.	801	1.09	873
	May	861	1.00	861
	June	711	1.02	725
	July	693	.92	638
	Aug.	786	.82	644
	Sept.	713	.90	642
	Oct.	459	.86	395
	Nov.	495	.83	411
	Dec.	597	.90	537
	TOTAL	8,032	.93	7,438
1968	Jan.	658	1.01	664
	Feb.	534	1.04	555
	Mar.	900	1.03	927
	Apr.	1,078	1.02	1,100
	May	976	1.11	1,083
	June	925	1.03	953
	July	865	.93	804
	Aug.	775	.81	628
	Sept.	675	.80	540
	Oct.	647	.79	511
	Nov.	675	.80	540
	Dec.	665	.77	512
	TOTAL	9,373	.94	8,817
1969	Jan.	628	0.99	621
	Feb.	509	1.10	560
	Mar.	727	1.05	763
	Apr.	927	1.05	973
	May	799	1.03	822
	June	870	.98	853
	July	994	.95	944
	Aug.	1,002	.83	832
	Sept	842	.82	691
	Oct.	662	.80	527
	Nov.	751	.80	601
	Dec.	832	.81	664
	TOTAL	9,543	.93	8,861
1970	Jan.	768	0.88	676
	Feb.	494	.96	474
	Mar.	510	1.00	510
	Apr.	969	.94	911
	May	946	.96	908
	June	821	.90	739
	July	815	.88	717
	Aug.	798	.87	691
	Sept.	756	.85	641
	Oct.	542	.84	455
	Nov.	483	.82	396
	Dec.	700	.79	553
	TOTAL	8,602	.89	7,671
1971	Jan.	544	0.77	418
	Feb.	430	.85	364
	Mar.	645	1.08	693
	Apr.	1,000	1.07	1,075
	May	933	.90	810
	June	896	.80	721
	July	933	.81	753
	Aug.	932	.87	809
	Sept.	801	.81	652
	Oct.	675	.85	573
	Nov.	786	.85	665
	Dec.	994	.77	762
	TOTAL	9,569	.87	8,295
1972	Jan.	840	0.76	640
	Feb.	471	.83	393
	Mar.	364	.94	343
	Apr.	793	.92	731
	May	912	.84	765
	June	890	.81	724
	July	872	.80	698
	Aug.	996	.80	798
	Sept.	945	.81	765
	Oct.	917	1.00	898
	Nov.	730	.82	582
	Dec.	1,070	.78	839
	TOTAL	9,800	.84	8,176
1973	Jan.	1,231	0.73	903
	Feb.	839	.81	683
	Mar.	1,204	.86	1,031
	Apr.	1,916	.82	1,566
	May	846	.81	689
	June	771	.85	655
	July	671	.85	567
	Aug.	586	.85	499
	Sept.	449	.87	390
	Oct.	516	.86	443
	Nov.	445	.85	378
	Dec.	354	.97	343
	TOTAL	9,828	.83	8,147
1974	Jan.	877	0.70	611
	Feb.	326	.83	271
	Mar.	434	.86	372
	Apr.	507	.86	438
	May	816	.87	714
	June	932	.83	775
	July	1,235	.78	961
	Aug.	1,229	.74	914
	Sept.	828	.75	623
	Oct.	609	.78	477
	Nov.	740	.78	579
	Dec.	582	.76	442
	TOTAL	9,115	.79	7,177
1975	Jan.	803	0.74	598
	Feb.	565	.79	445
	Mar.	548	.80	437
	Apr.	504	.92	464
	May	914	.88	805
	June	995	.83	830
	July	1,246	.89	1,108
	Aug.	1,029	.80	821
	Sept.	992	.78	772
	Oct.	649	.77	500
	Nov.	441	.86	381
	Dec.	524	.81	427
	TOTAL	9,210	.82	7,588
1976	Jan.	718	0.70	506
	Feb.	767	.75	573
	Mar.	712	.82	584
	Apr.	694	.85	590
	May	1,079	.87	944
	June	760	.85	643
	July	807	.80	648
	Aug.	722	.82	595
	Sept.	862	.80	692
	Oct.	819	.68	561
	Nov.	903	.68	614
	Dec.	829	.67	557
	TOTAL	9,672	.78	7,507
1977	Jan.	1,018	.75	765
	Feb.	487	.82	399
	Mar.	492	1.00	490
	Apr.	189	1.14	216
	May	220	1.00	221
	June	472	.91	431
	July	888	.83	740
	Aug.	1,245	.85	1,054
	Sept.	976	.86	839
	Oct.	419	.89	373
	Nov.	387	.87	336
	Dec.	804	.85	687
	TOTAL	7,597	.86	6,550
1978	Jan.	930	0.84	784
	Feb.	592	.85	503
	Mar.	694	.84	582
	Apr.	481	.84	406
	May	580	.89	517
	June	766	.92	706
	July	697	.92	643
	Aug	1,092	.93	1,012
	Sept.	1,015	.93	941
	Oct.	706	.93	657
	Nov.	746	.93	695
	Dec.	1,054	.93	982
	TOTAL	9,353	.90	8,427
	Jan.			
	Feb.			
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	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 16

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Grand Canyon, Arizona

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	18,796	.77	14,503	23 185	567	13 157
1942	14,925	.68	10,186	18 410	502	9241
1943	11,624	.86	10,033	14 338	635	9102
1944	13,330	.75	9,948	16 443	549	9025
1945	12,115	.83	10,097	14 944	613	9160
1946	9,119	.96	8,742	11 248	705	7931
1947	14,347	.79	11,295	17 697	579	10 247
1948	13,009	.75	9,799	16 047	554	8890
1949	14,622	.77	11,254	18 036	566	10 210
1950	10,836	.87	9,462	13 366	642	8584
1951	9,934	.92	9,133	12 254	676	8285
1952	18,106	.75	13,582	22 334	552	12 322
1953	8,804	.99	8,693	10 860	726	7886
1954	6,300	1.14	7,175	7771	838	6509
1955	7,287	1.03	7,494	8989	756	6799
1956	8,773	.82	7,174	10 821	601	6508
1957	18,910	.70	13,263	23 325	516	12 032
1958	13,461	.73	9,854	16 604	538	8940
1959	7,308	1.05	7,648	9014	770	6938
1960	9,154	.86	7,833	11 291	629	7106
1961	7,739	1.07	8,252	9546	784	7486
1962	14,839	.73	10,817	18 304	536	9813
1963	1,630	1.41	2,291	2011	1033	2078
1964	3,582	1.24	4,450	4418	914	4037
1965	11,773	.86	10,185	14 522	636	9239
1966	8,227	.77	6,333	10 148	566	5745
1967	8,032	.93	7,438	9907	681	6748
1968	9,373	.94	8,817	11 562	692	7999
1969	9,543	.93	8,861	11 771	683	8039
1970	8,602	.89	7,671	10 611	656	6959
1971	9,569	.87	8,295	11 803	638	7525
1972	9,800	.84	8,176	12 088	614	7417
1973	9,828	.83	8,147	12 123	610	7391
1974	9,115	.79	7,177	11 243	579	6511
1975	9,211	.82	7,592	11 362	606	6886
1976	9,672	.80	7,706	11 930	586	6989
1977	7,597	.86	6,550	9371	634	5942
1978	9,353	.90	8,427	11 537	662	7645
Total	398,245		334,353	491 234		303 321
Average	10,480	.84	8,799	12 927	617	7982

Table 17

Colorado River Basin

Historical Flow and Quality of Water Data

Virgin River at Littlefield, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	15	2.39	35
	Feb.	31	1.97	61
	Mar.	62	.82	51
	Apr.	62	.84	52
	May	131	.46	60
	June	19	1.75	34
	July	22	2.45	54
	Aug.	20	3.02	62
	Sept.	6	3.29	18
	Oct.	23	3.22	74
	Nov.	19	2.26	43
	Dec.	17	2.28	39
	TOTAL	427	1.37	583
1942	Jan.	20	2.25	44
	Feb.	16	2.28	35
	Mar.	20	1.88	38
	Apr.	50	1.01	51
	May	28	1.56	44
	June	5	3.15	16
	July	4	3.31	14
	Aug.	9	3.29	29
	Sept.	4	3.31	13
	Oct.	9	3.41	31
	Nov.	10	2.78	29
	Dec.	11	2.72	31
	TOTAL	186	2.01	375
1943	Jan.	18	2.32	42
	Feb.	21	2.14	45
	Mar.	36	1.28	47
	Apr.	34	1.36	46
	May	11	2.27	26
	June	4	3.35	13
	July	4	3.31	14
	Aug.	13	3.35	42
	Sept.	6	3.46	20
	Oct.	9	3.40	30
	Nov.	10	2.79	28
	Dec.	13	2.51	32
	TOTAL	179	2.15	385
1944	Jan.	13	2.47	33
	Feb.	15	2.31	35
	Mar.	26	1.64	42
	Apr.	25	1.66	42
	May	49	1.05	51
	June	11	2.32	25
	July	4	3.32	13
	Aug.	4	3.31	13
	Sept	4	3.31	14
	Oct.	5	3.30	16
	Nov.	13	2.48	32
	Dec.	12	2.65	31
	TOTAL	181	1.92	347
1945	Jan.	11	2.68	30
	Feb.	17	2.15	38
	Mar.	20	1.87	38
	Apr.	20	1.83	36
	May	25	1.55	39
	June	5	3.22	15
	July	5	3.31	15
	Aug.	26	3.06	79
	Sept.	8	3.19	25
	Oct.	20	3.14	62
	Nov.	10	2.75	29
	Dec.	14	2.47	35
	TOTAL	181	2.43	441
1946	Jan.	13	2.48	32
	Feb.	10	2.74	27
	Mar.	10	2.63	28
	Apr.	12	2.49	29
	May	5	3.31	15
	June	4	3.32	13
	July	6	3.40	21
	Aug.	13	3.17	42
	Sept.	4	3.31	13
	Oct.	37	2.18	81
	Nov.	33	1.85	61
	Dec.	22	2.12	47
	TOTAL	169	2.42	409
1947	Jan.	15	2.34	35
	Feb.	12	2.46	30
	Mar.	13	2.32	31
	Apr.	16	2.17	34
	May	17	1.98	33
	June	4	3.31	14
	July	5	3.30	16
	Aug.	14	2.97	41
	Sept.	4	3.31	14
	Oct.	8	3.34	27
	Nov.	9	2.89	27
	Dec.	14	2.46	34
	TOTAL	131	2.56	336
1948	Jan.	11	2.78	29
	Feb.	12	2.47	30
	Mar.	13	2.42	31
	Apr.	20	1.87	37
	May	10	2.47	25
	June	4	3.32	14
	July	4	3.31	14
	Aug.	5	3.31	18
	Sept.	6	3.39	20
	Oct.	6	3.34	20
	Nov.	10	2.87	27
	Dec.	10	2.85	29
	TOTAL	111	2.65	294
1949	Jan.	13	2.52	32
	Feb.	14	2.42	35
	Mar.	18	2.07	36
	Apr.	30	1.43	44
	May	28	1.53	43
	June	12	2.11	25
	July	4	3.19	14
	Aug.	4	3.20	13
	Sept.	7	3.27	23
	Oct.	9	3.07	26
	Nov.	11	2.68	29
	Dec.	13	2.51	34
	TOTAL	163	2.17	354
1950	Jan.	15	2.20	33
	Feb.	16	2.00	32
	Mar.	14	2.26	31
	Apr.	15	2.05	31
	May	6	2.87	19
	June	4	3.28	13
	July	12	3.38	40
	Aug.	6	3.43	19
	Sept.	6	3.35	20
	Oct.	5	3.40	17
	Nov.	9	3.14	28
	Dec.	10	2.91	30
	TOTAL	118	2.65	313
1951	Jan.	11	2.77	30
	Feb.	8	2.84	22
	Mar.	8	2.83	23
	Apr.	7	3.17	22
	May	10	2.74	27
	June	4	3.37	12
	July	6	3.34	20
	Aug.	16	3.27	55
	Sept.	6	3.20	20
	Oct.	7	3.24	22
	Nov.	9	2.94	26
	Dec.	20	2.42	49
	TOTAL	112	2.93	328
1952	Jan.	21	2.34	49
	Feb.	11	2.52	28
	Mar.	27	1.74	48
	Apr.	80	.76	60
	May	71	.68	49
	June	12	1.75	21
	July	4	3.27	14
	Aug.	5	3.43	18
	Sept.	6	3.34	20
	Oct.	6	3.40	20
	Nov.	10	2.84	29
	Dec.	14	2.53	34
	TOTAL	267	1.46	390
1953	Jan.	14	2.36	32
	Feb.	9	2.70	24
	Mar.	7	2.98	21
	Apr.	6	3.27	20
	May	5	3.27	16
	June	4	3.34	14
	July	8	3.46	28
	Aug.	13	3.04	40
	Sept.	4	3.38	13
	Oct.	7	3.31	24
	Nov.	10	3.07	29
	Dec.	11	2.83	31
	TOTAL	98	3.00	292
1954	Jan.	15	2.49	37
	Feb.	12	2.36	29
	Mar.	17	1.98	33
	Apr.	23	1.64	38
	May	10	2.35	23
	June	5	3.36	18
	July	8	3.42	26
	Aug.	10	3.44	34
	Sept.	9	3.56	32
	Oct.	9	3.48	30
	Nov.	9	3.13	29
	Dec.	13	2.71	36
	TOTAL	140	2.61	365
1955	Jan.	12	2.60	31
	Feb.	12	2.51	30
	Mar.	11	2.53	27
	Apr.	6	3.14	19
	May	5	3.18	16
	June	4	3.39	13
	July	10	3.61	37
	Aug.	40	3.69	149
	Sept.	5	3.26	15
	Oct.	5	3.51	19
	Nov.	10	3.05	31
	Dec.	13	2.60	34
	TOTAL	133	3.16	421
1956	Jan.	15	2.53	38
	Feb.	11	2.59	29
	Mar.	8	2.87	22
	Apr.	6	3.13	18
	May	4	3.23	15
	June	4	3.34	15
	July	8	3.53	27
	Aug.	4	3.35	13
	Sept.	4	3.35	12
	Oct.	4	3.39	14
	Nov.	6	3.50	21
	Dec.	8	3.29	25
	TOTAL	82	3.05	249
1957	Jan.	12	2.77	33
	Feb.	14	2.32	32
	Mar.	10	2.64	26
	Apr.	6	2.99	18
	May	15	2.04	31
	June	9	2.85	25
	July	4	3.31	13
	Aug.	9	3.41	31
	Sept.	4	3.27	12
	Oct.	14	3.02	44
	Nov.	21	2.45	51
	Dec.	15	2.04	31
	TOTAL	133	2.61	347
1958	Jan.	10	2.49	24
	Feb.	19	1.83	35
	Mar.	41	1.43	59
	Apr.	64	1.02	65
	May	69	1.05	73
	June	7	2.29	16
	July	6	3.17	19
	Aug.	5	3.22	18
	Sept.	22	3.13	70
	Oct.	8	3.16	24
	Nov.	11	2.62	28
	Dec.	10	2.67	26
	TOTAL	272	1.68	457
1959	Jan.	10	2.58	27
	Feb.	13	2.30	31
	Mar.	9	2.67	24
	Apr.	4	3.05	13
	May	4	3.07	13
	June	4	3.24	12
	July	4	3.32	13
	Aug.	12	3.35	40
	Sept.	4	3.20	13
	Oct.	5	3.30	15
	Nov.	13	2.90	36
	Dec.	9	2.69	23
	TOTAL	91	2.87	260
1960	Jan.	11	2.48	28
	Feb.	10	2.38	24
	Mar.	10	2.45	24
	Apr.	6	2.91	17
	May	5	3.03	14
	June	3	3.16	10
	July	4	3.18	12
	Aug.	3	3.20	11
	Sept.	6	3.51	20
	Oct.	6	3.05	19
	Nov.	12	2.80	35
	Dec.	8	2.71	22
	TOTAL	84	2.79	236
1961	Jan.	8	2.76	21
	Feb.	7	2.80	20
	Mar.	8	2.84	23
	Apr.	4	3.11	14
	May	4	3.14	12
	June	4	3.14	12
	July	8	3.22	27
	Aug.	17	3.58	60
	Sept.	22	3.36	73
	Oct.	5	3.41	19
	Nov.	8	3.07	23
	Dec.	13	2.69	34
	TOTAL	108	3.14	338
1962	Jan.	10	2.73	28
	Feb.	30	1.65	50
	Mar.	17	2.09	35
	Apr.	33	1.21	40
	May	9	2.24	19
	June	4	3.32	12
	July	4	3.29	13
	Aug.	3	3.46	11
	Sept.	7	3.28	24
	Oct.	7	3.32	21
	Nov.	6	3.18	20
	Dec.	7	2.75	20
	TOTAL	137	2.14	293
1963	Jan.	9	2.54	23
	Feb.	9	2.56	23
	Mar.	6	3.14	19
	Apr.	4	3.43	15
	May	4	3.41	13
	June	3	3.44	11
	July	3	3.48	12
	Aug.	11	3.33	36
	Sept.	14	3.54	48
	Oct.	5	3.32	18
	Nov.	10	3.00	28
	Dec.	7	2.96	20
	TOTAL	85	3.14	266
1964	Jan.	7	2.96	20
	Feb.	7	2.88	21
	Mar.	7	2.99	20
	Apr.	13	2.22	28
	May	11	2.22	24
	June	3	3.50	10
	July	4	3.63	14
	Aug.	14	3.81	53
	Sept.	3	3.63	11
	Oct.	3	3.58	12
	Nov.	6	3.32	22
	Dec.	9	2.98	26
	TOTAL	87	3.01	261
1965	Jan.	9	2.78	25
	Feb.	8	2.75	22
	Mar.	8	2.62	21
	Apr.	30	2.00	60
	May	23	1.52	35
	June	9	2.11	19
	July	3	3.67	11
	Aug.	5	3.40	17
	Sept.	6	3.00	18
	Oct.	6	3.00	18
	Nov.	21	1.90	40
	Dec.	26	1.58	41
	TOTAL	154	2.12	327

To obtain mg/L multiply T/AF by 735.29

Table 17

Colorado River Basin

Historical Flow and Quality of Water Data

Virgin River at Littlefield, Arizona

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	13	2.31	30
	Feb.	11	2.45	27
	Mar.	14	1.50	29
	Apr.	17	1.70	29
	May	6	3.00	18
	June	3	4.00	12
	July	3	4.00	12
	Aug.	3	3.67	11
	Sept.	4	3.50	14
	Oct.	6	3.33	20
	Nov.	9	2.78	25
	Dec.	73	1.99	145
	TOTAL	162	2.30	372
1967	Jan.	13	2.66	34
	Feb.	9	2.67	25
	Mar.	10	2.76	29
	Apr.	11	2.63	30
	May	20	1.88	37
	June	7	2.80	19
	July	4	3.57	14
	Aug.	7	3.32	25
	Sept.	14	3.41	46
	Oct.	7	3.13	21
	Nov.	9	2.71	25
	Dec.	13	2.49	32
	TOTAL	124	2.72	337
1968	Jan.	13	2.60	33
	Feb.	15	2.19	32
	Mar.	12	2.16	27
	Apr.	15	2.03	30
	May	17	1.80	30
	June	5	2.81	13
	July	6	3.52	20
	Aug.	14	3.09	45
	Sept.	3	3.60	12
	Oct.	6	3.41	20
	Nov.	7	3.05	22
	Dec.	11	2.79	30
	TOTAL	124	2.53	314
1969	Jan.	48	1.52	73
	Feb.	34	1.82	62
	Mar.	39	1.49	58
	Apr.	82	.87	71
	May	83	.71	59
	June	14	1.86	26
	July	6	3.17	19
	Aug.	4	3.75	15
	Sept	9	3.56	32
	Oct.	8	3.13	25
	Nov.	12	2.75	33
	Dec.	12	2.42	29
	TOTAL	351	1.43	502
1970	Jan.	13	2.08	27
	Feb.	9	2.44	22
	Mar.	12	2.83	34
	Apr.	4	3.50	14
	May	5	3.20	16
	June	4	3.25	13
	July	6	3.33	20
	Aug.	8	3.12	25
	Sept.	5	3.60	18
	Oct.	5	3.40	17
	Nov.	10	3.20	32
	Dec.	11	2.45	27
	TOTAL	92	2.88	265
1971	Jan.	10	2.45	26
	Feb.	9	2.48	23
	Mar.	9	2.74	24
	Apr.	5	3.17	16
	May	9	2.49	22
	June	4	3.29	12
	July	4	3.32	13
	Aug.	19	3.08	58
	Sept.	5	3.35	17
	Oct.	9	2.94	28
	Nov.	10	2.75	27
	Dec.	21	1.96	41
	TOTAL	114	2.69	307
1972	Jan.	11	2.66	28
	Feb.	9	2.70	24
	Mar.	6	3.08	17
	Apr.	4	3.32	13
	May	4	3.41	12
	June	15	3.21	48
	July	4	3.52	14
	Aug.	11	3.22	36
	Sept.	24	3.45	82
	Oct.	17	2.73	48
	Nov.	12	2.35	29
	Dec.	12	2.62	30
	TOTAL	129	2.96	381
1973	Jan.	11	2.49	28
	Feb.	14	2.36	34
	Mar.	34	1.82	61
	Apr.	67	1.24	83
	May	117	.82	96
	June	23	1.24	29
	July	5	2.96	14
	Aug.	5	3.29	16
	Sept.	3	3.30	11
	Oct.	5	3.32	17
	Nov.	11	2.68	29
	Dec.	11	2.44	27
	TOTAL	306	1.45	445
1974	Jan.	14	2.33	33
	Feb.	9	2.98	27
	Mar.	10	2.51	25
	Apr.	6	2.94	16
	May	4	3.17	13
	June	4	3.22	12
	July	5	3.30	15
	Aug.	5	3.45	17
	Sept.	7	3.31	25
	Oct.	9	3.24	29
	Nov.	11	3.15	36
	Dec.	9	3.00	27
	TOTAL	93	2.96	275
1975	Jan.	9	2.70	23
	Feb.	9	2.62	23
	Mar.	13	2.40	31
	Apr.	7	2.72	20
	May	15	2.17	32
	June	5	3.01	16
	July	9	2.81	24
	Aug.	11	3.26	37
	Sept.	4	3.48	14
	Oct.	6	3.44	20
	Nov.	7	3.15	21
	Dec.	8	2.55	21
	TOTAL	103	2.76	282
1976	Jan.	10	2.61	25
	Feb.	17	2.30	40
	Mar.	7	2.61	18
	Apr.	8	2.47	19
	May	9	2.34	21
	June	4	3.62	14
	July	5	3.64	18
	Aug.	5	3.59	17
	Sept.	7	3.36	22
	Oct.	13	3.03	39
	Nov.	7	3.12	21
	Dec.	7	3.00	21
	TOTAL	99	2.78	275
1977	Jan.	9	2.80	24
	Feb.	7	2.86	19
	Mar.	5	3.22	17
	Apr.	4	3.37	13
	May	6	2.41	15
	June	6	3.21	19
	July	7	3.45	25
	Aug.	7	3.79	26
	Sept.	4	3.52	14
	Oct.	4	3.45	15
	Nov.	6	3.23	20
	Dec.	8	2.95	23
	TOTAL	73	3.15	231
1978	Jan.	15	1.96	30
	Feb.	22	1.88	40
	Mar.	105	1.24	130
	Apr.	50	1.14	57
	May	29	1.05	31
	June	5	2.45	12
	July	4	3.41	14
	Aug	4	3.53	14
	Sept.	4	3.47	13
	Oct.	4	3.13	14
	Nov.	12	2.26	28
	Dec.	13	2.90	37
	TOTAL	268	1.57	420
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
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	Mar.			
	Apr.			
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	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 17

Colorado River Basin

Historical Flow and Quality of Water Data

Virgin River at Littlefield, Arizona

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	427	1.37	583	527	1004	529
1942	186	2.01	375	229	1485	340
1943	179	2.15	385	221	1579	349
1944	181	1.92	347	223	1413	315
1945	181	2.43	441	223	1794	400
1946	169	2.42	409	208	1784	371
1947	131	2.56	336	162	1883	305
1948	111	2.65	294	137	1949	267
1949	163	2.17	354	201	1597	321
1950	118	2.65	313	146	1945	284
1951	112	2.93	328	138	2159	298
1952	267	1.46	390	329	1076	354
1953	98	3.00	292	120	2208	265
1954	140	2.61	365	173	1913	331
1955	133	3.16	421	164	2329	382
1956	82	3.05	249	101	2238	226
1957	133	2.61	347	164	1921	315
1958	272	1.68	457	336	1235	415
1959	91	2.87	260	112	2107	236
1960	84	2.79	236	104	2058	214
1961	108	3.14	338	133	2308	307
1962	137	2.14	293	169	1574	266
1963	85	3.14	266	105	2295	241
1964	87	3.01	261	107	2215	237
1965	154	2.12	327	190	1563	297
1966	162	2.30	372	200	1685	337
1967	124	2.72	337	153	2000	306
1968	124	2.53	314	153	1856	284
1969	351	1.43	502	433	1051	455
1970	92	2.88	265	113	2124	240
1971	114	2.69	307	141	1979	279
1972	129	2.96	381	159	2176	346
1973	306	1.45	445	377	1072	404
1974	93	2.96	275	115	2165	249
1975	103	2.76	282	127	2025	256
1976	97	2.83	275	120	2080	249
1977	73	3.15	232	90	2319	210
1978	268	1.57	420	331	1153	381
Total	5,865		13,074	7234		11 861
Average	154	2.23	344	190	1642	312

Table 18

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Hoover Dam, Arizona — Nevada

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	589	1.08	636
	Feb.	500	1.11	555
	Mar.	552	1.10	607
	Apr.	518	1.08	560
	May	1,435	1.08	1,550
	June	1,810	1.07	1,935
	July	951	1.06	1,007
	Aug.	1,429	.97	1,386
	Sept.	1,576	.94	1,481
	Oct.	1,641	.94	1,543
	Nov.	1,817	.93	1,690
	Dec.	2,071	.94	1,947
	TOTAL	14,889	1.00	14,897
1942	Jan.	2,011	1.00	2,011
	Feb.	1,550	.99	1,535
	Mar.	1,425	1.00	1,425
	Apr.	1,301	1.00	1,301
	May	1,343	1.00	1,343
	June	1,561	1.01	1,577
	July	1,285	.99	1,272
	Aug.	846	.99	838
	Sept.	1,025	.98	1,005
	Oct.	1,163	.95	1,105
	Nov.	1,095	.90	986
	Dec.	1,157	.85	983
	TOTAL	15,762	.98	15,381
1943	Jan.	1,109	0.87	965
	Feb.	823	.89	732
	Mar.	971	.94	913
	Apr.	915	.95	869
	May	1,029	.94	967
	June	1,040	.93	967
	July	1,109	.91	1,009
	Aug.	1,042	.92	959
	Sept.	1,042	.91	948
	Oct.	1,179	.90	1,061
	Nov.	1,179	.86	1,014
	Dec.	1,277	.86	1,098
	TOTAL	12,715	.90	11,502
1944	Jan.	1,303	0.88	1,147
	Feb.	1,269	.97	1,231
	Mar.	1,307	.96	1,254
	Apr.	1,170	.97	1,135
	May	1,216	.98	1,192
	June	1,097	.95	1,042
	July	1,111	.93	1,033
	Aug.	1,211	.92	1,113
	Sept	1,132	.89	1,007
	Oct.	1,226	.94	1,152
	Nov.	1,186	.99	1,174
	Dec.	1,199	.94	1,127
	TOTAL	14,427	.94	13,607
1945	Jan.	1,239	0.93	1,152
	Feb.	1,100	.96	1,056
	Mar.	1,250	.96	1,200
	Apr.	1,042	.95	990
	May	1,068	.90	961
	June	1,014	.91	923
	July	861	.92	792
	Aug.	885	.93	823
	Sept.	869	.90	782
	Oct.	1,080	.88	950
	Nov.	1,042	.90	938
	Dec.	1,062	.89	945
	TOTAL	12,512	.92	11,512
1946	Jan.	1,116	0.87	971
	Feb.	1,047	.95	994
	Mar.	1,004	.88	884
	Apr.	872	.89	776
	May	903	.96	867
	June	817	.92	752
	July	838	.90	754
	Aug.	751	.91	683
	Sept.	759	.91	691
	Oct.	857	.92	788
	Nov.	762	.91	693
	Dec.	859	.90	773
	TOTAL	10,585	.91	9,626
1947	Jan.	984	0.90	886
	Feb.	886	.91	806
	Mar.	956	.92	879
	Apr.	859	.99	850
	May	951	1.03	979
	June	919	.95	873
	July	925	.96	888
	Aug.	865	.92	796
	Sept.	843	.92	776
	Oct.	828	.92	762
	Nov.	880	.92	810
	Dec.	1,063	.92	978
	TOTAL	10,959	.94	10,283
1948	Jan.	1,169	0.93	1,087
	Feb.	1,138	.93	1,058
	Mar.	1,150	.93	1,070
	Apr.	1,202	.97	1,166
	May	1,142	.93	1,062
	June	1,076	.88	947
	July	1,156	.86	994
	Aug.	968	.86	833
	Sept.	981	.85	834
	Oct.	917	.80	734
	Nov.	1,028	.88	905
	Dec.	1,124	.91	1,023
	TOTAL	13,051	.90	11,713
1949	Jan.	1,212	0.83	1,006
	Feb.	1,214	.84	1,020
	Mar.	1,291	.85	1,097
	Apr.	1,178	.86	1,013
	May	1,026	.83	852
	June	986	.87	858
	July	1,020	.84	857
	Aug.	1,062	.80	850
	Sept.	1,141	.78	890
	Oct.	1,176	.75	882
	Nov.	1,022	.83	848
	Dec.	1,238	.87	1,077
	TOTAL	13,566	.83	11,250
1950	Jan.	1,277	0.83	1,060
	Feb.	1,132	.81	917
	Mar.	1,246	.85	1,059
	Apr.	1,089	.85	926
	May	1,120	.84	941
	June	960	.83	797
	July	982	.79	776
	Aug.	872	.82	715
	Sept.	824	.79	651
	Oct.	848	.89	755
	Nov.	815	.88	717
	Dec.	851	.86	732
	TOTAL	12,016	.84	10,046
1951	Jan.	928	0.87	807
	Feb.	756	.87	658
	Mar.	860	.91	783
	Apr.	796	.93	740
	May	898	.92	826
	June	691	.91	629
	July	783	.92	720
	Aug.	907	.93	844
	Sept.	848	.92	780
	Oct.	756	.93	703
	Nov.	818	.93	761
	Dec.	829	.91	754
	TOTAL	9,870	.91	9,005
1952	Jan.	1,070	0.90	963
	Feb.	1,212	.93	1,127
	Mar.	1,371	.94	1,289
	Apr.	1,385	.94	1,302
	May	1,532	.94	1,440
	June	1,432	.91	1,303
	July	1,304	.83	1,082
	Aug.	1,307	.79	1,033
	Sept.	1,359	.73	992
	Oct.	1,291	.69	891
	Nov.	1,215	.66	802
	Dec.	1,338	.88	1,177
	TOTAL	15,816	.85	13,401
1953	Jan.	1,227	0.93	1,141
	Feb.	1,043	.91	949
	Mar.	1,046	.93	973
	Apr.	971	.94	913
	May	998	.91	908
	June	819	.89	729
	July	897	.87	780
	Aug	968	.87	842
	Sept.	968	.86	832
	Oct.	802	.86	690
	Nov.	749	.86	644
	Dec.	814	.85	692
	TOTAL	11,302	.89	10,093
1954	Jan.	836	0.88	736
	Feb.	721	.94	678
	Mar.	911	.95	865
	Apr.	975	.94	916
	May	1,101	.93	1,024
	June	929	.94	875
	July	1,027	.94	965
	Aug.	888	.97	861
	Sept.	933	.97	905
	Oct.	776	.94	729
	Nov.	676	.95	642
	Dec.	741	.97	719
	TOTAL	10,514	.94	9,913
1955	Jan.	725	0.99	718
	Feb.	705	1.04	733
	Mar.	906	1.08	978
	Apr.	882	1.11	979
	May	928	1.12	1,039
	June	680	1.12	762
	July	847	1.11	940
	Aug.	789	1.12	884
	Sept.	622	1.11	690
	Oct.	526	1.12	589
	Nov.	487	1.12	545
	Dec.	492	1.09	536
	TOTAL	8,589	1.09	9,393
1956	Jan.	583	1.09	635
	Feb.	499	1.10	549
	Mar.	769	1.12	861
	Apr.	840	1.14	958
	May	748	1.15	860
	June	784	1.17	917
	July	782	1.19	931
	Aug.	696	1.17	814
	Sept.	610	1.15	702
	Oct.	490	1.16	568
	Nov.	554	1.12	620
	Dec.	457	1.10	503
	TOTAL	7,812	1.14	8,918
1957	Jan.	534	1.07	571
	Feb.	470	1.08	508
	Mar.	739	1.11	820
	Apr.	890	1.09	970
	May	769	1.07	823
	June	828	1.06	878
	July	786	1.05	825
	Aug.	786	1.03	810
	Sept.	785	1.02	801
	Oct.	697	1.02	711
	Nov.	958	.99	948
	Dec.	1,081	.94	1,016
	TOTAL	9,323	1.04	9,681
1958	Jan.	1,245	0.90	1,120
	Feb.	846	.94	795
	Mar.	1,435	.90	1,292
	Apr.	1,473	.88	1,296
	May	1,115	.84	937
	June	819	.85	696
	July	894	.85	760
	Aug.	911	.83	756
	Sept.	792	.83	657
	Oct.	728	.82	597
	Nov.	746	.82	612
	Dec.	873	.83	725
	TOTAL	11,877	.86	10,243
1959	Jan.	795	0.85	676
	Feb.	648	.83	537
	Mar.	827	.88	728
	Apr.	916	.91	834
	May	949	.86	816
	June	760	.85	646
	July	848	.84	713
	Aug.	894	.83	742
	Sept.	773	.81	626
	Oct.	693	.82	568
	Nov.	607	.81	492
	Dec.	572	.81	463
	TOTAL	9,282	.84	7,841
1960	Jan.	629	0.86	541
	Feb.	512	.89	456
	Mar.	710	.89	632
	Apr.	909	.93	845
	May	856	.93	796
	June	1,015	.92	934
	July	984	.89	876
	Aug.	959	.93	892
	Sept.	806	.93	749
	Oct.	556	.92	512
	Nov.	489	.92	450
	Dec.	572	.92	526
	TOTAL	8,997	.91	8,209
1961	Jan.	591	0.93	549
	Feb.	577	.94	543
	Mar.	936	.95	889
	Apr.	904	.97	877
	May	943	.95	896
	June	842	.94	791
	July	822	.94	772
	Aug.	739	.96	709
	Sept.	690	.96	663
	Oct.	539	.93	502
	Nov.	517	.94	486
	Dec.	486	.95	462
	TOTAL	8,586	.95	8,139
1962	Jan.	482	0.93	448
	Feb.	497	.94	467
	Mar.	798	.94	750
	Apr.	902	.95	857
	May	887	1.00	887
	June	799	.94	751
	July	824	.91	750
	Aug.	857	.87	746
	Sept.	716	1.00	716
	Oct.	634	.86	545
	Nov.	613	.90	552
	Dec.	606	.93	564
	TOTAL	8,615	.93	8,033
1963	Jan.	482	0.99	478
	Feb.	575	.97	558
	Mar.	871	.95	828
	Apr.	865	.94	813
	May	911	.93	847
	June	764	.92	702
	July	908	.91	826
	Aug.	857	.90	771
	Sept.	724	.89	645
	Oct.	527	.90	475
	Nov.	464	.89	413
	Dec.	585	.90	526
	TOTAL	8,533	.92	7,882
1964	Jan.	633	0.93	589
	Feb.	583	.94	548
	Mar.	800	.95	760
	Apr.	859	.98	842
	May	844	.98	827
	June	719	.99	712
	July	866	.98	849
	Aug.	731	.99	724
	Sept.	623	.99	616
	Oct.	591	1.01	596
	Nov.	445	1.02	454
	Dec.	469	1.06	497
	TOTAL	8,163	.98	8,014
1965	Jan.	489	1.08	528
	Feb.	498	1.09	543
	Mar.	786	1.15	903
	Apr.	698	1.14	796
	May	872	1.14	994
	June	786	1.08	848
	July	815	1.08	880
	Aug.	817	1.11	907
	Sept.	655	1.12	734
	Oct.	535	1.05	562
	Nov.	418	1.03	430
	Dec.	423	1.06	449
	TOTAL	7,792	1.10	8,574

To obtain mg/L multiply T/AF by 735.29

Table 18

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Hoover Dam, Arizona — Nevada

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	252	1.03	260
	Feb.	436	1.02	445
	Mar.	785	1.05	824
	Apr.	846	1.05	888
	May	887	1.03	914
	June	783	1.06	831
	July	889	1.01	897
	Aug.	839	.98	822
	Sept.	672	1.00	672
	Oct.	467	.96	448
	Nov.	473	.93	440
	Dec.	448	.93	416
	TOTAL	7,777	1.01	7,857
1967	Jan.	500	0.94	470
	Feb.	574	.92	528
	Mar.	847	.91	771
	Apr.	771	.90	694
	May	889	.93	827
	June	782	.94	735
	July	832	.90	749
	Aug.	755	.90	679
	Sept.	494	.93	459
	Oct.	576	.93	536
	Nov.	556	.91	506
	Dec.	356	.92	328
	TOTAL	7,932	.92	7,282
1968	Jan.	396	0.94	372
	Feb.	496	.92	456
	Mar.	850	.93	791
	Apr.	883	.93	821
	May	853	.95	810
	June	752	.93	699
	July	757	.94	712
	Aug.	693	.97	672
	Sept.	663	.97	643
	Oct.	486	.98	476
	Nov.	457	.99	452
	Dec.	553	1.00	553
	TOTAL	7,839	.95	7,457
1969	Jan.	549	1.02	560
	Feb.	552	1.02	563
	Mar.	825	1.02	841
	Apr.	894	1.02	912
	May	834	1.00	834
	June	753	1.02	768
	July	772	1.01	780
	Aug.	693	1.02	707
	Sept	618	1.00	618
	Oct.	523	1.00	523
	Nov.	426	1.00	426
	Dec.	453	1.01	458
	TOTAL	7,892	1.01	7,990
1970	Jan.	603	1.04	627
	Feb.	536	1.03	552
	Mar.	753	1.03	776
	Apr.	919	1.02	937
	May	927	.97	899
	June	780	1.00	780
	July	792	.98	776
	Aug.	676	1.00	677
	Sept.	507	.97	492
	Oct.	583	1.01	589
	Nov.	450	1.07	481
	Dec.	497	1.09	542
	TOTAL	8,023	1.01	8,128
1971	Jan.	561	1.07	598
	Feb.	663	1.00	663
	Mar.	860	1.01	872
	Apr.	913	1.04	954
	May	861	1.04	894
	June	741	1.00	741
	July	740	.98	727
	Aug.	741	.99	732
	Sept.	623	1.00	622
	Oct.	503	1.01	509
	Nov.	452	1.02	463
	Dec.	506	1.01	522
	TOTAL	8,164	1.02	8,297
1972	Jan.	568	1.08	612
	Feb.	636	1.02	646
	Mar.	905	.98	887
	Apr.	877	.97	854
	May	866	.97	841
	June	795	.99	790
	July	769	.98	755
	Aug.	756	.96	723
	Sept.	634	.95	602
	Oct.	517	.95	490
	Nov.	397	.98	387
	Dec.	379	.99	375
	TOTAL	8,099	.98	7,962
1973	Jan.	581	0.99	577
	Feb.	554	1.01	561
	Mar.	611	.99	603
	Apr.	865	.96	828
	May	1,011	.95	963
	June	683	.95	650
	July	823	.96	788
	Aug.	857	.96	823
	Sept.	659	.95	630
	Oct.	560	.95	530
	Nov.	526	.93	491
	Dec.	571	.92	523
	TOTAL	8,301	.96	7,967
1974	Jan.	436	0.94	409
	Feb.	589	.96	563
	Mar.	864	.96	829
	Apr.	951	.95	908
	May	960	.95	909
	June	880	.93	821
	July	847	.93	792
	Aug.	948	.93	885
	Sept.	714	.90	644
	Oct.	614	.90	552
	Nov.	504	.90	455
	Dec.	425	.91	385
	TOTAL	8,732	.93	8,152
1975	Jan.	515	0.93	481
	Feb.	617	.91	560
	Mar.	749	.94	701
	Apr.	871	.96	835
	May	969	.92	888
	June	807	.91	734
	July	830	.95	787
	Aug.	805	.95	762
	Sept.	668	.93	662
	Oct.	549	.96	526
	Nov.	486	.93	454
	Dec.	501	.90	449
	TOTAL	8,367	.93	7,839
1976	Jan.	509	0.93	473
	Feb.	496	.90	446
	Mar.	910	.90	822
	Apr.	879	.91	797
	May	929	.93	865
	June	716	.91	650
	July	843	.92	775
	Aug.	894	.93	830
	Sept.	609	.92	560
	Oct.	351	.93	328
	Nov.	304	.91	277
	Dec.	487	.92	448
	TOTAL	7,926	.92	7,271
1977	Jan.	250	0.96	241
	Feb.	608	.92	562
	Mar.	854	.90	773
	Apr.	988	.89	878
	May	761	.90	681
	June	720	.90	651
	July	892	.91	816
	Aug.	876	.92	807
	Sept.	469	.90	423
	Oct.	428	.90	384
	Nov.	463	.90	415
	Dec.	563	.91	514
	TOTAL	7,873	.91	7,144
1978	Jan.	235	0.91	213
	Feb.	429	.92	393
	Mar.	740	.93	691
	Apr.	902	.92	832
	May	860	.93	798
	June	654	.95	623
	July	831	.93	771
	Aug.	892	.93	832
	Sept.	688	.93	642
	Oct.	502	.93	469
	Nov.	375	.95	356
	Dec.	368	.97	356
	TOTAL	7,477	.93	6,976
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
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	June			
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	Aug.			
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	Nov.			
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	TOTAL			
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	Dec.			
	TOTAL			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 18

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Hoover Dam, Arizona - Nevada

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	14,889	1.00	14,897	18 366	736	13 515
1942	15,762	.98	15,381	19 442	718	13 954
1943	12,715	.90	11,502	15 684	665	10 435
1944	14,427	.94	13,607	17 796	694	12 344
1945	12,512	.92	11,512	15 434	677	10 444
1946	10,585	.91	9,626	13 057	669	8733
1947	10,959	.94	10,283	13 518	690	9329
1948	13,051	.90	11,713	16 098	660	10 626
1949	13,566	.83	11,250	16 734	610	10 206
1950	12,016	.84	10,046	14 822	615	9114
1951	9,870	.91	9,005	12 175	671	8169
1952	15,816	.85	13,401	19 509	623	12 157
1953	11,302	.89	10,093	13 941	657	9156
1954	10,514	.94	9,913	12 969	693	8993
1955	8,589	1.09	9,393	10 595	804	8521
1956	7,812	1.14	8,918	9636	840	8090
1957	9,323	1.04	9,681	11 500	764	8783
1958	11,877	.86	10,243	14 650	634	9292
1959	9,282	.84	7,841	11 449	621	7113
1960	8,997	.91	8,209	11 098	671	7447
1961	8,586	.95	8,139	10 591	697	7384
1962	8,615	.93	8,033	10 627	686	7288
1963	8,533	.92	7,882	10 525	679	7151
1964	8,163	.98	8,014	10 069	722	7270
1965	7,792	1.10	8,574	9611	809	7778
1966	7,777	1.01	7,857	9593	743	7128
1967	7,932	.92	7,282	9784	675	6606
1968	7,839	.95	7,457	9669	700	6765
1969	7,892	1.01	7,990	9735	745	7249
1970	8,023	1.01	8,128	9896	745	7374
1971	8,164	1.02	8,297	10 070	747	7527
1972	8,099	.98	7,962	9990	720	7223
1973	8,301	.96	7,967	10 239	706	7228
1974	8,723	.93	8,152	10 771	686	7395
1975	8,367	.93	7,702	10 321	685	7069
1976	7,927	.92	7,269	9778	674	6594
1977	7,873	.91	7,144	9711	667	6481
1978	7,477	.93	6,976	9223	686	6328
Total	379,956		357,429	468 676		324 259
Average	9,999	.94	9,406	12 334	691	8533

Table 19

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Parker Dam, Arizona – California

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	627	1.11	698
	Feb.	561	1.14	642
	Mar.	750	1.14	854
	Apr.	608	1.12	679
	May	1,359	1.12	1,524
	June	1,628	1.11	1,808
	July	998	1.10	1,098
	Aug.	1,332	1.04	1,381
	Sept.	1,528	.98	1,495
	Oct.	1,585	.98	1,550
	Nov.	1,731	.95	1,641
	Dec.	2,042	1.04	2,116
	TOTAL	14,749	1.05	15,486
1942	Jan.	1,957	1.09	1,963
	Feb.	1,482	1.00	1,480
	Mar.	1,494	.99	1,476
	Apr.	1,136	1.01	1,143
	May	1,588	1.01	1,602
	June	1,536	1.01	1,549
	July	1,226	.98	1,197
	Aug.	880	1.07	939
	Sept.	797	1.00	794
	Oct.	845	.99	833
	Nov.	1,041	.99	1,028
	Dec.	1,213	.89	1,084
	TOTAL	15,195	.99	15,088
1943	Jan.	1,015	0.93	948
	Feb.	746	.88	657
	Mar.	886	.97	863
	Apr.	877	.95	837
	May	957	.97	933
	June	976	.98	961
	July	1,086	.90	981
	Aug.	990	.91	904
	Sept.	1,006	.90	908
	Oct.	1,160	.92	1,062
	Nov.	1,149	.87	1,003
	Dec.	1,231	.87	1,076
	TOTAL	12,079	.92	11,133
1944	Jan.	1,241	0.90	1,121
	Feb.	1,223	.92	1,131
	Mar.	1,297	.96	1,240
	Apr.	1,164	.98	1,136
	May	1,116	.98	1,089
	June	983	.99	969
	July	1,035	.95	988
	Aug.	1,148	.96	1,098
	Sept	1,114	.89	994
	Oct.	1,178	.88	1,042
	Nov.	1,156	.88	1,023
	Dec.	1,187	.94	1,110
	TOTAL	13,842	.93	12,941
1945	Jan.	1,186	0.94	1,121
	Feb.	1,061	.91	969
	Mar.	1,232	.94	1,152
	Apr.	985	.94	929
	May	970	.94	915
	June	919	.99	914
	July	913	.92	844
	Aug.	770	.90	694
	Sept.	824	.91	751
	Oct.	1,038	.85	884
	Nov.	1,036	.89	924
	Dec.	1,099	.90	992
	TOTAL	12,033	.92	11,089
1946	Jan.	1,041	0.90	939
	Feb.	1,028	.96	991
	Mar.	944	.89	843
	Apr.	830	1.04	867
	May	873	.94	825
	June	754	.92	696
	July	801	.91	731
	Aug.	722	.89	642
	Sept.	730	.91	665
	Oct.	759	.91	691
	Nov.	789	.91	720
	Dec.	870	.91	794
	TOTAL	10,141	.93	9,404
1947	Jan.	953	0.91	870
	Feb.	899	.92	829
	Mar.	940	.94	888
	Apr.	797	.97	777
	May	905	.99	892
	June	860	.98	847
	July	844	.97	822
	Aug.	892	.96	860
	Sept.	819	.98	800
	Oct.	837	.91	765
	Nov.	880	.87	768
	Dec.	1,037	.83	862
	TOTAL	10,663	.94	9,980
1948	Jan.	1,160	0.96	1,109
	Feb.	1,160	.92	1,062
	Mar.	1,107	.91	1,009
	Apr.	1,083	.92	999
	May	1,115	.91	1,016
	June	989	.93	923
	July	1,108	.90	999
	Aug.	986	.89	880
	Sept.	941	.88	831
	Oct.	918	.86	791
	Nov.	978	.81	793
	Dec.	1,106	.92	1,019
	TOTAL	12,651	.90	11,431
1949	Jan.	1,229	0.89	1,099
	Feb.	1,192	.85	1,015
	Mar.	1,236	.84	1,044
	Apr.	1,116	.88	985
	May	983	1.05	866
	June	923	.89	824
	July	952	.89	849
	Aug.	1,013	.84	852
	Sept.	1,099	.83	913
	Oct.	1,148	.80	918
	Nov.	1,011	.77	778
	Dec.	1,158	.74	855
	TOTAL	13,060	.84	10,998
1950	Jan.	1,080	0.86	931
	Feb.	1,036	.85	882
	Mar.	1,209	.84	1,017
	Apr.	998	.88	879
	May	1,066	.88	941
	June	900	.87	785
	July	897	.85	765
	Aug.	833	.84	698
	Sept.	704	.84	590
	Oct.	651	.86	558
	Nov.	542	.87	473
	Dec.	557	.89	494
	TOTAL	10,473	.86	9,013
1951	Jan.	550	0.89	488
	Feb.	501	.89	448
	Mar.	730	.90	657
	Apr.	765	.89	682
	May	675	.90	607
	June	862	.90	779
	July	945	.91	862
	Aug.	945	.89	840
	Sept.	723	.88	636
	Oct.	709	.90	638
	Nov.	560	.90	502
	Dec.	707	.91	642
	TOTAL	8,672	.90	7,781
1952	Jan.	1,104	0.91	1,008
	Feb.	1,134	.89	1,012
	Mar.	1,424	.89	1,273
	Apr.	1,300	.92	1,202
	May	1,443	.95	1,366
	June	1,419	.95	1,341
	July	1,263	.90	1,142
	Aug.	1,296	.85	1,105
	Sept.	1,321	.81	1,074
	Oct.	1,234	.76	935
	Nov.	1,172	.71	829
	Dec.	1,303	.69	895
	TOTAL	15,413	.86	13,182
1953	Jan.	1,198	0.68	813
	Feb.	1,020	.83	848
	Mar.	947	.90	853
	Apr.	808	.93	753
	May	953	.92	880
	June	956	.92	882
	July	1,093	.89	973
	Aug.	1,056	.86	909
	Sept.	823	.85	700
	Oct.	634	.86	544
	Nov.	527	.86	455
	Dec.	634	.87	550
	TOTAL	10,649	.86	9,160
1954	Jan.	797	0.86	685
	Feb.	661	.85	560
	Mar.	782	.86	673
	Apr.	864	.86	746
	May	1,015	.91	927
	June	883	.94	834
	July	1,000	.93	934
	Aug.	982	.93	918
	Sept.	754	.94	706
	Oct.	636	.94	599
	Nov.	638	.94	601
	Dec.	659	.94	618
	TOTAL	9,671	.91	8,801
1955	Jan.	734	0.95	699
	Feb.	598	.96	574
	Mar.	733	.98	722
	Apr.	758	.99	753
	May	792	1.02	804
	June	866	1.06	914
	July	963	1.10	1,060
	Aug.	849	1.09	924
	Sept.	694	1.07	740
	Oct.	499	1.08	540
	Nov.	369	1.10	407
	Dec.	286	1.09	312
	TOTAL	8,141	1.04	8,449
1956	Jan.	317	1.11	352
	Feb.	365	1.12	407
	Mar.	628	1.13	708
	Apr.	684	1.12	766
	May	671	1.10	735
	June	787	1.12	880
	July	865	1.13	976
	Aug.	823	1.12	920
	Sept.	634	1.15	728
	Oct.	486	1.10	536
	Nov.	321	1.12	359
	Dec.	288	1.15	330
	TOTAL	6,869	1.12	7,697
1957	Jan.	243	1.15	279
	Feb.	349	1.13	395
	Mar.	589	1.12	657
	Apr.	731	1.09	796
	May	645	1.09	704
	June	783	1.08	845
	July	890	1.06	941
	Aug.	817	1.04	848
	Sept.	661	1.01	670
	Oct.	503	1.02	513
	Nov.	781	1.03	802
	Dec.	1,005	1.04	1,044
	TOTAL	7,997	1.06	8,494
1958	Jan.	1,285	1.00	1,280
	Feb.	565	.95	536
	Mar.	1,345	.91	1,229
	Apr.	1,333	.89	1,191
	May	1,013	.87	883
	June	854	.86	735
	July	930	.86	803
	Aug.	867	.84	729
	Sept.	714	.83	590
	Oct.	610	.84	510
	Nov.	623	.84	521
	Dec.	753	.85	639
	TOTAL	10,892	.89	9,646
1959	Jan.	677	0.84	566
	Feb.	593	.83	495
	Mar.	690	.84	579
	Apr.	832	.85	707
	May	706	.88	620
	June	797	.89	709
	July	962	.86	829
	Aug.	873	.81	706
	Sept.	682	.82	557
	Oct.	558	.84	471
	Nov.	405	.84	342
	Dec.	411	.83	343
	TOTAL	8,186	.85	6,924
1960	Jan.	428	0.82	353
	Feb.	474	.82	388
	Mar.	760	.83	630
	Apr.	810	.87	705
	May	748	.88	651
	June	879	.90	794
	July	986	.89	880
	Aug.	868	.90	780
	Sept.	640	.89	568
	Oct.	490	.87	428
	Nov.	397	.90	356
	Dec.	322	.91	293
	TOTAL	7,794	.88	6,826
1961	Jan.	379	0.92	347
	Feb.	453	.91	414
	Mar.	742	.92	684
	Apr.	725	.92	669
	May	705	.94	664
	June	822	.94	776
	July	900	.93	841
	Aug.	710	.93	661
	Sept.	606	.92	556
	Oct.	412	.91	374
	Nov.	319	.94	300
	Dec.	202	.92	186
	TOTAL	6,975	.93	6,472
1962	Jan.	334	0.93	310
	Feb.	374	.93	346
	Mar.	692	.94	652
	Apr.	756	.96	729
	May	686	.97	667
	June	778	1.00	775
	July	882	.97	859
	Aug.	821	.99	816
	Sept.	644	.97	627
	Oct.	471	.98	460
	Nov.	434	.97	423
	Dec.	287	1.00	286
	TOTAL	7,159	.97	6,950
1963	Jan.	350	1.00	349
	Feb.	467	1.00	466
	Mar.	735	.99	731
	Apr.	690	.99	685
	May	708	.97	687
	June	840	.95	802
	July	933	.92	862
	Aug.	819	.91	747
	Sept.	630	.91	572
	Oct.	438	.88	385
	Nov.	334	.88	294
	Dec.	307	.89	272
	TOTAL	7,251	.94	6,852
1964	Jan.	363	0.91	329
	Feb.	479	.90	432
	Mar.	640	.91	582
	Apr.	652	.91	596
	May	598	.92	552
	June	742	.95	706
	July	864	.95	824
	Aug.	795	.95	754
	Sept.	589	.96	564
	Oct.	409	.96	393
	Nov.	275	.96	264
	Dec.	245	1.00	246
	TOTAL	6,651	.94	6,242
1965	Jan.	290	1.01	294
	Feb.	423	1.00	424
	Mar.	634	1.03	651
	Apr.	581	1.06	614
	May	604	1.07	645
	June	710	1.11	790
	July	846	1.09	924
	Aug.	867	1.08	940
	Sept.	599	1.08	648
	Oct.	385	1.11	426
	Nov.	220	1.10	243
	Dec.	197	.95	187
	TOTAL	6,356	1.07	6,786

To obtain mg/L multiply T/AF by 735.29

Table 19

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Parker Dam, Arizona – California

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	177	0.73	129
	Feb.	413	1.04	428
	Mar.	604	1.08	655
	Apr.	729	1.08	785
	May	699	1.10	766
	June	790	1.12	887
	July	901	1.07	966
	Aug.	852	1.04	890
	Sept.	585	1.07	626
	Oct.	357	.96	343
	Nov.	256	1.00	256
	Dec.	320	.97	311
	TOTAL	6,683	1.05	7,042
1967	Jan.	306	0.98	299
	Feb.	431	1.01	434
	Mar.	677	.98	664
	Apr.	608	.98	594
	May	648	.98	635
	June	726	1.01	733
	July	835	.95	794
	Aug.	749	.98	734
	Sept.	490	.97	474
	Oct.	435	.95	413
	Nov.	247	.93	230
	Dec.	170	.96	163
	TOTAL	6,322	.98	6,167
1968	Jan.	351	0.94	330
	Feb.	450	.89	400
	Mar.	680	.93	632
	Apr.	700	.93	652
	May	626	.97	608
	June	722	.95	685
	July	779	.96	745
	Aug.	725	.95	686
	Sept.	585	.98	573
	Oct.	404	.98	394
	Nov.	309	.99	306
	Dec.	312	1.00	312
	TOTAL	6,643	.95	6,323
1969	Jan.	254	1.01	256
	Feb.	467	1.02	476
	Mar.	740	.95	703
	Apr.	713	1.03	734
	May	640	1.08	692
	June	674	1.05	708
	July	765	1.03	787
	Aug.	733	.99	726
	Sept	488	.99	483
	Oct.	434	.97	420
	Nov.	220	1.03	227
	Dec.	310	1.02	317
	TOTAL	6,438	1.01	6,529
1970	Jan.	367	1.03	378
	Feb.	442	1.04	460
	Mar.	654	1.02	667
	Apr.	750	1.04	780
	May	657	1.03	676
	June	706	1.03	727
	July	792	1.00	792
	Aug.	675	1.02	688
	Sept.	530	1.01	535
	Oct.	454	1.03	468
	Nov.	304	1.04	316
	Dec.	328	1.09	358
	TOTAL	6,659	1.03	6,845
1971	Jan.	339	1.07	363
	Feb.	486	1.03	503
	Mar.	743	1.04	771
	Apr.	746	1.07	796
	May	661	1.05	691
	June	743	1.01	751
	July	877	1.02	896
	Aug.	690	1.02	704
	Sept.	565	1.01	570
	Oct.	397	1.04	414
	Nov.	309	1.03	319
	Dec.	355	1.04	371
	TOTAL	6,911	1.03	7,149
1972	Jan.	346	1.05	362
	Feb.	480	1.07	513
	Mar.	747	1.07	797
	Apr.	766	1.05	806
	May	700	1.02	714
	June	689	1.01	694
	July	875	1.00	872
	Aug.	716	.97	694
	Sept.	574	.98	562
	Oct.	224	.99	221
	Nov.	283	.97	274
	Dec.	389	1.00	389
	TOTAL	6,789	1.02	6,898
1973	Jan.	355	1.01	358
	Feb.	348	1.00	347
	Mar.	642	.95	613
	Apr.	800	.96	770
	May	696	.99	691
	June	673	1.00	673
	July	829	1.01	837
	Aug.	726	1.01	731
	Sept.	644	.98	632
	Oct.	484	.98	472
	Nov.	310	.97	302
	Dec.	340	.97	332
	TOTAL	6,847	.99	6,758
1974	Jan.	245	0.98	238
	Feb.	481	.98	472
	Mar.	705	.97	682
	Apr.	864	.97	841
	May	756	.97	730
	June	791	.96	763
	July	874	.96	837
	Aug.	825	.92	759
	Sept.	625	.91	567
	Oct.	400	.93	372
	Nov.	281	.92	258
	Dec.	297	.95	282
	TOTAL	7,144	.95	6,801
1975	Jan.	363	0.97	351
	Feb.	447	.98	440
	Mar.	690	.98	675
	Apr.	795	.95	755
	May	770	.96	737
	June	694	.96	667
	July	825	.95	786
	Aug.	802	.92	737
	Sept.	650	.93	602
	Oct.	447	.96	457
	Nov.	337	.97	327
	Dec.	360	.97	349
	TOTAL	7,210	.95	6,883
1976	Jan.	353	0.95	337
	Feb.	364	.95	346
	Mar.	805	.96	771
	Apr.	771	.96	738
	May	694	.95	657
	June	717	.97	699
	July	790	.95	747
	Aug.	843	.94	796
	Sept.	400	.94	375
	Oct.	355	.92	328
	Nov.	249	.92	230
	Dec.	356	.96	342
	TOTAL	6,697	.95	6,366
1977	Jan.	258	0.94	242
	Feb.	498	.94	470
	Mar.	683	.94	640
	Apr.	812	.94	764
	May	652	.93	606
	June	760	.92	701
	July	956	.92	877
	Aug.	688	.87	598
	Sept.	460	.92	422
	Oct.	348	.93	324
	Nov.	288	.94	270
	Dec.	308	.99	304
	TOTAL	6,711	.93	6,216
1978	Jan.	137	0.96	131
	Feb.	398	.93	372
	Mar.	692	.92	637
	Apr.	849	.93	792
	May	679	.93	629
	June	763	.92	699
	July	906	.92	832
	Aug	792	.91	719
	Sept.	573	.93	533
	Oct.	360	.92	332
	Nov.	266	.93	248
	Dec.	268	.97	261
	TOTAL	6,681	.93	6,184
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			
	Jan.			
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	TOTAL			
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	TOTAL			
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	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 19

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Parker Dam, Arizona - California

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	14,749	1.05	15,486	18 193	772	14 049
1942	15,195	.99	15,088	18 743	730	13 688
1943	12,079	.92	11,133	14 899	678	10 100
1944	13,842	.93	12,941	17 074	688	11 740
1945	12,033	.92	11,089	14 843	678	10 060
1946	10,141	.93	9,404	12 509	682	8531
1947	10,663	.94	9,980	13 153	688	9054
1948	12,651	.90	11,431	15 605	665	10 370
1949	13,060	.84	10,998	16 110	619	9977
1950	10,473	.86	9,013	12 918	633	8177
1951	8,672	.90	7,781	10 697	660	7059
1952	15,413	.86	13,182	19 012	629	11 959
1953	10,649	.86	9,160	13 136	633	8310
1954	9,671	.91	8,801	11 929	669	7984
1955	8,141	1.04	8,449	10 042	763	7665
1956	6,869	1.12	7,697	8473	824	6983
1957	7,997	1.06	8,494	9864	781	7706
1958	10,892	.89	9,646	13 435	651	8751
1959	8,186	.85	6,924	10 097	622	6281
1960	7,794	.88	6,826	9614	644	6193
1961	6,975	.93	6,472	8604	682	5871
1962	7,159	.97	6,950	8831	714	6305
1963	7,251	.94	6,852	8944	695	6216
1964	6,651	.94	6,242	8204	690	5663
1965	6,356	1.07	6,786	7840	785	6156
1966	6,683	1.05	7,042	8243	775	6389
1967	6,322	.98	6,167	7798	717	5595
1968	6,643	.95	6,323	8194	700	5736
1969	6,438	1.01	6,529	7941	746	5923
1970	6,659	1.03	6,845	8214	756	6210
1971	6,911	1.03	7,149	8525	761	6489
1972	6.789	1.02	6,898	8374	747	6258
1973	6,847	.99	6,758	8446	726	6131
1974	7,144	.95	6,801	8812	700	6170
1975	7,210	.96	6,883	8893	702	6244
1976	6,697	.95	6,367	8261	699	5776
1977	6,711	.93	6,216	8278	681	5639
1978	6,681	.93	6,184	8241	681	5610
Total	341,297		322,987	420 989		293 015
Average	8,982	.95	8,500	11 079	696	7711

Table 20

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Imperial Dam, Arizona-California

Calendar Year	Month	Flow 1000 (A F)	Concentration (T/A F)	T.D.S. 1000 (Tons)
1941	Jan.	642	1.10	706
	Feb.	535	1.15	615
	Mar.	743	.90	669
	Apr.	562	1.04	584
	May	1,150	1.11	1,277
	June	1,605	1.21	1,942
	July	965	1.17	1,129
	Aug.	1,192	1.09	1,299
	Sept.	1,444	.99	1,430
	Oct.	1,505	1.02	1,535
	Nov.	1,671	1.02	1,704
	Dec.	2,010	1.04	2,090
	TOTAL	14,024	1.07	14,980
1942	Jan.	1,876	1.08	2,026
	Feb.	1,590	1.09	1,733
	Mar.	1,476	1.09	1,609
	Apr.	1,080	1.11	1,199
	May	1,524	1.10	1,676
	June	1,465	1.11	1,626
	July	1,199	1.11	1,331
	Aug.	844	1.09	920
	Sept.	742	1.11	824
	Oct.	761	1.08	822
	Nov.	981	1.03	1,010
	Dec.	1,176	.97	1,141
	TOTAL	14,714	1.08	15,917
1943	Jan.	1,011	0.94	950
	Feb.	729	.92	671
	Mar.	846	.95	804
	Apr.	802	.96	770
	May	842	.98	825
	June	876	.98	858
	July	972	.95	923
	Aug.	910	.94	855
	Sept.	917	.94	862
	Oct.	1,094	.94	1,028
	Nov.	1,124	.93	1,045
	Dec.	1,222	.89	1,088
	TOTAL	11,345	.94	10,679
1944	Jan.	1,209	0.89	1,076
	Feb.	1,216	.94	1,143
	Mar.	1,289	.97	1,250
	Apr.	1,126	1.00	1,126
	May	1,055	1.01	1,066
	June	900	1.02	918
	July	920	.99	911
	Aug.	1,041	.97	1,010
	Sept	1,041	.94	979
	Oct.	1,123	.92	1,033
	Nov.	1,142	.89	1,016
	Dec.	1,143	.89	1,017
	TOTAL	13,205	.95	12,545
1945	Jan.	1,160	0.99	1,137
	Feb.	1,047	.97	1,016
	Mar.	1,193	.97	1,157
	Apr.	947	.98	928
	May	905	1.00	905
	June	860	.99	851
	July	817	.96	784
	Aug.	718	.94	675
	Sept.	745	.92	685
	Oct.	912	.88	803
	Nov.	1,011	.89	900
	Dec.	1,075	.93	1,000
	TOTAL	11,390	.95	10,841
1946	Jan.	1,008	0.94	948
	Feb.	1,005	.92	925
	Mar.	927	.94	871
	Apr.	759	.96	729
	May	786	.98	770
	June	658	.99	651
	July	719	.97	697
	Aug.	666	.94	626
	Sept.	639	.95	607
	Oct.	707	.97	686
	Nov.	757	.96	727
	Dec.	855	.94	804
	TOTAL	9,486	.95	9,041
1947	Jan.	933	0.95	886
	Feb.	872	.95	828
	Mar.	934	.98	915
	Apr.	737	1.02	752
	May	827	1.01	835
	June	787	1.02	803
	July	743	1.01	750
	Aug.	830	.99	822
	Sept.	733	1.00	733
	Oct.	753	.95	715
	Nov.	851	.90	766
	Dec.	1,041	.87	906
	TOTAL	10,041	.97	9,711
1948	Jan.	1,106	0.97	1,073
	Feb.	1,135	.94	1,067
	Mar.	1,092	.95	1,037
	Apr.	1,007	.94	947
	May	1,051	.95	998
	June	916	.95	870
	July	1,003	.95	953
	Aug.	906	.94	852
	Sept.	871	.91	793
	Oct.	901	.89	802
	Nov.	945	.86	813
	Dec.	1,103	.94	1,037
	TOTAL	12,036	.93	11,242
1949	Jan.	1,237	0.92	1,138
	Feb.	1,183	.88	1,041
	Mar.	1,226	.88	1,079
	Apr.	1,084	.91	986
	May	927	.92	853
	June	871	.93	810
	July	860	.92	791
	Aug.	934	.88	822
	Sept.	996	.86	857
	Oct.	1,103	.83	915
	Nov.	1,000	.93	930
	Dec.	1,146	.77	882
	TOTAL	12,567	.88	11,104
1950	Jan.	1,088	0.89	968
	Feb.	994	.97	865
	Mar.	1,169	.88	1,029
	Apr.	936	.90	842
	May	1,002	.91	912
	June	841	.89	748
	July	822	.89	732
	Aug.	758	.88	667
	Sept.	643	.87	559
	Oct.	603	.94	567
	Nov.	510	.95	485
	Dec.	540	.95	513
	TOTAL	9,906	.90	8,887
1951	Jan.	558	0.95	530
	Feb.	498	.96	478
	Mar.	635	.96	610
	Apr.	744	.96	714
	May	606	.99	600
	June	703	.98	689
	July	820	.98	804
	Aug.	853	.95	810
	Sept.	697	.93	648
	Oct.	682	.96	655
	Nov.	559	.97	542
	Dec.	698	.98	684
	TOTAL	8,053	.96	7,764
1952	Jan.	1,058	0.95	1,005
	Feb.	1,107	.96	1,063
	Mar.	1,424	.92	1,310
	Apr.	1,279	.97	1,241
	May	1,345	1.00	1,345
	June	1,309	.99	1,296
	July	1,182	.97	1,147
	Aug.	1,178	.92	1,084
	Sept.	1,219	.87	1,061
	Oct.	1,240	.84	1,042
	Nov.	1,176	.78	917
	Dec.	1,298	.75	974
	TOTAL	14,815	.91	13,485
1953	Jan.	1,216	0.77	936
	Feb.	1,022	.89	910
	Mar.	911	.95	865
	Apr.	756	1.01	764
	May	856	1.01	865
	June	811	1.00	811
	July	980	.96	941
	Aug.	931	.95	884
	Sept.	776	.93	722
	Oct.	644	.96	618
	Nov.	522	.97	506
	Dec.	620	.95	589
	TOTAL	10,045	.94	9,411
1954	Jan.	783	0.94	736
	Feb.	661	.94	621
	Mar.	723	.94	680
	Apr.	773	.94	727
	May	929	1.05	975
	June	804	1.03	828
	July	885	1.01	894
	Aug.	887	1.03	914
	Sept.	719	1.02	733
	Oct.	620	1.03	639
	Nov.	602	1.02	614
	Dec.	644	1.03	663
	TOTAL	9,030	1.00	9,024
1955	Jan.	739	1.00	739
	Feb	593	1.03	611
	Mar.	678	1.07	725
	Apr.	716	1.09	780
	May	729	1.13	824
	June	746	1.20	895
	July	882	1.21	1,067
	Aug.	811	1.18	957
	Sept.	638	1.17	746
	Oct.	499	1.20	599
	Nov.	379	1.24	470
	Dec.	298	1.29	384
	TOTAL	7,708	1.14	8,797
1956	Jan.	298	1.31	390
	Feb.	344	1.24	427
	Mar.	546	1.24	677
	Apr.	646	1.23	795
	May	594	1.26	748
	June	666	1.25	833
	July	753	1.25	941
	Aug.	717	1.22	875
	Sept.	583	1.24	723
	Oct.	479	1.24	594
	Nov.	343	1.28	439
	Dec.	297	1.30	386
	TOTAL	6,266	1.25	7,828
1957	Jan.	258	1.36	351
	Feb.	314	1.32	414
	Mar.	520	1.23	640
	Apr.	667	1.18	787
	May	581	1.19	691
	June	651	1.19	775
	July	794	1.22	969
	Aug.	759	1.08	820
	Sept.	616	1.12	690
	Oct.	511	1.16	593
	Nov.	695	1.14	792
	Dec.	978	1.10	1,076
	TOTAL	7,344	1.17	8,598
1958	Jan.	1,299	1.05	1,364
	Feb.	637	1.07	682
	Mar.	1,253	1.06	1,328
	Apr.	1,280	1.02	1,306
	May	1,016	1.00	1,016
	June	769	1.01	777
	July	812	.96	780
	Aug.	802	.97	778
	Sept.	655	.97	635
	Oct.	624	1.01	630
	Nov.	592	1.00	592
	Dec.	761	.97	738
	TOTAL	10,500	1.01	10,626
1959	Jan.	674	0.99	667
	Feb.	592	.99	586
	Mar.	618	1.02	630
	Apr.	770	1.01	778
	May	646	1.05	678
	June	679	1.03	699
	July	824	.99	816
	Aug.	821	1.04	854
	Sept.	644	1.04	670
	Oct.	565	1.03	582
	Nov.	421	1.04	438
	Dec.	441	1.01	445
	TOTAL	7,695	1.02	7,843
1960	Jan.	449	1.02	458
	Feb.	436	1.00	436
	Mar.	651	.99	644
	Apr.	762	.99	754
	May	650	1.07	696
	June	736	1.07	788
	July	845	1.07	904
	Aug.	777	1.06	824
	Sept.	606	1.09	661
	Oct.	481	1.10	529
	Nov.	360	1.14	410
	Dec.	354	1.15	407
	TOTAL	7,107	1.06	7,511
1961	Jan.	342	1.18	404
	Feb.	400	1.15	460
	Mar.	648	1.10	713
	Apr.	666	1.08	719
	May	618	1.14	705
	June	691	1.08	746
	July	755	1.09	823
	Aug.	671	1.12	752
	Sept.	541	1.14	617
	Oct.	427	1.10	470
	Nov.	312	1.12	349
	Dec.	222	1.18	262
	TOTAL	6,293	1.12	7,020
1962	Jan.	337	1.11	374
	Feb.	304	1.14	347
	Mar.	597	1.06	633
	Apr.	689	1.06	730
	May	619	1.11	688
	June	648	1.12	725
	July	741	1.11	822
	Aug.	730	1.12	818
	Sept.	593	1.11	658
	Oct.	458	1.15	527
	Nov.	439	1.16	509
	Dec.	303	1.18	358
	TOTAL	6,458	1.11	7,189
1963	Jan.	337	1.14	384
	Feb.	393	1.11	436
	Mar.	615	1.10	676
	Apr.	647	1.09	705
	May	602	1.09	656
	June	691	1.06	733
	July	775	1.04	806
	Aug.	757	1.02	772
	Sept.	595	1.04	619
	Oct.	461	1.08	498
	Nov.	340	1.12	381
	Dec.	309	1.13	350
	TOTAL	6,522	1.08	7,016
1964	Jan.	337	1.12	377
	Feb.	415	1.07	444
	Mar.	562	1.06	595
	Apr.	609	1.07	652
	May	530	1.10	583
	June	576	1.15	663
	July	719	1.09	784
	Aug.	679	1.09	740
	Sept.	539	1.14	615
	Oct.	396	1.22	483
	Nov.	281	1.26	354
	Dec.	257	1.27	326
	TOTAL	5,900	1.12	6,616
1965	Jan.	271	1.26	341
	Feb.	332	1.26	418
	Mar.	548	1.20	658
	Apr.	566	1.15	651
	May	548	1.22	669
	June	558	1.22	680
	July	709	1.26	893
	Aug.	737	1.28	943
	Sept.	540	1.31	708
	Oct.	400	1.29	516
	Nov.	257	1.33	342
	Dec.	237	1.22	290
	TOTAL	5,703	1.25	7,109

To obtain mg/L multiply T/AF by 735.29

Table 20

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Imperial Dam, Arizona-California

Calendar Year	Month	Flow 1000 (A F)	Concen-tration (T/A F)	T.D.S. 1000 (Tons)
1966	Jan.	203	1.13	229
	Feb.	334	1.21	404
	Mar.	517	1.21	626
	Apr.	622	1.22	758
	May	576	1.24	715
	June	637	1.31	835
	July	729	1.20	874
	Aug.	733	1.18	865
	Sept.	532	1.21	643
	Oct.	389	1.23	478
	Nov.	263	1.28	337
	Dec.	314	1.18	369
	TOTAL	5,849	1.22	7,133
1967	Jan.	301	1.21	364
	Feb.	369	1.16	428
	Mar.	593	1.12	664
	Apr.	558	1.15	642
	May	550	1.16	638
	June	595	1.16	690
	July	673	1.08	727
	Aug.	672	1.09	732
	Sept.	450	1.16	522
	Oct.	412	1.12	461
	Nov.	268	1.22	327
	Dec.	174	1.35	235
	TOTAL	5,615	1.15	6,430
1968	Jan.	342	1.18	404
	Feb.	366	1.10	403
	Mar.	566	1.10	623
	Apr.	622	1.09	678
	May	532	1.18	628
	June	580	1.10	638
	July	625	1.14	713
	Aug.	609	1.16	706
	Sept.	494	1.17	578
	Oct.	399	1.21	483
	Nov.	297	1.25	371
	Dec.	309	1.25	386
	TOTAL	5,741	1.15	6,611
1969	Jan.	271	1.30	352
	Feb.	376	1.18	444
	Mar.	601	1.12	675
	Apr.	638	1.20	766
	May	550	1.19	655
	June	553	1.17	647
	July	622	1.16	721
	Aug.	628	1.18	740
	Sept	443	1.23	544
	Oct.	417	1.22	509
	Nov.	225	1.32	297
	Dec.	292	1.29	376
	TOTAL	5,616	1.20	6,726
1970	Jan.	352	1.20	423
	Feb.	352	1.21	424
	Mar.	558	1.17	653
	Apr.	677	1.16	788
	May	540	1.22	661
	June	549	1.20	658
	July	623	1.19	738
	Aug.	577	1.20	695
	Sept.	440	1.22	535
	Oct.	423	1.24	525
	Nov.	299	1.24	370
	Dec.	315	1.29	407
	TOTAL	5,705	1.21	6,877
1971	Jan.	324	1.32	427
	Feb.	391	1.23	482
	Mar.	612	1.19	728
	Apr.	627	1.20	751
	May	524	1.22	637
	June	579	1.17	679
	July	676	1.14	772
	Aug.	600	1.14	687
	Sept.	472	1.16	550
	Oct.	390	1.23	480
	Nov.	300	1.30	389
	Dec.	334	1.28	428
	TOTAL	5,829	1.20	7,010
1972	Jan.	341	1.28	435
	Feb.	389	1.24	481
	Mar.	618	1.19	735
	Apr.	644	1.17	756
	May	560	1.18	659
	June	559	1.16	648
	July	667	1.15	766
	Aug.	633	1.12	708
	Sept.	484	1.17	567
	Oct.	295	1.38	407
	Nov.	267	1.28	343
	Dec.	340	1.24	424
	TOTAL	5,797	1.20	6,929
1973	Jan.	361	1.20	432
	Feb.	306	1.21	371
	Mar.	532	1.12	594
	Apr.	663	1.09	722
	May	571	1.15	658
	June	524	1.15	601
	July	645	1.11	715
	Aug.	613	1.15	707
	Sept.	539	1.13	610
	Oct.	452	1.16	524
	Nov.	310	1.23	383
	Dec.	331	1.23	407
	TOTAL	5,847	1.15	6,724
1974	Jan.	255	1.28	326
	Feb.	408	1.14	465
	Mar.	571	1.12	642
	Apr.	714	1.11	795
	May	626	1.14	713
	June	624	1.12	696
	July	727	1.10	798
	Aug.	733	1.08	795
	Sept.	558	1.11	621
	Oct.	409	1.17	480
	Nov.	292	1.25	364
	Dec.	301	1.23	370
	TOTAL	6,218	1.14	7,065
1975	Jan.	351	1.17	411
	Feb.	382	1.14	438
	Mar.	559	1.11	622
	Apr.	662	1.10	731
	May	642	1.12	722
	June	555	1.12	623
	July	654	1.09	713
	Aug.	662	1.09	724
	Sept.	561	1.11	622
	Oct.	450	1.16	521
	Nov.	334	1.20	401
	Dec.	349	1.18	413
	TOTAL	6,161	1.13	6,941
1976	Jan.	341	1.18	403
	Feb.	328	1.18	387
	Mar.	658	1.07	707
	Apr.	679	1.09	742
	May	592	1.12	660
	June	557	1.11	618
	July	647	1.08	701
	Aug.	670	1.08	722
	Sept.	450	1.09	492
	Oct.	369	1.16	427
	Nov.	257	1.26	324
	Dec.	355	1.19	422
	TOTAL	5,902	1.12	6,605
1977	Jan.	264	1.24	326
	Feb.	389	1.12	438
	Mar.	569	1.10	627
	Apr.	681	1.09	740
	May	534	1.12	598
	June	586	1.09	640
	July	734	1.06	779
	Aug.	603	1.10	661
	Sept.	433	1.13	489
	Oct.	325	1.17	381
	Nov.	277	1.18	329
	Dec.	310	1.16	359
	TOTAL	5,705	1.12	6,367
1978	Jan.	171	1.34	229
	Feb.	340	1.10	375
	Mar.	550	1.05	578
	Apr.	697	1.05	732
	May	563	1.10	617
	June	589	1.09	639
	July	708	1.08	765
	Aug.	664	1.09	721
	Sept.	501	1.11	555
	Oct.	357	1.15	412
	Nov.	274	1.21	332
	Dec.	285	1.21	343
	TOTAL	5,700	1.11	6,298
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	Nov.			
	Dec.			
	TOTAL			

To obtain mg/L multiply T/AF by 735.29

Table 20

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Imperial Dam, Arizona-California

(Annual Summary)

Calendar Year	Flow 1000 (AF)	Concentration (T/AF)	T.D.S. 1000 (TON)	Flow 1 000 000 (m^3)	Concentration (mg/L)	T.D.S. 1000 (t)
1941	14,024	1.07	14,980	17 298	786	13 590
1942	14,714	1.08	15,917	18 150	796	14 440
1943	11,345	.94	10,679	13 994	692	9688
1944	13,205	.95	12,545	16 288	699	11 381
1945	11,390	.95	10,841	14 050	700	9835
1946	9,486	.95	9,041	11 701	701	8202
1947	10,041	.97	9,711	12 385	711	8810
1948	12,036	.93	11,242	14 846	687	10 199
1949	12,567	.88	11,104	15 501	650	10 074
1950	9,906	.90	8,887	12 219	660	8062
1951	8,053	.96	7,764	9933	709	7044
1952	14,815	.91	13,485	18 274	669	12 234
1953	10,045	.94	9,411	12 390	689	8538
1954	9,030	1.00	9,024	11 138	735	8187
1955	7,708	1.14	8,798	9508	840	7982
1956	6,266	1.25	7,828	7729	919	7102
1957	7,344	1.17	8,598	9059	861	7800
1958	10,500	1.01	10,626	12 952	744	9640
1959	7,695	1.02	7,843	9492	750	7115
1960	7,107	1.06	7,511	8766	777	6814
1961	6,293	1.12	7,020	7762	821	6369
1962	6,458	1.11	7,189	7966	819	6522
1963	6,522	1.08	7,016	8045	791	6365
1964	5,900	1.12	6,616	7278	825	6002
1965	5,703	1.25	7,109	7035	917	6449
1966	5,849	1.22	7,133	7215	897	6471
1967	5,615	1.15	6,430	6926	842	5833
1968	5,741	1.15	6,611	7081	847	5997
1969	5,616	1.20	6,726	6927	881	6102
1970	5,705	1.21	6,877	7037	887	6239
1971	5,829	1.20	7,010	7190	884	6359
1972	5,797	1.20	6,929	7150	879	6286
1973	5,847	1.15	6,724	7212	846	6100
1974	6,218	1.14	7,065	7670	836	6409
1975	6,161	1.13	6,941	7599	828	6297
1976	5,902	1.12	6,607	7280	823	5994
1977	5,705	1.12	6,367	7037	821	5776
1978	5,700	1.10	6,298	7031	812	5713
Total	313,838		328,502	387 114		298 020
Average	8,259	1.05	8,645	10 187	769	7843