State Water Resources Control Board
Hearing Name IID Transfer - Phase 1
Exhibit: 19
For Ident: ____ In Evidence: ____

WATER CONSERVATION PLAN

1985

IMPERIAL IRRIGATION DISTRICT

Water Conservation Plan

THE COVER PHOTO OF THE J. MELVIN SHELDON RESERVOIR IS SYMBOLIC OF THE IMPERIAL IRRIGATION DISTRICT'S CONTINUING COMMITMENT TO AGRICULTURE AND THE EFFICIENT MANAGEMENT OF OUR LIFE BLOOD THAT CREATED THIS DESERT MIRACLE.

1985

IID-353

IIDXO

IMPERIAL IRRIGATION DISTRICT

INTER-OFFICE MEMORANDUM

TO Board of Directors

COPIES TO

DATE August 8, 1985

FROM General Manager

DEPARTMENT AT Imperial

SUBJECT Water Conservation Plan

Since the presentation of the Draft Water Conservation Plan to the Board on January 22, 1985, the document was distributed to more than twenty agencies and individuals for comments. Written suggestions and comments were received from representatives of eight agencies within the 60-day comment period, or shortly thereafter.

District staff, primarily members of the Water Conservation Task Group, have reviewed the submitted suggestions and incorporated those which were determined to be appropriate into the revised document. Following that, there has been a complete in-house review and, in addition, a brief but thorough review by representatives of Parsons Water Resources.

I now recommend that the Board, by Resolution, accept the document as the District's official Water Conservation Plan, and authorize broad distribution thereof to all interested parties.

Charles L. Shreves

CHARLES L. SHREVES

RESOLUTION NO 19-85

WHEREAS, Imperial Irrigation District Resolution No. 38-84, adopted June 27, 1984, provided that the District shall continue its implementation of its expanded water conservation program; and

WHEREAS, a Draft Water Conservation Plan, prepared by District staff together with engineering and legal consultants, was submitted to the Board of Directors on January 22, 1985; and

WHEREAS, in response to the District's invitation, several concerned agencies submitted comments on the draft plan; said comments being incorporated in the final document, where appropriate.

NOW THEREFORE, BE IT HEREBY RESOLVED, that the Imperial Irrigation District Board of Directors accepts the 1985 Water Conservation Plan submitted in final form this date, as the official plan of the District, and reaffirms the actions authorized by Resolution No. 38-84 to implement the studies, planning, and conservation measures identified in the 1985 Water Conservation Plan.

PASSED AND ADOPTED THIS 13th day of August, 1985.

IMPERIAL IRRIGATION DISTRICT

IMPERIAL IRRIGATION DISTRICT
ORGANIZED
JULY 25, 1911
EL CENTRO, CALIFORNIA

By: W. R. Condit
President

By: Larry E. Beck
Secretary

ACKNOWLEDGEMENTS

BOARD OF DIRECTORS

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Imperial Irrigation District

WATER CONSERVATION PLAN

Abstract

The District's Water Conservation Plan describes short-term programs to be implemented in 1985 through 1989; and long-term goals for water conservation, both structural and nonstructural, which are the direct responsibility of the District. It also describes many programs which are intended to aid water users in their application and use of water on-farm.

Altogether, after full implementation of the described projects and programs, it is estimated that 325,000 acre-feet of water or more can be salvaged each year.

Financing of projects will continue using funds available from the Water Conservation Fund plus monthly accruals into this fund at the rate of $1.75/AF of water sold. About $6.3 million will be expended during 1985 in designated programs. If additional funds become available, the programs described will be accelerated so that water savings can be achieved in the shortest practical time.

The Plan is a "general plan" for improvement of conveyance, storage, and irrigation facilities in Imperial Valley. Conservation will result from the actions described in the Plan.

EXECUTIVE SUMMARY

IMPERIAL IRRIGATION DISTRICT
WATER CONSERVATION PLAN

EXECUTIVE SUMMARY

This Water Conservation Plan of the Imperial Irrigation District (District) is intended to be a general plan to improve the District's water distribution system. The Plan emphasizes programs for physical improvement, management procedures applicable to District facilities, and irrigation management techniques by which the District can help agricultural water users increase their on-farm irrigation efficiencies.

With efficiencies of 73 to 81 percent, the District is recognized by the U. S. Bureau of Reclamation (USBR) as comparing well with a number of other systems in the United States. Nevertheless, the USBR has studied various "opportunities" that are available to the District to conserve water. These opportunities will be expensive to implement, but it may be possible for the District to fund water conservation improvements from revenues generated by the transfer of water that has been conserved by the District in exchange for contractual rights to purchase the water saved.

It must be noted that Imperial Valley's infrastructure is an integral part of California's water system. Several other California water suppliers, in particular the Metropolitan Water District (MWD), also divert water from the Colorado River, which makes the transfer and exchange of water physically possible, provided satisfactory contractual arrangements are made.

Background

The District is a public corporation organized in 1911 under the California Irrigation District Act, California Water Code Sections 20500 et seq. It is governed by a five-person Board of Directors elected by the District voters. The gross area of the District is 1,062,290 acres, with about 465,000 acres in the central part of the District known as the "Imperial Unit" and irrigated for agricultural purposes. According to the 1980 census, Imperial Valley contains nine cities and towns with a total population of approximately 65,000; about 27,000 people live in the Valley's unincorporated areas.

Revenues for the District's water operations generated primarily from the \$9/acre-foot (AF) charge would result in \$22.5 million for a typical year in which 2.5 million acre-feet (MAF) of water are sold. The Water Conservation Fund is allocated \$1.75/AF of water sold, so that in a typical year the Water Conservation Fund would be credited with \$4.375 million.

Imperial Valley contains relatively recent deposits of water-transported
The central irrigated area served by the District generally lies below level, and it has fine-textured silts rather than sands usually assoc with desert areas. The soil types that predominate in the developed are the Valley are Imperial, 300,000 acres; Holtville, 80,000 acres; Meloland, 40,000 acres.

Imperial Valley is seismically active having had more than 60 earthquakes recorded Richter Scale magnitudes of 5.0 and greater since 1900. The V has a typical desert climate with summer daytime temperatures exceeding 1 on more than 100 days each year, but the Valley has a mild and favo climate the remainder of the year. The mean annual temperature (1914 to is 72.5°F, and the average annual rainfall is 2.91 inches. Although frosts are not common, a low temperature of 16°F was once recorded; the temperature of 119°F has been recorded several times.

The Valley is subject to infrequent but sometimes intense storms. In Tropical Storm Kathleen caused extensive flood damage, which was exceede 1977 by the damage from Tropical Storm Doreen.

The Colorado River, the sole source of water for Imperial Valley, is on the most physically developed and regulated rivers in America. "The L the River," as applied to the Colorado River, has evolved out of a combi of both federal and state statutes, interstate compacts, court decisions decrees, contracts with the United States, an international treaty, ope criteria and administrative decisions. All of the foregoing have result a division or apportionment of the waters of the Colorado River among u thereof, or the rights to the "consumptive use" of the Colorado River w However, it must be pointed out that it is highly probable in the near fu the Colorado will not yield a sufficient supply of water in dry and no years to meet the increasing demands for its use without the withdraw water from storage reservoirs.

The high salinity of Colorado River water presents acute problems fo users. Dissolved salts in the water damage the plumbing and appliance domestic users. For agricultural users, water salinity can destroy cro or at least reduce crop yield and restrict the choice of crops to be The USBR estimated that economic losses from salinity in the Colorado R Basin average $113 million annually (USBR, 1984b), but this loss could than double by the year 2010 if no corrective measures are taken.

The ultimate repository for drainage water from the District is the Sea. With a surface area of about 383 square miles (or 245,000 acres), California's largest lake. The Sea receives drainage from about 1,075 sq miles, or 690,000 acres of irrigated lands in the Imperial, Coachella

Mexicali Valleys.

During the past several years, the elevation of the Salton Sea has served as a barometer, rising in the spring and falling in the summer and fall, usually ending each winter at an elevation higher than the previous year. Because agricultural drainage from Imperial Valley is the largest inflow element to the Sea, those concerned about the rising level of the Sea suggest that the District reduce its agricultural drainage in order to stabilize or lower the level of the Sea. The engineering firm of Bookman-Edmonston concluded (B-E, 1983) that inflow from the District has actually declined in recent years (1976-1983). The other principal components of inflow to the Sea, i.e., rainfall, storm runoff, and inflow from Mexico during that same time period, were substantially higher than normal.

Water Rights

The water of the Colorado River is used by both the Upper Basin States (Colorado, New Mexico, Utah, and Wyoming) and the Lower Basin States (Arizona, California, and Nevada), as well as by Mexico. In accordance with the Colorado River Compact, the Upper and Lower Basin States are each entitled to the exclusive beneficial consumptive use of 7.5 MAF of Colorado River water each year, in perpetuity. In addition, an option is granted to the Lower Basin States for the use of an additional 1.0 MAF for beneficial consumptive use. The 1921 California Limitation Act limits California's annual consumptive usage to 4.4 MAF, plus not more than one-half of any excess or surplus water unapportioned by the Compact.

By treaty signed on February 3, 1944, Mexico is entitled to 1.5 MAF of the Colorado River water each year. In years of low flow, any shortfall required to meet Mexican treaty rights will be made in equal quantities by the Upper and Lower Basin States.

The 1931 California Seven-Party Agreement provides that the Palo Verde Irrigation District, the Yuma Project, the Imperial Irrigation District and lands in Imperial and Coachella Valleys to be served by the All-American Canal, and 16,000 acres of Mesa lands in the Palo Verde Irrigation District are entitled to 3.85 million AF annually under the first three priorities after satisfaction of Mexican entitlement under the existing treaty of 1944. Priority 4 allocates 550,000 AF annually to the MWD. These first four California priorities total 4.4 MAF.

The District has a "present perfected right" to 2.6 MAF annually. One significance of the District's present perfected right is that in times of shortage, present perfected rights must be satisfied first. Of the users described in the Seven-Party Agreement, only the Palo Verde Irrigation District, Imperial Irrigation District, and the Reservation Division, Yuma

Project California Division (non-Indian portion), have present p rights. Although there is no explicit contractual prohibition transfer of conserved or surplus water, which is a portion of water d to the District pursuant to federal contract, it would be appropi obtain the prior consent of the Secretary of Interior. Conserved or water, which is a portion of District water appropriated pursuant law, may be used outside of the District boundaries if the District's Directors finds it to be for the best interest of the District. (See Code Sections 22259, 109, 1011, and 1244.)

Description of Water System

Imperial Dam is the diversion point on the Colorado River from which w delivered to users in Arizona, Mexico and California. Water is conve this point to the Imperial Valley via the 80-mile-long All-America which was built by the USBR in the 1930s. Through this Canal, an ave 2.75 MAF of water annually has been conveyed over the past ten year head of the District system at Drop No. 1. Several main canals branch All-American: the East Highline, Central Main, Westside Main, and New Canals. Service to Imperial Valley is provided from these four main c from the tributary lateral canals that they supply. In total, 1,703 m irrigation canals are within the District. Four regulating reservoir total storage capacity of 1,570 AF are included within the dist system.

The Water Control Section of the District's Water Department is resp for the transmission of water through the main canal system and its di to the laterals for distribution to the users. Water distribut complicated task that involves adjusting the appropriate check, delive other structures. There are approximately 3,400 check structures a delivery structures within the system. A coordinated procedure has e handle this complex distribution process.

The primary user of water within Imperial Valley is the agricultural which in 1983 used approximately 98 percent of the water supplied Valley. The average acreages of crop planted within the period within the Valley are:

Crop	Acres
Alfalfa	181,000
Wheat & Barley	132,500
Cotton	69,500
Sugar Beets	51,500
Lettuce	40,000
Melons	16,500
Sudan	16,000
Misc. Garden	28,500
Misc. Field	15,500
Misc. Permanent	14,000
Sorghum, Grain	11,500
Total	576,500

The methods used to irrigate these crops include sprinkler, furrow, border, corrugation, basin, drip and tailwater return irrigation. Irrigation is the most important management practice of the Imperial Valley farmer and must be adapted to the crop, soil conditions, and other parameters as required.

The actual on-farm use of water can be derived by adding the consumptive use and leaching requirements and dividing the sum by the on-farm application efficiency. Consumptive use refers to the amount of water used by crops to build up plant tissue, water transpired from plant surfaces, and water evaporated from the soil surface. The typical average consumptive use within the Valley is estimated as 3.7 AF/acre. The leaching requirement refers to that amount of water applied in excess of the consumptive use to leach out salts from the soil profile; it is estimated to average 0.6 AF/acre for soils that have been sufficiently leached (reclaimed) in the past.

As part of its operating system, the District maintains an extensive drainage system. The lateral drain system is laid out to provide a drainage outlet for each 160-acre plot and, as such, the drains usually parallel the canals. The District is obligated to provide its drains at sufficient depth - generally 6 to 10 feet deep - to accept tile drain discharge. Where the drain cannot be maintained at sufficient depth, a sump and pump are provided and maintained by the District. These drains are used to collect excess surface flow (tailwater) from agricultural fields, subsurface tile discharges, and spills from canals and laterals. There are over 1,453 miles of surface drains that can be divided into three main areas: Alamo River System, New River System, and drains that flow directly into the Salton Sea. Approximately 430 control structures are installed along the drainage system.

Extensive maintenance is required for the entire irrigation and drainage system.

Past District Water Conservation Programs

The District has initiated many water conservation programs an participated in various programs in cooperation with governmental agen The District has also offered public education programs and has encour innovative on-farm practices.

The District's canal lining program, which began in 1954, has resulted in 871 miles (IID, 1985) of canals being concrete lined, over one-half District's water conveyance system. In addition, 9 miles of canals have replaced with concrete pipe. Concrete lining virtually eliminates s losses and reduces evaporation losses because of the smaller exposed surface area. Pipelining can eliminate seepage and evaporation losses.

The District's four regulating reservoirs, providing a total storage ca of 1,570 AF, have been built since 1975 at a total cost of $3.3 million. is estimated that 6,200 AF of water are conserved annually through the these reservoirs, which help reduce operational spills from the canal s they serve.

Another major structural improvement has been the installation of 6 mi drainage lines parallel to the East Highline Canal to recover canal se losses. Water entering these drains is pumped back into the can delivery to farms at a rate of 17,500 feet per year. The total constru cost was $492,000. Approximately $50,000 is spent annually for operati maintenance costs.

Improvements in the operational procedures used to distribute and d water increase the efficiency of the water conveyance system. An training program for zanjeros and hydrographers keeps these employees inf of new techniques in water measurement and management. Radio eq installed in Water Department vehicles ensures the rapid communi required to provide operational flexibility, helping to reduce operat spills. The flexibility of control is further enhanced through the electronic monitoring and control devices installed at 22 major struct some of which are located on the All-American Canal and at th reservoirs.

The 1976 Drain Water Reuse Program permits farmers to utilize drainage free of charge, for irrigation or reclamation. The effect of this pro to reduce inflow to the Salton Sea and encourage water use to its ult capacity. The California Fish and Game Department, in cooperation wi District, uses drain water to maintain a 1,400-acre wildlife habitat a to the Salton Sea. The District has also constructed a 100-acre pond i New River bottom using reclaimed water.

The District has implemented a series of educational programs to encourage agricultural water conservation. These range in complexity from public meetings to full-scale programs and include demonstrations of tailwater recovery systems, training procedures for irrigators to irrigate with minimum tailwater, training procedures in various irrigation scheduling methods, field demonstration days teaching methods to measure water, and the demonstration program in irrigation scheduling using the neutron probe. In the neutron probe program, soil moisture is monitored once or twice a week with a neutron probe; the data is plotted on a graph. Based on the soil moisture data, recommendations are sent to the grower advising when to irrigate and how much to apply.

The administrative tools used by the District Board of Directors to initiate many of the above-mentioned programs have been the 13-Point and 21-Point Programs. As part of the 13-Point Program, the Tailwater Assessment Program requires that a daily inventory of tailwater discharge be taken. A charge of three or more times the water rate for the water delivered that day is assessed to users found discharging excessive tailwater. This assessment program is still in effect.

The District has been involved in various cooperative studies and programs to research innovative water conservation methods. Different levels of involvement have been required of the District. For example, the District has helped the USDA Research Station in Brawley by constructing a lysimeter to determine crop water consumption; helped to construct an underground soil column laboratory, a reservoir, and a pumping station; installed four evaporation and weather stations; and provided labor, equipment, and materials for a 5-year irrigation efficiency study.

The District has also cooperated with the University of California Extension Service farm advisory staff for many years, mainly by furnishing water flow and water quality data. Recently, the District has participated in the California Irrigation Management Information System and mobile laboratory programs sponsored by the University in conjunction with the California Department of Water Resources (DWR).

Imperial Valley farmers have been practicing water conservation from the beginning of development in the Valley. The land had to be properly tiled, graded, smoothed and otherwise prepared for the uniform application of water to the crop. More than 80 percent of Imperial Valley fields needed to be tiled for proper drainage in order to remove the excess salts from the soil root zone. Other management practices include land leveling and the conscientious use of both traditional and innovative methods to ensure the uniform application of water to the soil.

The water conservation efforts by the District and the local farmers saved water and reduced agricultural drainage into the Salton Sea. measurement of the drainage quantity is a prime indicator of the ove effectiveness of water conservation. Because of yearly variations in cro patterns, weather, economic conditions and other factors, it is necessar compare Salton Sea inflow for a series of years to obtain a be understanding of the long-term trend. Available District records inc that the average District inflow has been on the decline for the pas years.

Other Programs for Consideration

(1) Structural Programs: Change measurement structures to improve accuracy, pipeline canals to eliminate seepage and evaporation, desalinize a portion of the Colorado River water upstream of deliver the District system in order to lower the leaching requirement.

(2) Operational Programs: Standardize delivery head increments to a "matching" of orders in order to reduce spill and sequence deliveries to allow their timely movement.

(3) Administrative Programs: Allot water based on specific requirements, accelerate water rate structures, provide monetary other incentives for those who generate acceptable tailwater dischar and develop a conservation plan for nonagricultural water users the District.

(4) On-farm Programs: Select and possibly develop crops with lower usage and establish programs to reduce excessive leaching on sandy sc

(5) USBR Recommendations: The USBR concluded in its Special Report "cost-effective water conservation opportunities are available to District (USBR, 1984b)." Emphasis was placed on the need for fur detailed study, eventually leading to funding selected programs. USBR envisions that construction would begin in 1990 and would occur a 5 to 25-year period, with a projected total capital expenditur $124.9 million to conserve a portion of 354,000 AF of water poten available.

(6) DWR Recommendations: The DWR suggested various programs (DWR, 19 save an estimated 178,000 AF of leaching water and tailwater, 50,0C of canal spills, 110,000 AF of canal seepage by lining, and 30,000 A seepage recovery lines.

Other suggestions for conserving water have come from individual far and the Citizens' Salton Sea Committee. Several other water conser a programs have been suggested for consideration; however, few have been incorporated into the 1985 Plan either because of prohibitive cost or the availability of more attractive options. No discussion of feasibility is made herein of these programs.

Water Conservation Plan

The District's 1985 Budget was approved by its Board of Directors in December 1984, and within this budget is an allocation of $6.4 million for the Water Conservation Program. Assuming that in 1985 a total of 2.5 MAF of water at $9/AF is sold, the water conservation budget would represent 28 percent of the Water Department's budget.

An accounting procedure was adopted to provide for a separate accounting of water delivered versus water ordered and billed. This change in procedure allows for the use of billing records to determine the actual quantities of water delivered to users. In addition, a new tailwater assessment program is being developed to evaluate the quantity of tailwater produced within the District. A statistical sampling plan to measure operational spills will be formulated prior to implementation.

To quantify the amount of lateral canal seepage, the following canal seepage study will be implemented in 1985: First, a map showing all unlined sections of laterals will be prepared along with an inventory thereof. These inventoried laterals will be rated by expected seepage characteristics in general terms of highest, high, low and lowest. Superimposed on the map will be a soils map to aid in determining seepage rates. Several seepage measurements will be made each year using ponding studies. Using the aforementioned map and the results of the ponding tests, an annual estimate will be prepared of the total seepage in unlined laterals. An annual memorandum report will document relevant data, test results, and the annual estimate of seepage.

A tile-flow monitoring program will be implemented to augment the District's current sump study by installing recorders on 10 tile outlets in the areas of the District not covered by sumps. This data will be used to determine flows from tile drainage lines for the whole District as part of the total water budget. An additional study will evaluate the actual leaching fraction necessary to grow crops in Imperial Valley. The leaching requirement will vary for different crops, soil types, and other parameters.

Financing Water Conservation

Water conservation projects have been funded by a portion of the revenues from water sales. It is anticipated that future water conservation projects and programs will be funded in the same manner. However, proposals have recently been made that water conservation projects be paid for by others. concept is believed to stem from the USBR's study and draft report of wa conservation opportunities in which it is estimated that there are w losses within the District that might be conserved (USBR, 198 Furthermore, assuming that the District now delivers its full agricult water requirement to farmers, it appears that such conserved water coul available for sale to other California entities.

By Resolution 8-84 (Supplement 1), adopted January 24, 1984, the Dist invited "other members of the Seven-Party Agreement, the Bureau of Reclamat and beneficial users, including geothermal industry, within the District discuss water conservation opportunities...including the cost and metho payment for such conservation, and the potential use by the District and ot members of the Seven-Party Agreement of the water thus conserved."

It is not known if agreements might be made that would provide money to District from any of these other parties or other sources. Discussions taken place and firm agreements appear possible. Three main components pr to any agreement have not been determined: water quantities that ca conserved, cost of measures to conserve water, and terms of reimburseme the District through sales of conserved water. Studies to determine th components will be necessary and have been contracted for.

The USBR's 1984 CLSI study (USBR, 1984a) has the purpose to "further st the application of water conservation measures to existing Imperial Irrig District irrigation facilities, operations, and practices in promoting efficient use of water, and to develop an additional water supply for fu needs in the District and in Southern California."

Other means of financing (e.g., loans or bond sales) may be considered at future time, as will increased rates or assessments if deemed necessary.

In the USBR's Special Report (USBR, 1984b), it is estimated that the ca cost of "cost effective" programs would be $124.9 million. The Distri evaluating this estimate and is now participating with the USBR in the study on an equal cost-sharing basis. Estimates of cost and quantitie water savings will be refined at the conclusion of the study. District will continue independent studies as well and have retained consultants this purpose.

Expenditures on water conservation projects and programs, structu improvements, and management programs will be made at the maximum commensurate with funding capabilities, including revenues derived from of water.

Structural Programs

The District has budgeted $2.25 million for the 1985 canal-lining program. The canal-lining schedule is based on seepage potential, hydrilla infestations, and operational considerations.

Construction of a $1.2-million regulatory reservoir at the Trifolium Extension heading of the Westside Main Canal is scheduled for 1986. The total capacity will be roughly 300 AF, and it is estimated that 4,100 AF/year of operational spill will be conserved by this strategic placement of a reservoir adjacent to the Trifolium Extension spill structure.

It is projected that 10 timber slide gates will be replaced by aluminum gates on operational discharge structures to eliminate leakage.

Operational Programs

A study will be made to determine the type and functions of a computerized SCADA system and any necessary changes to upgrade the communication network. Specifications will be prepared for equipment procurement in 1986. The zanjero training program will continue as part of the normal ongoing procedure.

Administrative Programs

Additional zanjeros will be employed to improve delivery flexibility and to monitor tailwater. Additional water conservation employees will be hired.

The tailwater assessment program will be continued, and it will be reviewed for improvements.

Educational Programs

Six demonstration tailwater recovery systems will be constructed to determine the effectiveness and costs of tailwater recovery systems.

Newspaper articles, brochures, and instruction booklets relating to water conservation are being released through the Public Information and Community Services Section.

Four field-irrigation demonstrations will be conducted. A series of video irrigation training programs will be developed to provide training for 10 growers and their irrigators in methods that produce minimum tailwater discharge.

Cooperative Programs

The District has budgeted $162,000 for a 50-percent, cost-sharing program the USBR on canal and system improvement study. Priority has been giv study seepage losses of the East Highline Canal and the possibility constructing an 8,000-AF reservoir along the All-American Canal.

A joint study with a research team from the USDA is being made of fluctuat that occur in lateral canals and in determining ways of minimizing fluctuations.

Money has been allocated to pay for the cost of electricity to pump water for irrigation. This will help an ongoing study being performed b USDA.

A pond will be constructed at the outlet of the Elder 14 Drain into th River to divert 825 AF of drainage water each year to this waterfowl hab area.

In cooperation with the USBR, the irrigation scheduling program, invol 12,000 to 15,000 acres, will be continued.

Research Programs

Preliminary design will begin of a spill interceptor canal and reservo intercept flows from the East Highline System into the Alamo River.

A complete analysis is being conducted of data gathered from the "mod demand irrigation trial" program.

A computerized water management program developed by the USBR wil implemented on one or two zanjero runs.

Long-Term Goals

The firm of Parsons Water Resources, Inc., a subsidiary of The P Corporation in Pasadena, California, submitted a proposal that includ preliminary schedule to implement various features of the District's estimates of water conservation, and preliminary cost estimates. P conducted an on-site review of the District's system and operati interviewed operating personnel, and reviewed pertinent documents inc the USBR and DWR reports. District reports and records were also stud document existing conditions.

The estimated cost of implementing all of the elements of Parsons' pro plan was approximately $450 million. Parsons' tentative plannin implementation schedule extends over a 13-year period. The cumu estimated water yield would be 550,000 AF/year if all elements proposed were implemented.

In May 1985, Parsons was authorized to proceed with initial studies and analyses in order to quantify the District's present and future water needs and determine the conserved water that might be available for use by others and the potential transferees for that water. These studies will be completed in the fall of 1985. It is also intended that Parsons will continue to assist the District to develop and implement various water conservation projects and measures included in this plan, as further refined during the implementation planning phase. As directed by the District, Parsons will also provide technical, legal, and financial experts and consultants as may be necessary or useful to enable the water conservation program to proceed efficiently and expeditiously.

To manage its water supply effectively, the District intends to continue expanding its water conservation programs, limited only by available funds and construction schedule.

Miscellaneous Programs to Reduce Salton Sea Inflow

The Water Conservation Plan is designed to reduce losses, most of which contribute to the inflow to the Salton Sea. Assuming that other inflow elements remain unchanged, the level of the Sea is expected to decline. However, recognizing that conservation programs take time to implement, whether that time is 5 years or 20 years, other alternative programs need to be considered that can be applied in a shorter time period.

Several proposals will be studied during 1985 that are not specifically in the Water Conservation Plan, including:

(1) Spreading drain water on available idle land by ponding, flooding, or sprinkling.

(2) Constructing storm detention basins on the East and West Mesas.

(3) Irrigating with free drain water (through the cooperation of landowners) and alternating with canal water.

(4) Pumping water from the Salton Sea to shallow ponds adjacent to the Sea.

(5) Pumping water from drains to shallow ponds on the East and West Mesas (or other available lands) for wildlife ponds/marshes or other uses.

(6) Supporting the continued investigation of diverting the New River at or south of the Mexican border to Laguna Salada in Mexico.

(7) Separating tile drain flows from tailwater to reuse surface runoff.

Environmental Issues

In accordance with the California Environmental Quality Act (CEQA), District has by resolution adopted the State CEQA guidelines. guidelines provide that certain programs are exempt from prepa environmental assessments. Programs in this category include concrete li existing District canals, pipelining portions of laterals and dr installing road crossings, and replacing existing structures.

The District has prepared a declaration of negative impact for each regul reservoir, and it will continue to file this type of environmental review similar projects. As major projects in the Water Conservation Plan prepared for implementation, an environmental assessment as required by guidelines will be prepared. The major environmental issues expected to b concern are:

(1) Reduction of flows in drains.

(2) Reduction of inflow to Salton Sea.

(3) Increase in salinity of drain waters.

(4) The impact of these three factors on fish and wildlife, recreat and aesthetic values.

Conclusions

This Plan delineates specific projects and programs to save water. The a high degree of probability for conservation as a result of increa efficiencies of the District's systems and the farmers' irrigation operat

As stated in the Introduction, this Plan is a general plan for improvem (both structural and nonstructural) of conveyance, storage, and irrig facilities in Imperial Valley. Conservation of water will result from actions described in the Plan.

The Plan should be reviewed annually by the Board of Directors and modifie conditions change. The time schedules and proposed future expenditure subject to review. As funds may become available from outside sou schedules will be tightened and expenditures accelerated to accomplish earliest construction of structural works and implementation of nonstruc programs.

At this point, and presumably throughout the period of implementation Plan is voluntary on the part of District's water users. There will continued monitoring of tailwater, with special assessments and penalties assigned. By a coordinated effort, landowners and water users will continue to improve their use of water.

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SUPPLEMENT*

1. Imperial Irrigation District Resolutions Relating to Water Conservation.

2. State Water Resources Control Board Water Rights Decision 1600, "Imperial Irrigation District Alleged Waste and Unreasonable Use of Water" June 1984 (excerpts, "Conclusion" and "Order").

3. Letter from Ralph Gilbert (Imperial Valley farmer) to Mr. (R. F.) Carter and Mr. (J. M.) Sheldon, dated September 19, 1974.

4. Letter to Board of Directors from Citizens' Salton Sea Committee, dated June 1, 1976.

5. Memorandum of Understanding between the Agricultural Research Service and Imperial Irrigation District for project entitled "Use of Saline Drainage Water for Irrigation: a field demonstration in Imperial Valley," dated February 16, 1982.

6. Technical paper entitled "Irrigation Efficiency in Imperial," J. D. Oster, J. L. Meyer, L. Hermsmeier, and M. Kaddah, extracted from Proceedings of the Specialty Conference sponsored by the Irrigation and Drainage Division of the American Society of Civil Engineers, entitled "Water Today and Tomorrow," held at Flagstaff, Arizona, July 24-26, 1984.

7. University of California Cooperative Extension, Division of Agriculture and Natural Resources Leaflet 21379 "California's Water Resources," April 1984.

8. Memorandum of Understanding between Imperial Irrigation District and U.S. Water Conservation Laboratory, Phoenix, Arizona, for Cooperative Delivery Response Study, dated January 3, 1985.

9. Agreement between the Bureau of Reclamation and Imperial Irrigation District to Provide for an Advance of Funds to Supplement Available Appropriated Federal Funds for the Canal lining and System Improvement Study, dated June 3, 1985.

10. Advisory Panel on Agricultural Water Conservation, Report of Findings, dated May 1979, and submitted to the Director, Department of Water Resources.

*Bound Separately

11. Advisory Committee on Agricultural Water Problems/Water Conservation in Agriculture, Short-Term and Long-Term Strategy, September 1980, submitted to sponsoring agencies.

12. Governor George Deukmejian's presentation to the California Legislature and others, entitled "California's Water Future, Policy and Plumbing Go Hand in Hand, A Call to Action," April 5, 1984.

13. List of canals and laterals recommended by Division Superintendents to be concrete lined due to high seepage.

14. Canal and Lateral Mileage and Location of Operational Discharges (spills).

15. Water Conservationn Information and Advice mailed to District consumers.

CHAPTER I
INTRODUCTION

CHAPTER I

INTRODUCTION

A. PURPOSE

The Water Conservation Plan (Plan) of the Imperial Irrigation District (District) is a general plan that has been created to improve the District's water distribution system during the next 10 to 15 years, including the extension of current programs. The planned improvements are expected to increase efficiency, reduce maintenance costs and subsequently result in water savings. Emphasis is placed on physical improvements and management programs adaptable to District facilities. High priority is also given to irrigation management programs in which the District can provide leadership, information and advisory services to help the users increase efficiencies in their application of irrigation water to Imperial Valley lands.

The District delivers Colorado River water to about 0.5 million acres of land within Imperial Valley for agricultural, domestic, industrial and other beneficial uses. This supply is the sole source of water for the Valley. Rainfall and runoff are infrequent and insufficient. Groundwater is not usable because of its low quality.

Before the District was organized in 1911, private developers, beginning in 1901, had constructed extensive systems of earth canals and laterals to serve about 220,000 acres of land in Imperial Valley. The District subsequently assumed control of operations of all private facilities and consolidated them into one system. Later, by extending and completing conveyance facilities, the District increased its capacity to deliver water to the present service area of approximately 500,000 acres. An extensive drainage system was constructed (beginning in 1923), and on-farm tile drainage systems were installed by landowners beginning in 1929.

During this period of construction, the District operated and maintained the canal and open-drain systems, as necessary, to provide continuous service to water users. Removal of silt and weed control were constant maintenance problems. The District has gradually improved the systems by (1) replacing timber and rubble structures with concrete, (2) replacing timber bridges and corrugated iron culverts with reinforced concrete pipe, (3) pouring concrete lining over one-half of the lateral canal system, (4) installing remote and automatic controls on major structures, and (5) constructing four regulating reservoirs during the past 8 years to conserve water and provide more flexible service. The District has implemented a comprehensive water conservation program (detailed in

Chapter VI). This program has gradually improved the efficiency of the District's system and has resulted in conserving water that was previously lost to seepage or operational spills.

B. SCOPE

The scope of this Plan is broad - to outline water conservation within the Imperial Irrigation District. The District is a complex and expansive system of water distribution and usage. Therefore, it was decided to write this Plan as a document that will serve as a single-source reference concerning water conservation within the District.

The Plan is divided into six chapters. Chapters I through V provide a backdrop upon which Chapter VI, the Plan itself, is superimposed.

Chapter II describes the unique geography of the Imperial Valley and continues with the history and development of the Imperial Valley, in particular, the Imperial Irrigation District.

Chapter III consists of an extensive description of the distribution and usage of water within the District. The District's irrigation and drainage conveyance systems are portrayed in considerable detail, as are the agricultural uses of water within the system. The urban, industrial, recreation and wildlife uses of water are discussed briefly.

Chapters IV and V detail water conservation programs. Included are past District programs and accomplishments, as well as programs that have been suggested by agencies and groups outside the District.

Chapter VI, the culmination of this entire report, summarizes the Water Conservation Plan and discusses the programs that the District plans to implement. The 1985 Plan is very specific and is tied in closely with other short-term plans outlined for the period through 1989. Long-term goals are also presented.

Environmental issues and financing are discussed because they are constraints to any large-scale improvements of the District's water system. An Appendix to the Plan includes a list of acronyms, definitions, and bibliography. Additional pertinent material is included in the Supplement under separate binding.

C. DISTRICT ORGANIZATION AND AUTHORITY

The District is a public corporation organized in 1911 under the California Irrigation District Act, California Water Code, Sections 20500 et seq (the "Law"). It is governed by a Board of Directors composed of five persons elected by the voters of the District.

The District has divided operations into two main departments: Water Department and Power Department. Diversion and delivery of Colorado River water for irrigation and domestic uses and operation and maintenance of drainage canals and facilities are performed by the Water Department. Production, transmission and distribution of power are functions of the Power Department. Separate accounting records are maintained for each department.

The District Organization is charted in Exhibit I.1 showing management personnel for the departments, sections and units. Management is under the direction of the General Manager. Five departments are each headed by a Department Manager. These departments are:

Water
Power
Operations Services
Finance and Accounting
Personnel

Several officers work directly under the Board but also report to the General Manager.

In accordance with California Water Code:

Section 22075: "A district may do any act necessary to furnish sufficient water in the district for any beneficial use."

Section 22078: "A district may control, distribute, spread, sink, treat, purify, recapture and salvage any water including but not limited to sewage waters for the beneficial use or uses of the district or its inhabitants or the owners of rights to waters therein."

Section 21385: "The board except as otherwise specifically provided has the power and it shall be its duty to manage and conduct the business and affairs of the district."

Section 22842: describes certain specific powers of the Board and provides that the Board may:

"(a) Provide for and create divisions or departments for management and operating purposes.
(b) Appoint department heads.
(c) Classify and reclassify employees.
(d) Fix the duties, terms, and time of employment.
(e) Provide for and fix salaries, compensation, and expenses of department heads, executives, and employees."

The Board of Directors has adopted Rules and Regulations governing the distribution and use of water, as well as the construction, operation and maintenance of the canal and drainage system.

D. NEED FOR CONSERVATION

As the population of California and the western "Sun Belt" states and subsequent demands for food and fiber products produced by western irrigated agriculture increase, the problem of providing water to meet these requirements becomes more difficult. California still has untapped water resources (DWR, 1983), and it is necessary to develop these water supplies. However, the state must try to use its existing water supplies more efficiently, because this is often more economical and more environmentally acceptable than developing new supplies. Water conservation has thus become a national and state priority (WWEF, 1979a).

Water is becoming increasingly expensive. Political and social problems associated with developing new supplies have become more and more difficult to resolve in the last two decades. Although it is generally recognized that water supply projects will still be needed to increase the developed supply from the available resources in the state, water conservation must be emphasized.

The District has a firm, relatively large water supply but, because of impending water shortages in the Southern California metropolitan area and the obvious limitations of the Colorado River as a resource, the District is looked on critically. Discharge of drainage water into the Salton Sea is considered to be wasteful. Some critics do not understand or accept the need for soil leaching to maintain the agricultural economy. Agricultural drainage from Imperial Valley provides freshwater replinishment to the Salton Sea, making it a valuable recreation, fishery and wildlife area enjoyed by thousands of visitors. However, the level of the Salton Sea has risen gradually and continually for many years. This increase is the result of the inflow from Mexico, infrequent but often intense storms, and man-made sources exceeding evaporation. It is possible that a reduction in agricultural drainage could help stabilize the level of the sea.

Statewide emphasis has been placed on urban water use efficiency by the passage of Assembly Bill 797 (1983) as well as reclamation of sewage effluent for beneficial uses. Agricultural water conservation is aimed at reducing losses that occur in the storage and distribution of water for the consumptive use by crops. Gross agricultural water requirement is equal to consumptive use plus, in the case of Imperial Valley, leaching requirements, divided by overall efficiency of distribution and

IMPERIAL IRRIGATION DISTRICT
ORGANIZATION CHART

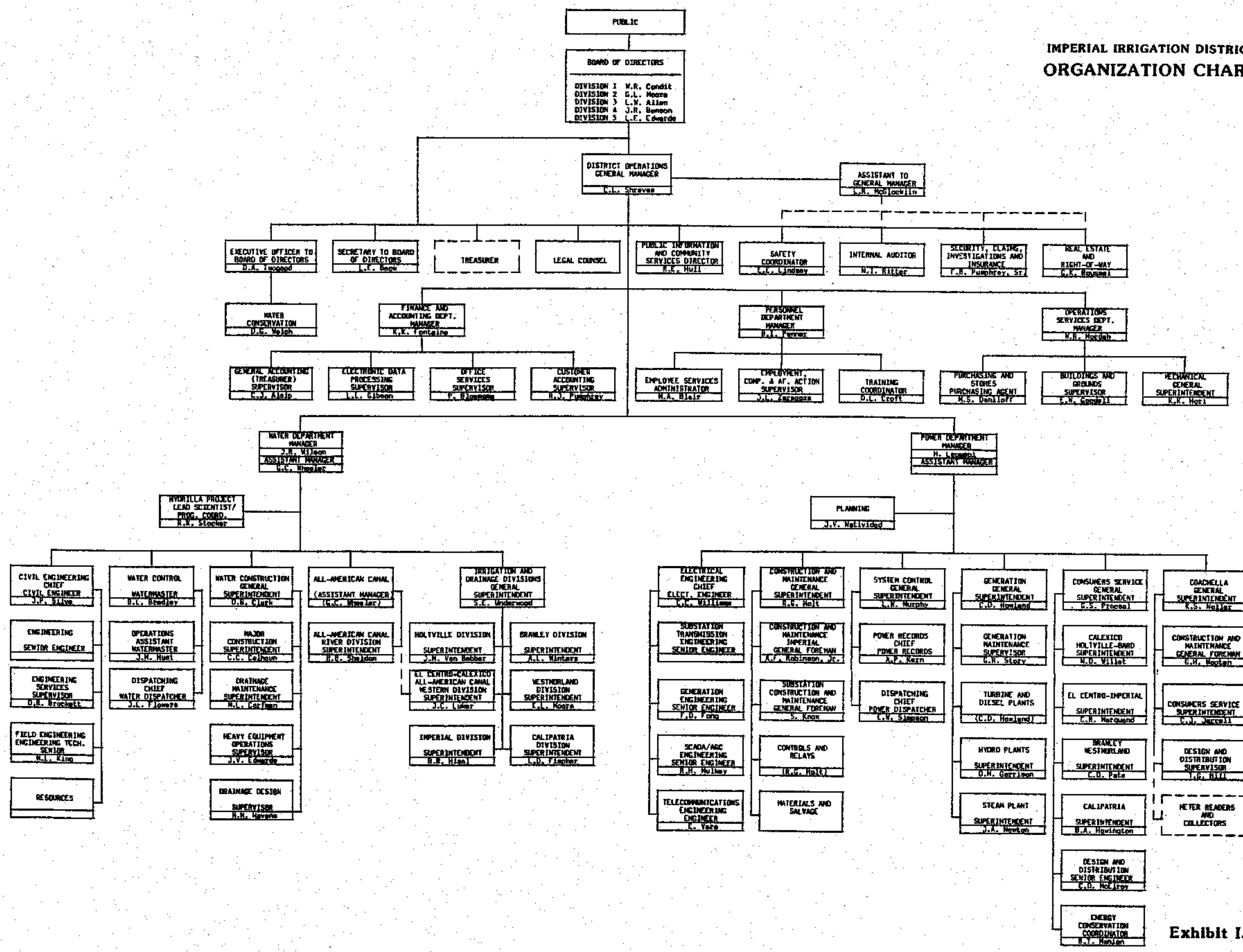


Exhibit I.1

application. Increasing this efficiency factor is the primary goal of water conservation.

Agricultural water conservation is being emphasized in the state because of the magnitude of water use (WWEF, 1979b):

> "Californians often see the much-quoted statistic that agriculture uses 85% of the delivered water in the state. Therefore, when we are asked to conserve water, those aware of this statistic often raise questions about the importance of saving water in our homes and offices when agriculture uses so much. Environmental groups have taken up this cry in the form of the '10% solution.' They reason that if agriculture saved between 10-20% a year of the 36 million acre-feet (MAF) of delivered water, there would be no need to develop additional water resources. However, the state presently estimates that by the year 2000, California's net water demand may exceed the net dependable supply by about 3 MAF per year. The question also arises: Do we have the technical ability to accomplish a 10% agricultural water savings in the near future?
>
> "The subject of agricultural water conservation and increased agricultural efficiency has been receiving more public attention during the last year. In May, the California Department of Water Resources (DWR) convened a panel of out-of-state experts to advise on water conservation programs and potentials in California. The panel concluded that a potential exists for saving water, although they recognized that irrigation practices in many areas of California are already highly efficient. The panel concluded, 'Statewide implementation of water conservation measures will help reduce the water shortages forecast for the near future, without curtailing the present level of agricultural production or economic activity.'"

More than 5 years later, emphasis was still being placed on water use (WWEF, 1984):

> "While agricultural water experts and economists argue about conservation figures, the public sometimes gets lost in a maze of statistics. Farm conservation practices may seem irrelevant to those of us who live in urban areas. But the basic reason why this subject concerns the non-farmer is that water saved through efficient agricultural practices could, theoretically, free water for urban use."

The following examples illustrate methods used to conserve agricultural water (WWEF, 1979c):

1. Store water in surface impoundments that allow for timely releases.

2. Store water underground where it is not subject to evaporation or outflow to the ocean.

3. Construct concrete delivery and distribution canals and ditches to reduce seepage losses.

4. Improve irrigation efficiency by reducing tailwater runoff and deep percolation through improved water application systems and timing of irrigations.

5. Create on-farm and basin return flow systems, recycle water a number of times within the farm or basin to result in high farm and basin efficiencies.

6. Reduce irrecoverable flows to the ocean or salt sinks by diverting or intercepting them for beneficial purposes before they are lost.

7. Use of brackish water through special management, salt-tolerant crops, or for biomass production.

8. Through genetics, develop shorter season crops, or varieties of crops that use less water and tolerate drought with economical production.

9. Reduce irrecoverable evapotranspiration losses to the air by modifying surfaces, watershed, and riparian vegetation using crop selection and by managing irrigation more carefully.

Irrigation practices in California have already reached a high level of efficiency. The District has been recognized by the U.S. Department of Interior, Bureau of Reclamation (USBR), as comparing well with other irrigation systems in the United States and has one of the highest overall water use efficiencies in the lower Colorado River area (Table I.1.). Water use efficiency by agriculture is much higher than that by urban use, where large proportions of water flow through sewage treatment plants and, in the case of coastal cities, discharge into the Pacific Ocean.

Water conservation can be accomplished in the District irrigation system by physical means, including canal lining, automated controls, reservoirs and other recovery systems. Water users can also make physical improvements and practice better water management procedures. The District and its water users must work together to make the best use of water consistent with practical and economic limitations.

Irrigation management can benefit the water user significantly. It is highly probable that the user will be able to order and use less water and

TABLE I.1
DELIVERY EFFICIENCIES OF IRRIGATION DISTRICT
(1975-1978)

Irrigation Districts	1975	1976	1977	1978
Imperial Irrigation District				
On-farm efficiency	73	80	81	77
District efficiency	65	71	73	70
Coachella Valley Water District				
On-farm efficiency	51	50	55	53
District efficiency	43	44	46	46
Reservation Division I.D.				
On-farm efficiency	45	47	58	60
District efficiency	36	38	47	50
YCWUA (Valley Div.) I.D.				
On-farm efficiency	64	80	71	72
District efficiency	49	60	54	52
Yuma Mesa Irrig. & Drain. Div.				
On-farm efficiency	33	33	29	32
District efficiency	30	30	27	30
Unit "B" Irrigation District				
On-farm efficiency	33	32	35	38
District efficiency	32	31	33	36
Yuma Irrigation District				
On-farm efficiency	62	63	61	61
District efficiency	59	61	59	53
North Gila Irrigation District				
On-farm efficiency	29	40	46	42
District efficiency	28	30	43	40
Wellton-Mohawk Irrigation District				
On-farm efficiency	55	52	63	64
District efficiency	50	47	57	57
Colorado River Indian Tribes				
On-farm efficiency	57	65	76	64
District efficiency	44	50	58	48
Palo Verde Irrigation District				
On-farm efficiency	46	33	45	42
District efficiency	36	26	35	33

Source: From summary sheet prepared by USBR, INCLUDED IN "Report on Water Use Efficiency Comparisons," Bookman-Edmonston Engineering, Inc., 1983.

conceivably increase yields. As the District improves its system toward a goal of computerized management and automated system control, significant reductions can be realized in operating and maintenance costs.

To be effective, any water conservation plan must have the support of all of its water users. Considerable education will be necessary, requiring the cooperation of local, state and federal agencies. Applicable information must be presented in understandable and usable form to the water user and the general public. This will be a continuing effort. The physical or structural elements of water conservation can be accomplished more rapidly, depending on the availability of funds.

Finally, a serious water conservation effort will ensure Imperial Valley of a firm and sufficient water supply to meet its requirements.

During the past years, the USBR has been studying water conservation "opportunities" in Imperial Valley. These studies have identified methods of conserving water by structural and nonstructural improvements and programs, similar to the District's existing programs.

The District's record in water conservation has gradually and progressively improved during the past three decades. Current emphasis is on outside funding of water conservation improvements in exchange for contractual rights to purchase the quantity of water saved. Specifically, the Metropolitan Water District (MWD) of Southern California, Parsons Engineering Company and others recognize that urban users can afford to pay a higher cost than agricultural water users in Imperial Valley, whether it be for new water projects, reclamation, or water conservation.

E. STATEWIDE WATER PERSPECTIVE

Various water resource projects in California have been developed over the last century in response to increasing demands from population growth and expansion of irrigated agriculture. Today, this state has the most complex and extensive water system in the world. The importation of Colorado River water into Imperial Valley was among the earliest water projects constructed in the state. Although physically separated from the major projects - Central Valley Project (CVP) and State Water Project (SWP) - Imperial Valley has become a part of the whole state's water picture. Because several other California entities, especially MWD, also divert water from the Colorado River, the transfer and exchange of water are physically possible. It is important to understand the major elements of California's vast water system.

Each system was developed to fulfill a need, sometimes due to drought or flood, but usually to furnish a water supply for urban growth, agricultural expansion, or hydroelectric power. The reservoirs constructed for most of these projects are multipurpose, providing recreation and aesthetic benefits, as well as flood control and the other primary uses. These reservoirs provide conservation, by storing surplus water (usually during the spring) and releasing it later (usually during the summer) for beneficial uses.

On April 5, 1985, Governor Deukmejian stated to the California Legislature (Supplement 12):

> "Water is the lifeblood of California. In a semi-arid region, with incomparable climate and rich soils, it is our most precious resource.
>
> "Over more than 100 years, the people of the state have built a vast interrelated system of dams, reservoirs, canals and hydroelectric plants. Every city and town, every farm, every factory have benefited. In many ways, our prosperity as a state has paralleled our development of water resources."

In reference to the proposal for MWD to fund water savings improvements in Imperial Valley, the Governor stated that:

> "This program has statewide significance because any water which MWD can obtain by water salvage directly reduces its need to import water from Northern California."

Although population in California continues to increase, no new major water project has been constructed during the past decade or so. The focus instead has been on conservation and reclamation (treatment and reuse of sewage effluent).

California is a state of vast contrasts. Climates range from subtropical to alpine and geography from desert to seashore, to 14,000-foot-high mountains. Precipitation ranges from 2 to 100 inches and more per year. Furthermore, precipitation and runoff are highly variable from year to year with below-normal precipitation often occurring several years in a row. All of the snow and most of the rainfall occur during the winter months, while the greatest demands for water occur in the summer after the snow in the mountains has melted and run off.

Total precipitation falling within California averages over 190 million acre-feet (MAF) per year. About 71 MAF (DWR Bulletin 160-83, 1983) become available for uses such as drinking water, irrigation, fish and groundwater recharge. More than one-half of the total annual runoff flows into the Pacific Ocean, often in the form of floods. Many streams such as those on the North Coast flow unchecked year-round into the ocean. In addition to in-state streams, there is inflow from Oregon through the Klamath River to Northern California and diversions from the Colorado River into Southern California.

The total annual surface water supply in the state averages about 23 MAF, including the Klamath River, developed by man-made dams, reservoirs, other diversion works and distribution systems. An additional 16 MAF are pumped from groundwater. In some areas, groundwater pumping exceeds the average annual recharge, causing water tables to decline. When Colorado River imports (4.4 MAF) and reclaimed waste water (0.7 MAF) are included, the total developed annual water supply in the state is about 44 MAF.

California's aggregate annual water demand today is about 42 MAF, almost 36 MAF for agriculture and 5.8 MAF for urban use in an average year (U.C. 1984). In 1983, the DWR reported that net water use in 1980 was 33.1 MAF and projected net use in 2010 will be 37.3 MAF (DWR 1983a), considerably lower than projections made 20 years before. To meet this demand, it is apparent that additional water supplies in the aggregate amount of about 4.2 MAF must be made available by development, reclamation, or reuse - or the demand must be reduced by water conservation or other means. In years past, California met water demands by constructing diversion and storage works and conveyance systems. During the last two decades, the main efforts have been on reclamation and conservation.

Water development and use started in California with Spanish missions in the late 1700s, where gardens of fruits, vegetables and occasional grain fields were irrigated by diversions from local streams. With the gold rush of 1849, more complex water systems were developed. Small reservoirs and open ditches were required for placer mining. Some of those original systems are still in use today.

As gold mining declined, agriculture became increasingly important. Water companies and irrigation districts were formed following passage of the 1887 Wright Irrigation District Act. Before the turn of the century, irrigated agriculture was expanding rapidly in the Central and Southern California coastal areas, and the Sacramento and San Joaquin Valleys, usually along or close to natural streams. During the 1880s, several dams were constructed, including Bear Valley, Hemet, Sweetwater, and Cuyamaca Dams. Shallow wells were dug, many reaching artesian (flowing) water, but not until about 1910 with the advent of deep-well turbine pumps did groundwater become important as a water source.

As the Cities of Los Angeles and San Francisco began to outstrip their local water supplies in the early 1900s, it became apparent that imports of water from other areas would be necessary. Water projects followed. All had one purpose in common - to move water from the point of origin to the place of need. In nearly all cases, storage facilities near the source were required. These are briefly described below:

1. Los Angeles

As early as 1900 it became apparent that local water supplies would not be sufficient to satisfy the rapidly growing City of Los Angeles, and studies were begun by William Mulholland to find a new water source (MWD, 1978/79). Although it was more than 200 miles away, Mulholland's surveys determined that water could be brought by gravity from Owens Valley to Los Angeles. Bonds were sold, and reservoirs, canals, tunnels, and pipelines were built. In 1913, water began flowing south from the eastern High Sierra to the San Fernando Valley. Hydroelectric plants were later constructed along the aqueduct, which had an initial capacity of 200 million gallons per day (mgd). In 1940, the system was extended northward to the Mono Basin. Later, a second barrel was added to the aqueduct between Owens and San Fernando Valleys.

Today, the Los Angeles Aqueduct is the city's main water source, importing about 0.5 MAF of water per year. The city was instrumental in forming MWD to develop a supply from the Colorado River. During the past 10 years, the city has received between 19,000 and 105,000 AF/year from MWD, although the amount varies yearly.

2. San Francisco - East Bay Area

Since San Francisco has practically no local water supply, it has been necessary to import water to the city from the beginning. Other than water hauled on barges from Sausalito, the first imported water for San Francisco was received through a system of flumes and tunnels from Lobos Creek. Later, water projects were developed on the east side of San Jose to store local runoff. After lengthy studies and struggles with naturalist interests opposing the development, the city constructed the primary phase of the Hetch Hetchy project on the Tuolumne River within the limits of Yosemite National Park and placed it in service in 1934. Today, the 134-mile-long aqueduct conveys about 0.5 MAF per year to the city.

The East Bay Municipal Utility District (EBMUD), formed in 1923, decided to develop its main water supply on the Mokelumne River (SWRCB, 1955). EBMUD completed construction of the Pardee Dam and a 130-mile-long aqueduct to serve the cities and towns along the edge of San Francisco Bay from Rodeo (north of Richmond) to San Lorenzo (north of Hayward). The current average annual import is about 300,000 AF/year.

3. Central Valley Project

In 1933, the Legislature passed the State Central Valley Act, after California had suffered through a long drought that began in 1928. Because of the depression of the 1930s, the state could not finance the project and asked the federal government for help. The federal Central Valley Project (CVP) accomplished much of the water development that had been authorized by the 1933 state act.

Developing the CVP began in 1935 by the USBR after years of study and planning by the State of California. This project serves the Sacramento and San Joaquin Valleys and consists of a major network of dams, reservoirs, hydroelectric plants and canals, primarily furnishing irrigation water to the rich Central Valley of California. The key feature of the CVP is Shasta Dam, completed shortly after World War II. Its water storage capacity is 4.5 MAF, and its 375-MW hydroelectric power plant produces 1.2 billion KWH (USBR, 1979).

The CVP was designed and built to impound headwaters of the Sacramento and Trinity Rivers and to release water, as needed, down the Sacramento River and through the Delta, where 22 rivers and streams converge. At a pumping plant near Tracy, water for delivery to the San Joaquin Valley is lifted about 200 feet into the Delta-Mendota Canal. This terminates 120 miles to the south at Mendota pool on the San Joaquin River, primarily supplying a replacement source to lands formerly irrigated by San Joaquin River flows. During the winter, the Delta-Mendota Canal brings surplus water from the Delta to San Luis Reservoir, a joint federal-state facility near Los Banos, serving the west side of the San Joaquin Valley (Westlands Water District and others).

The Friant-Kern Project, consisting of Friant Dam on the San Joaquin River near Fresno and its two canals, the 36-mile Madera Canal and the 160-mile Friant-Kern Canal extending south to Kern County, is the major unit serving the east side of the San Joaquin Valley from Chowchilla south to Bakersfield. The joint federal-state San Luis Canal extends 102 miles to Kettleman City, where it continues southward as the California Aqueduct.

Numerous other dams and reservoirs, hydro plants, pumping plants, and several large canals make up the complex system which provides supplemental water to about 4 million acres of agricultural land in California's Central Valley. In 1980, total project deliveries were about 7 MAF for all uses.

After more than 40 years of operations, the CVP is not yet complete. New Melones Dam on the Stanislaus River, completed in 1978, was prevented from full use by litigation until 1983 but is now being operated as an integrated unit of the CVP. Construction of Auburn Dam started in 1974, on the North Fork of the American River but is now at a standstill and wrapped in controversy. Finally, the San Felipe Division of the CVP to serve San Benito and Santa Clara Counties is under construction and expected to be completed soon.

4. State Water Project

In 1951, the Legislature authorized the SWP. In 1957, the Water Resources Plan, conceived as a general guide to water development projects and management strategies, was completed. Together with the CVP, the (SWP) was designed to conserve surplus water from sources in Northern California and move it south to meet expanding agricultural and urban water needs in Central and Southern California.

The 1959 Burns-Porter Act provided the major financing for the initial features of the SWP (known earlier as the Feather River Project). In 1960, the voters approved a $1.75 billion bond issue to finance the original features and construction began.

According to the MWD (1984), the initial features of the Project, completed in 1973, included 18 reservoirs, 12 pumping plants, 3 pumping-generating plants, 2 generating plants, and 516 miles of aqueducts. In addition to storage and distribution, the SWP provides recreational opportunities and enhances fish and wildlife habitats. Major features of the SWP are:

a. Oroville Dam on the Feather River with 3.5 MAF storage capacity is the Project's principal reservoir.

b. The Sacramento-San Joaquin Delta Pumping Plant lifts water 244 feet into the California Aqueduct.

c. The California Aqueduct extends 444 miles from the Delta to Perris Reservoir. The aggregate length of its several components is 562 miles. The Aqueduct features include several pumping plants and reservoirs.

d. San Luis Dam near Los Banos is a joint federal-state feature, with a capacity of 2.0 MAF.

e. The A. D. Edmonston Pumping Plant south of Bakersfield, with total capacity of 4,410 cubic feet per second (ft^3/s), lifts water over the Tehachapi Mountains of 1,926 feet, which equates to more water pumped higher than anywhere else in the world.

The SWP was designed for a delivery capacity of 4.23 MAF. DWR Bulletin 132-84 (1984) indicates that the SWP firm yield now totals about 2.4 MAF, based on coordinated operation with the CVP. In the past, there have been up to 2.9 MAF delivered to SWP contractors.

No significant features have been added to increase the yield of the Project since 1973. Efforts by the Legislature in the past few years have failed to win approval for construction of necessary Delta facilities. The proposed Peripheral Canal would have increased the dry-weather yield of the SWP by an estimated 700,000 AF. It is now discharged to the ocean and helping to preserve fishing and water quality in the Delta. Efforts by the Legislature in 1984 to authorize Delta transfer facilities failed once again. These efforts focused on physical improvements to transfer water through the Delta channels, along with improving fisheries, water quality and Delta levees.

According to the DWR, contractor requests for SWP entitlement water are estimated to increase from 1.9 MAF in 1985 to 3.7 MAF in 2010 (DWR, 1984a). These requests reflect increases in urban population demand on MWD's Colorado River supply. Table I.2 gives the DWR estimates of the current SWP capability to meet projected water demands:

TABLE I.2
FIRST-YEAR PROJECT WATER DEMAND VERSUS SUPPLY

Water Supply[a]		Water Demand: Table A[b]	Water Demand: Contractor Requests
Present Min. Project Yield	(2.5 MAF)	1982	1986
Dry Year	(2.47 MAF)	1982	1986
Average Year	(3.19 MAF)	1986	1991
Wet Year	(3.49 MAF)	1987	1997

[a]Water supply amounts exclude operational water losses.
[b]Maximum amount of water to be delivered under contract; not all contractors use maximum amounts.

The 30 SWP contractors will pay 80 percent of SWP costs; power users, 13 percent; and state and federal funds for flood control, recreation, fish and wildlife benefits pay the remainder. Charges are made for several components of costs to cover capital, operating, and maintenance expenses. The apportioned capital cost and minimum operation and maintenance components must be paid regardless of the quantity of water received by a contractor. Other charges are based on quantities delivered.

5. Metropolitan Water District of Southern California

The MWD, serving the major cities and urban areas of the Southern California coastal plain, was formed in 1928 to build an aqueduct from the Colorado River and distribute water to its member cities (MWD, 1978/79; 1984). Planning began in 1923 under the leadership of William Mulholland. Construction started in 1932, and the aqueduct, including 29 tunnels and five pumping plants, began delivering Colorado River water to several MWD member cities in June 1941. The MWD historic and projected water supply is shown in Exhibit I.2.

Water for the south coastal area of California served by MWD comes from (1) local water supplies, (2) the Los Angeles Aqueduct supply from the Mono Basin-Owens Valley, (3) Colorado River and (4) State Water Project.

The Colorado River Aqueduct, beginning at the W. P. Whitsett Intake Pumping Plant on the western shore of Lake Havasu, carries Colorado River water 242 miles to Lake Mathews, its terminal reservoir near Riverside, California. The aqueduct system consists of five pumping plants (Whitsett, Gene, Iron Mountain, Eagle Mountain, and Hinds); 92.1 miles of tunnels; 62.8 miles of concrete-lined canals; 54.5 miles of concrete conduit; 28.5 miles of inverted siphons that cross under drainage channels or other topographical depressions; two reservoirs; and transmission lines that deliver power for system pumping plants from Hoover and Parker hydroelectric power plants and from the Southern California Edison Company. The aqueduct was designed for a capacity of 1,605 ft^3/s that would provide for the delivery of MWD's annual entitlement to Colorado River water if operated at that flow 92 percent of the time. The aqueduct is capable of carrying flows slightly higher than this design capacity.

The five pumping plants lift Colorado River water a total of 1,617 feet to convey it to the MWD service area. Each plant has nine pumps originally designed with a 200-ft^3/s pumping capacity. Through various modifications, the individual pumping capacity of each pump has been increased so that the capacities now average 220 ft^3/s. Eight pumps at each plant can deliver the MWD's annual entitlement to Colorado River water. The ninth pump is used as a spare to facilitate maintenance, repairs and/or to provide additional emergency pumping capacity.

MWD's second source of imported water is the SWP operated by the DWR. Water that is surplus to the needs of the Delta is diverted from natural channels in the southern Delta to supply public agencies with water for which they have contracted. SWP water is conveyed via the California Aqueduct to Castaic Lake on the western side of MWD's service area and to Devil Canyon Afterbay and then to Lake Perris on the eastern side of the MWD service area.

Contracts call for the SWP to provide a firm yield, which is to be available during a repeat of a historic 7-year dry period. Should a repeat of this magnitude occur, present SWP facilities will be incapable of supplying all of the water required by contract and requested by the contractors. The SWP was to be built in stages as the demand for water increased.

The existing facilities of the SWP provide about one-half of the firm yield for which 30 public agencies ultimately contracted. Planning for additional facilities had been under way for several years. However, immediately following failure of Proposition 9 in June 1982 (the referendum on SB-200 concerning construction of the Peripheral Canal), DWR suspended planning studies of the two reservoirs (the Thomes-Newville in the Sacramento Valley and Los Vaqueros located southwest of the Delta) and a Delta transfer facility. SB-200 was the State's plan providing for continued development of the State's water resources, while setting forth conditions for specified new projects, mainly the Peripheral Canal.

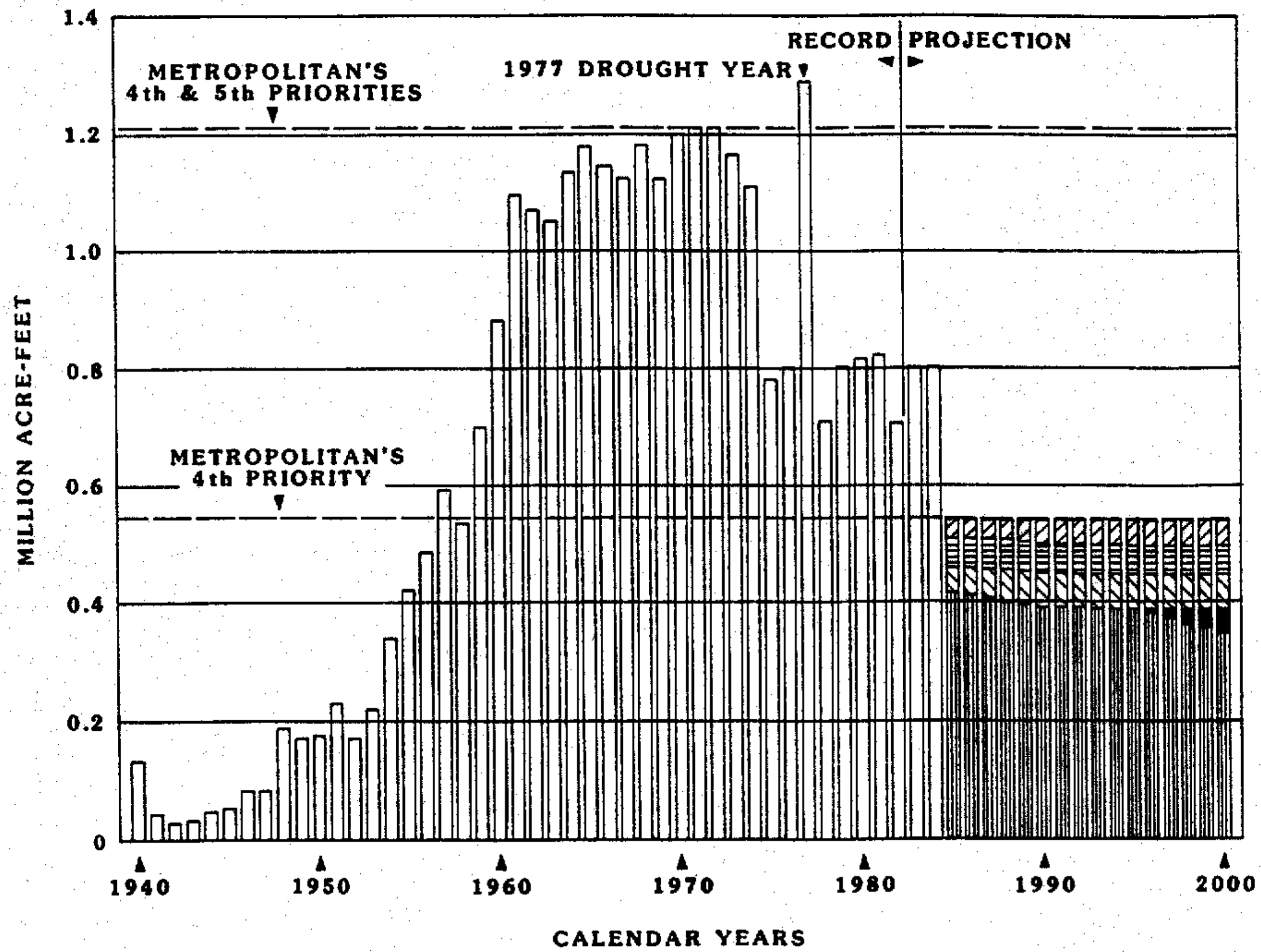
In 1984, efforts by the Governor and the Legislature to pass a "water package" failed once more. Proponents of the package were optimistic early in the year because the major elements (a "Through-Delta Channel" and storage facilities south of the Delta) seemed to be acceptable to Delta, fishery, and environmental interests, formerly opposed to the "Peripheral Canal" as proposed by SB-200.

In 1985, a number of bills have been introduced in the legislature to designate a Delta facility. Without construction of such a facility, the state is less likely to meet its contractual obligations for delivery of water to all of its contractors in the future.

The MWD distribution system begins at the terminus of the Colorado River Aqueduct at the west portal of San Jacinto Tunnel and SWP delivery points at Castaic Lake and Devil Canyon Afterbay. The system consists of 775 miles of pipeline, eight reservoirs, five filtration plants, and numerous regulating structures that are strategically situated along the system. These facilities provide water throughout the Southern California coastal area for domestic, municipal, industrial, agricultural, and groundwater replenishment purposes.

The MWD operates two terminal reservoirs, one emergency storage reservoir, and five regulating reservoirs in its distribution system.

Metropolitan Water District-
Colorado River Water Supply



LEGEND

Losses
Diversions
Desert Power Plants
Use Of Existing Indian And Miscellaneous Rights*
Deliveries
Exchanges

* A lawsuit now pending could result in additional water rights being granted to the Indian tribes.

Exhibit I.2

Terminal reservoirs provide storage for seasonal demand variations, while the regulating reservoirs provide operating flexibility. The locations and capacities of the reservoirs are listed in Table I.3.

TABLE I.3
RESERVOIR LOCATIONS AND CAPACITIES

Reservoir - Type	Location	Storage (AF)
Lake Mathews - Terminus of the Colorado River Aqueduct	10 miles southwest of Riverside	182,800
Lake Skinner - Terminus of the San Diego Canal	15 miles southwest of Hemet	44,000
San Joaquin - Regulatory	Newport Beach	3,000
Live Oak - Regulatory	La Verne	2,500
Garvey - Regulatory	Monterey Park	1,600
Palos Verdes - Regulatory	Rolling Hills	1,100
Orange County - Regulatory	Brea	200
Morris - Emergency Storage	5 miles north of Azusa on the San Gabriel River	30,000

The MWD has five filtration plants that filter Colorado River and state project waters in compliance with the California Department of Health Services' requirements. Approximately 335 service connections provide deliveries to member agencies.

Unusually heavy rains during 1982-1983 limited the demand for groundwater replenishment, agricultural water and, in some instances, domestic water. Water deliveries totaled 1,226,361 AF, down approximately 18.4 percent from the previous year: 968,100 AF were for domestic or municipal purposes; 146,289 AF for agricultural purposes; 67,923 AF for replenishment of underground basins; and 44,049 AF for injection into seawater barriers. Domestic and municipal water accounted for approximately 79 percent of total sales. Agricultural uses accounted for approximately 12 percent.

During the 1982-1983 fiscal year, Colorado River water was blended with state project water in an average 50-50 ratio at the Weymouth, Skinner and Dierner plants. Blended water was supplied to a large part of MWD's service area. The blend at these plants varied somewhat throughout the year to accommodate various shutdowns, to maintain total dissolved solid (TDS) levels below 500 milligrams per liter (mg/L), and to ensure satisfactory water quality. Water quality varies as the ratio of Colorado River water and state project water changes. Deliveries in 1983-1984 totaled 1.43 MAF. Water deliveries over the past 10 years have varied from 1.23 MAF to 1.50 MAF. The low and high values occurred back-to-back in 1982-1983 and 1981-1982, respectively.

Urban water demands have accounted for 86 percent of sales during the past 10 years. Deliveries are projected to increase to 2.21 MAF in 2010.

F. SUMMARY OF WATER RIGHTS

The District holds three classes of water rights: state permit rights, present perfected rights, and federal contractual rights.

During the early development of the Imperial Valley, certain individuals and the California Development Company made a series of water appropriations as required by California law. These appropriative rights are based on a series of notices of appropriations made between 1895 and 1899. The notices were posted at Hanlon's Heading, the point of diversion on the Colorado River, and were thereafter recorded. Each appropriation was for 10,000 ft^3/s of River water; the individual appropriations were assigned to the California Development Company. These rights are the basis of the District's present perfected rights as discussed below.

Because of financial difficulty, the Southern Pacific Company obtained all of the assets of the California Development Company. The property sold included "the water rights, franchises, water heading, and appropriated water rights of the Colorado River owned by said California Development Company."

On July 25, 1911, the Imperial Irrigation District was organized and by deed (dated June 22, 1916) Southern Pacific Company conveyed to Imperial Irrigation District all of the property of the California Development Company, including all water rights.

1. The Colorado River Compact of 1922

Within a few years after the District was organized, irrigation had expanded to such an extent that all of the water in the River was completely used except in times of high flows. It was soon recognized that without flood control and storage facilities, a dependable water supply could not be guaranteed.

In addition, the people of Colorado, New Mexico, Utah and Wyoming (the Upper Basin States) became increasingly aware of California's expanding use of Colorado River water. The existing law at that time provided that states' water rights were to be determined according to the doctrine of priority of appropriations, that is, the earlier the appropriation, the greater the right. As a result, the Upper Basin States and the Lower Basin States (Arizona, California and Nevada) entered into an interstate agreement that equitably divided waters of the Colorado River. This agreement, the Colorado River Compact, provided, among other things, that the Upper Basin and the Lower Basin were each apportioned to the exclusive beneficial consumptive use of 7.5 MAF each year, in perpetuity. The Compact provided that the consent of the United States was necessary. The consent of the United States was conditioned by Section 4 (a) of the Boulder Canyon Project Act, which required that California pass an act limiting California's annual consumptive use of Colorado River water to 4.4 MAF per year, plus not more than one-half of any excess or surplus water unapportioned by the Compact. California met this requirement by passing the California Limitation Act on March 4, 1929.

By treaty signed on February 3, 1944, Mexico is entitled to 1.5 MAF of the Colorado River water each year. In years of low flow, any shortfall required to meet Mexican treaty rights will be made good in equal quantities by the Upper Basin States and the Lower Basin States. This treaty takes precedence over the Colorado River Compact.

2. 1928 Boulder Canyon Project Act

On December 21, 1928, Congress passed the Boulder Canyon Project Act, which authorized the construction of Hoover Dam and Power Plant and the All-American Canal to Imperial and Coachella Valleys. As contracted lands benefiting from the All-American Canal were to repay the cost in 40 years without interest. Those lands were not charged for water or for its use, storage or delivery. In addition, the Project Act required the District and other water users to enter into water delivery contracts with the Secretary of Interior. Finally, the Act authorized the states to enter into an agreement: Of the 7.5 MAF of water annually apportioned to the Lower Basin, Nevada would receive 0.3 MAF, Arizona would receive 2.8 MAF (plus one-half of any excess water unapportioned by the Colorado River Compact), and California would receive 4.4 MAF (plus one-half of any excess water unapportioned by the Compact). This proposed apportionment was never agreed upon by the Lower Basin States, but in 1964 the U.S. Supreme Court in Arizona v. California (373 U.S. at 546) concluded that an agreement was not necessary because the Project Act authorized the Secretary of Interior to deliver the water in accordance with the apportionment.

3. 1931 California Seven-Party Agreement

To complete the apportionment in California, the Secretary of Interior requested the State of California to prioritize water rights among the major users:

(1) Palo Verde Irrigation District
(2) Yuma Project
(3) Imperial Irrigation District
(4) Coachella Valley County Water District
(5) Metropolitan Water District
(6) City of San Diego and
(7) County of San Diego

On August 18, 1931, the California Seven-Party Agreement was signed, and Table I.4 highlights the water apportionment priorities.

Note that the first four California priorities total 4.4 MAF annually, of which the agricultural agencies are entitled to 3.85 MAF. As a result of the Colorado River Basin Project Act (September 30, 1968), the 4.4 MAF are also the quantities accorded priority over the Central Arizona Project.

4. <u>1934 Compromise Agreement</u>

After execution of the California Seven-Party Agreement, a draft contract for water delivery was submitted to the District by the Secretary of Interior. This draft contemplated extending District boundaries to include the area in Coachella Valley. Coachella Valley desired to maintain its own organization. The District negotiated another contract with the Secretary of Interior that was adopted by the District and approved by the voters. Following approval, the District filed an action in the Superior Court for the validation of the contract. Coachella Valley, appearing through individual property owners, objected to the validation of the contract. Following judgment in favor of the District and during Coachella Valley's appeal, negotiations were carried on between Imperial and Coachella that resulted in an Agreement of Compromise dated February 14, 1934. As a result of this Agreement, the District has priority over Coachella in times of shortage.

TABLE I.4
PRIORITY ESTABLISHED BY THE CALIFORNIA SEVEN-PARTY AGREEMENT FOR WATER APPORTIONMENT

	Priority/User	Apportionment	
1.	Palo Verde Irrigation District (For use exclusively upon 104,500 acres of valley land in and adjoining district)		
2.	Yuma Project (For use on California Division, not exceeding 25,000 acres of land)		
3a.	Imperial Irrigation District & Coachella Valley County Water District (Lands served by All-American Canal in Imperial and Coachella Valleys)	3.85 MAF	
3b.	Palo Verde Irrigation District (For use exclusively on an additional 16,000 acres of mesa lands)		4.40 MAF
4.	Metropolitan Water District (For use on S. Cal. Coastal Plain)	0.55 MAF	
5a.	Metropolitan Water District (For use on S. Cal. Coastal Plain)	0.55 MAF	
5b.	City and County of San Diego[a]	0.112 MAF	
6a.	District and CVCWD	0.3 MAF	
6b.	Palo Verde Irrigation District (For 16,000 acres of mesa lands)		
	TOTAL WITHIN CALIFORNIA	5.362 MAF	

[a]Apportionment merged with those of MWD in 1946.

5. District Water Rights

With this background, a review of Imperial Valley's existing water rights is now presented.

a. State Permit Rights

The District claims appropriative water rights by virtue of its Applications and Permits issued by the State of California. These rights are supplementary and subservient to the District's other appropriative rights. Second, as discussed above, the District has contractual rights by virtue of the Boulder Canyon Project Act and the All-American Canal Contract which incorporated the priorities of the California Seven-Party Agreement. Finally, and most important, as a result of the appropriations made between 1895 and 1899, the District has present perfected rights to the beneficial use of the waters of the Colorado River system. While the water available to the District pursuant to its present perfected rights may be included in the actual quantity of water to be delivered pursuant to its contract with the Secretary of Interior, the legal and practical significance of the District's present perfected rights must not be underestimated.

b. Present Perfected Rights

To fully explain the District's water rights, it is important to understand the true nature of present perfected rights. The term was first used in the Colorado River Compact, which provided that "present perfected rights to the beneficial use of waters of the Colorado River system are unimpaired by the Compact." The term is also found in the Boulder Canyon Project Act, which provided that the dam and reservoir authorized by the Act should be used for specific purposes, including "satisfaction of present perfected rights in pursuance of Article VIII of the Colorado River Compact."

The term was not defined until the Supreme Court's 1964 decree in Arizona v. California. There it was defined as a water right acquired in accordance with state law, which right had been exercised by the actual diversion of a specific quantity of water that has been applied to a defined area of land or to definite municipal or industrial works and existing as of June 25, 1929, the effective date of the Act. By a 1979 supplemental decree, the District's present perfected rights were set at 2,600,000 AF annually because that was the annual quantity being diverted by the District on June 25, 1929, and was actually being used on the 424,145 acres then being irrigated. These vested rights predate the 1902 Reclamation Law and are not subject to reclamation law limitations. See Bryant v. Yellen 447 U.S. at 352 (1980).

One significance of the District's present perfected rights is that, in times of shortage, present perfected rights must be satisfied first, after satisfaction of Mexico entitlement under the existing treaty of 1944. Of the users described in the Seven-Party Agreement, only the Palo Verde Irrigation District, the District, and the Reservation Division, Yuma Project

California Division (non-Indian portion), have present perfected rights. In addition, certain Indian Reservations have present perfected water rights as decreed by the U.S. Supreme Court (March 9, 1964) in Arizona v. California, et al, and a subsequent court order dated January 9, 1979. (MWD, Coachella, and the other users do not have present perfected rights.) Palo Verde is limited to 219,780 AF or the quantity of mainstream water necessary to supply the consumptive use required to irrigate 33,604 acres. The Yuma Project (Reservation Division) is entitled to 38,270 AF of diversions or the quantity of mainstream water necessary to supply the consumptive use required to irrigate 6,294 acres.

c. Federal Contractual Rights

As set forth above, the District has certain contractual rights with the United States pursuant to a described priority agreement. Pursuant to the All-American Canal Contract and the Seven-Party Agreement, the District and Coachella, along with Palo Verde and the Yuma Project, are entitled to divert 3.85 MAF annually. After the Central Arizona Project begins its diversions, the MWD may be limited to a maximum of 550,000 AF. Accordingly, in times of normal flow, the balance of the priorities cannot be satisfied, except in those years when the Secretary determines that greater than normal amounts of water will be available, or in years in which the Secretary allows California to divert unused portions of Arizona and Nevada apportionments.

G. DISTRICT WATER USE

1. Use of Water within the District

Water diverted by the District pursuant to its present perfected rights or contractual rights can be used for domestic and agricultural purposes. The Colorado River Compact, the foundational document for "the law of the River," apportions in perpetuity to the Lower Basin 7.5 MAF each year for application to "domestic and agricultural uses." The term "domestic use" is defined in Article II (h) of the Compact as including "...the use of water for household, stock, municipal, mining, milling, industrial, or other like purposes ...."

Further, Article IV (b) provides that Colorado River water may be impounded and used for the generation of electrical power, "but such impounding and use shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes."

The Boulder Canyon Project Act contains a number of references that are helpful when read in conjunction with the Colorado River Compact. Section 1 of the Act recites that one purpose of the Act is "for storage and for the delivery of the stored waters thereof for reclamation of public lands and other beneficial uses ...." Also, in Section 1, it is provided that "no charge shall be made for water or for the use, storage or delivery of water for irrigation or water for potable purposes in the Imperial or Coachella Valleys." Section 4 limits California to 4.4 MAF, plus one-half of excess or surplus water "including all uses under contracts made under the provisions of this Act and all water necessary for the supply of any rights which may now exist."

In Section 5, the Secretary of Interior is authorized to contract for the delivery of water "at such points on the River and on said Canal as may be agreed upon for irrigation and domestic uses." In addition, Section 5 specifies that such contracts "...shall be for permanent service." In Section 6, it is provided that the dam and reservoir shall be used "for irrigation and domestic uses and satisfaction of present perfected rights."

The All-American Canal Contract contains several references to the use of water within the District. As set forth in Article 17, the United States is required to deliver to the District water that is available for use in California under the the Colorado River Compact and the Boulder Canyon Project Act. The District's allotment is included within the third priority, which is for the beneficial consumptive use of not more than 3,850,000 AF in the first three priorities. Section 17 also provides that water shall be delivered as ordered by the District "and as reasonably required for potable and irrigation purposes." This Section provides that the Contract is for permanent service and that the dam and reservoir shall be used "for irrigation and domestic uses and satisfaction of present perfected rights."

Finally, Article 29 of the Contract specifically provides that "all rights based upon this Contract shall be subject to and controlled by the Colorado River Compact."

Section IIA of the 1964 Decree in <u>Arizona v. California</u> provides that the United States is enjoined from operating regulatory structures and from releasing water other than in accordance with the following order of priority: "(1) for River regulation, improvement of navigation, and flood control; (2) for irrigation and domestic uses, including the satisfaction of present perfected rights; and (3) for power." In the

1979 supplemental decree, the District's present perfected rights are defined, in part, as "water necessary to supply the consumptive use required for irrigation of 424,145 acres and for the satisfaction of related uses ...."

Land within the boundaries of the District is not entitled to any particular quantity of water but is entitled to the amount that can be put to beneficial use. All lands within the District have equal water rights. In times of shortage, the quantity available is prorated to all lands based on the assessed valuation of each parcel and the total assessed valuation of all parcels.

2. Water Use outside District Boundaries

Conserved or surplus water may be transferred to other qualified users for use outside the District's boundaries if the District's Board of Directors finds it to be for the best interests of the District.

In addition to the District's state permit rights, it has present perfected rights and contractual rights. The present perfected rights are water rights "acquired in accordance with state law." The Colorado River Compact does not impair these rights (see Article VIII). Moreover, the Boulder Canyon Project Act is subject to the terms of the Compact and specifically provides that the Project shall be used for the "satisfaction of present perfected rights in pursuance of Article VIII of said Colorado River Compact" (see Section 6 of the Project Act). The Seven-Party Water Agreement between the California users applies to water delivered pursuant to the Colorado River Compact and the Boulder Canyon Project Act. Because the District's present perfected rights are unimpaired by the Compact and the Project Act, the Seven-Party Agreement does not vitiate those rights.

Further, the All-American Canal Contract between the United States and the District provides that the delivery of water as a result of the Boulder Canyon Project Act is "subject to the terms of the Colorado River Compact." The Contract is subject to the satisfaction of present perfected rights and is without prejudice to any other or additional rights that the District has (see Section 17 of the Contract).

Accordingly, the District's present perfected rights are fully recognized and protected by virtue of the United States Supreme Court decree and the supplemental decree in *Arizona v. California* and are not subject to any use limitation contained in the Compact, the Boulder Canyon Project Act, or the Seven-Party Agreement.

Neither federal nor state law would seem to prohibit the transfer of conserved water to other qualified users, such as the MWD. In certain instances, the Secretary of Interior's consent may be necessary, but it seems unlikely that such a transfer would be objectionable. Moreover, the Secretary's consent would be consistent with the powers granted him by Congress and recognized by the Supreme Court in Arizona v. California, 373 U.S. 567 (1963).

Although water delivered to the District under contract with the Secretary is subject to congressional provisions, it is clear that "... Congress intended to defer to the substance, as well as the form, of state water law" (California v. United States, 438 U.S. 645 at 675 (1978)). In that case, the Supreme Court agreed with California that "... a state may impose any conditions on the 'control, appropriation, use or distribution of water' ... not inconsistent with clear congressional directives respecting the project" (Id. at 672). Further, the court held that the "history of the relationship between the Federal Government and the states and the reclamation of the arid lands of the western states is both long and involved, but through it runs the consistent thread of purposeful and continued deference to state water law by Congress" (Id. at 653).

Recently, the Supreme Court held that the Boulder Canyon Act "... was supplemental to the reclamation laws ... [and] required the Secretary of Interior [to] observe rights to Colorado River water that had been perfected under state law ...." Bryant v. Yellen, 447 U.S. at 355 (1980). The court further held that "... state law was not displaced by the Project Act and must be consulted in determining the content and characteristics of the [decreed] water right that was adjudicated to [the District] by our decree" (Id. at 371); see also Environmental Defense Fund v. East Bay Municipal Utility District, 26 Cal. 3d 183 (1979).

It is the policy of the State of California to encourage the voluntary transfer of water provided that such a transfer is "consistent with the public welfare of the place of export and the place of import." Water Code Section 109.

Water Code Section 1011 provides that appropriated water may be conserved and thereafter "may be sold, leased, exchanged, or otherwise transferred ...." and the reduction in use resulting from conservation efforts "shall be deemed equivalent to a reasonable beneficial use of water to the extent of such cessation or reduction in use ...." In addition, Water Code Section 1244 provides that any such transfer "... sale shall not constitute evidence of waste ... [nor] any determination of forfeiture [of] water appropriated prior to December 19, 1914." And Water Code Section 1012 specifically protects the District against a forfeiture in the event the District transfers conserved water.

Finally, Water Code Section 22259 authorizes the District Board to "... enter into a contract for the lease or sale of any surplus water or use of surplus water not then necessary for use within the District, for use either within or without the District."

In conclusion, federal and state law and contracts would allow the District to transfer conserved water to other qualified users.

(Note: This water rights summary is not intended to be a comprehensive analysis of the District's water rights or the District's rights concerning transfer of conserved water to users outside of the District. Under various factual situations, other legal and nonlegal factors would have to be considered.)

H. WATER USE EFFICIENCY

1. General

Efficiency of water use can be defined by different terms. The terms commonly used, and as used in this report, are given in the Appendix. The operations of the District that affect the conveyance system efficiency and the on-farm operations are discussed below.

2. Operational Considerations

The District's operational procedures and water users' on-farm irrigation practices parallel the history of irrigation development in the Imperial Valley. Physical structures to divert water from the Colorado River were made entirely by private enterprise. Land leveling for irrigation on farms was almost totally accomplished by horsedrawn fresno scrapers and wooden floats.

The result is that most of the irrigation canals and laterals, the on-farm ditches, and leveled fields are constructed to fit the general contour of the land, which slopes toward the Salton Sea. After the District distribution system and on-farm developments were in operation, it became extremely difficult to make major changes because of the year-round cropping and irrigation.

Construction of Imperial Dam and the All-American Canal made little change in the irrigation distribution system within the Valley. From an operation and maintenance standpoint, water delivered through the All-American Canal system is more silt-free than prior waters, thereby resulting in more growth of moss, algae and aquatic weeds in the District's distribution system. Such growth can be controlled best by drying up the distribution canals and laterals about once a month. The climate, soils, and land ownership pattern in the District lend themselves to intensive commercial agriculture with relatively few small or part-time farming operations. As a result, there is little need for small or short-time irrigation water orders.

The general characteristic of the District's irrigation distribution system continues to be one that has limited water storage capacity in the canals; the water elevation in some canals has to be raised by the use of check gates so as to deliver adequate streams of water to farmers' headgates. Some canals can be drained for maintenance and aquatic vegetation control by diverting water into spillways or drains when "run-down" water cannot be delivered to water users.

3. On-Farm Operations

Farm ditches and irrigated lands generally slope toward the Salton Sea. This, along with the low infiltration rate of the fine-textured clay soils that dominate the Valley, makes it difficult to irrigate most crops without some tailwater (runoff) from the low end of the field. Fortunately, the fine-textured soils have a high water-holding capacity so that if an irrigator has irrigated an entire field before the end of his 24-hour water order, he is often able to re-irrigate part of the land without losing excess water by deep percolation. Because Colorado River water is relatively high in TDS, some downward percolation of water beyond the root zone is necessary to avoid accumulation of excess salt in the root zone after evapotranspiration; in fact, re-irrigation may provide beneficial leaching.

It must be emphasized that each irrigation serves the basic purpose of replenishing the moisture that has been extracted from the soil by evapotranspiration. Any water applied in excess of this amount will eventually find its way to the Alamo or New Rivers or directly to the Salton Sea through: (1) runoff from the lower end of the farmers' fields (tailwater), (2) as deep percolation drainage water (leach water), or (3) as spill water from canals or laterals if deliveries to farmers are discontinued early and no other water users can take the excess water operational spill.

The District places its order on Wednesday for the block of deliveries for the following week, starting Monday. This forecast of water requirement is based on past usage. The farmers place their orders for water 1 to 3 days in advance. Daily changes must be made 3 days in advance in 24-hour increments. A detailed description is included in Chapter III.

4. Irrigation Procedures in Other Western Areas

Irrigation projects in the Western United States use many different systems for delivering water orders. For efficient irrigation, an irrigator must know the depth of water needed to replenish the water that has been extracted from the root zone by plants and evaporation. He must decide whether he is going to include additional water in each irrigation for salt leaching or whether that is to be accomplished by separate irrigations (often preplanting).

After the depth of the water needed is determined and the acreage to be irrigated is known, it is a simple matter to calculate the total acre-inches or acre-feet of water for an order. Depending on the design of each district's system and its method of operation, a water user places an order combining: (1) a rate of flow, and (2) a length of time; this sum yields the total quantity of water desired. For example, on the nearby Yuma Mesa Irrigation and Drainage District and Wellton-Mohawk Irrigation and Drainage District in Arizona, deliveries are made largely in units of 15 to 16 ft^3/s and the time of irrigation varies accordingly.

In the District, the time is fixed in 24-hour units and the rate of flow varies to match the total quantity of water desired. In other words, the only difference in the system of ordering water in the District (compared to other districts in the Lower Colorado River area) is that the District holds the time constant units (24 hours) and varies the rate of delivery (cubic feet per second), while other districts tend to hold the rate of delivery in constant units and vary the time.

In each district in the Western United States, the system used for water users scheduling water orders has been developed around: (1) the design of the project conveyance and distribution system in relation to the source location and quantity of water supply, (2) quantity of water service the water users want and can afford, and (3) the local characteristics of soils, topography, drainage, and cropping patterns. In the case of the District, those characteristics are rather unusual. As pointed out heretofore, the District's distribution system and on-farm development predated the construction of major storage and diversion works of the Colorado River and the delivery of silt-free water. It takes 5 days for water releases from Lake Mead storage to reach Imperial Dam and another day or more for the water delivered to the District at Imperial Dam to reach most of the water users. Imperial Valley's agriculture involves high-cost and high-risk crops (i.e., lettuce, cabbage, tomatoes, onions, etc.) in which a shortage of water at critical periods can be disastrous. Therefore, reliable water service is a must. The characteristics of fine-textured soils result in low water-intake rates. Excess water from field applications finds its way to the Salton Sea in the form of surface runoff and spills rather than in unseen deep percolation such as occurs in districts with coarser textured soils.

A comparison of delivery efficiencies of most of the Lower Colorado agencies is given in Table I.1. All have lower values than the District.

5. District Irrigation Efficiency

Despite the unusual and unfavorable operational characteristics, the District has perfected a system for estimating its water needs, placing its orders for diversions from Imperial Dam, and delivering water to its water users. This has resulted in the District having among the highest conveyance, on-farm irrigation, and overall project irrigation efficiencies of all gravity irrigated projects in the United States.

Bookman-Edmonston Engineering, Inc., summarized the efficiencies of water conveyance and on-farm irrigation (Table I.5). (B-E, 1983). Annual efficiencies of conveyance averaged 91 percent for the 4-year period 1977 to 1980. The annual on-farm irrigation values during the same period averaged 72 percent. Overall District irrigation efficiencies averaged 66 percent for the 4-year period.

6. Comparison with Municipal Use

A comparison of agricultural use can be made with that of municipal and domestic use. The same principles apply including import, conveyance losses, deliveries and used water (sewage). For example, the water supply for the City of Los Angeles is shown in Table I.6. The data is for the 1980-1981 fiscal year. The City of Los Angeles has a 91.6-percent conveyance system efficiency. A small part of the loss is reservoir evaporation. Most of the loss includes meter discrepancies, reservoir seepage, main leaks, and other minor uses and losses.

The relation of sales to consumptive use as a measure of efficiency (the same measure as used for agriculture) indicates an efficiency use of 34.5 percent, but the overall efficiency for Los Angeles is 31.6 percent.

The estimated sewage flow from the City of Los Angeles is about 54 percent of sales (applied water). This could be related to leaching in the Imperial Valley that is on the order of 15 percent of delivered water. It is also noted that currently well over 99 percent of the sewage generated in the City of Los Angeles is discharged to the Pacific Ocean.

This comparison illustrates that the efficiencies within the District are comparable to urban areas when considering conveyance efficiency, and they are exceedingly high when considering overall efficiency. The relative efficiencies illustrate only that they are related to the specific use and are not a sole measure of effective use.

TABLE I.5
EFFICIENCY OF WATER CONVEYANCE AND ON-FARM IRRIGATION
IMPERIAL IRRIGATION DISTRICT, CALIFORNIA
(1977-1980)

Item	Amount
Acres Irrigated	460,000 acres
Diversions below Drop No. 1	2,734,000 AF
Diversions per Acre Irrigated	5.94 AF
Delivered to Farms (total)	2,496,500 AF
Conveyance System Efficiency	91%
On-Farm Consumptive Use (total)	1,797,000 AF
On-Farm Consumptive Use (per acre)	3.90 AF
On-farm Irrigation Efficiency	72%
District Irrigation Efficiency	66%
Leaching Requirements	270,000 AF
Unit Irrigation Efficiency	83%

TABLE I.6
WATER USE IN CITY OF LOS ANGELES

Item	Amount	
Production[a]		
Los Angeles Aqueduct	476,000 AF	
MWD	46,000 AF	
Local Wells	95,000 AF	
Total	617,000 AF	
Sales[a]	565,000 AF	
Losses	52,000 AF	
Losses in Percent of Production		8.4%
Sewage (over 99% to Ocean)[b]	305,000 AF	
Sewage in Percent of Sales		54%
Consumptive Use (75% of Outside Use)	195,000 AF	
Conveyance System Efficiency	$\frac{565,000}{617,000}$ =	91.6%
Efficiency of Use	$\frac{195,000}{565,000}$ =	34.5%
Overall Efficiency		31.6%

[a]LADWP, 1981.

[b]54% of sales based on data for Southern California area (DWR, 1974).

CHAPTER II
BACKGROUND

CHAPTER II

BACKGROUND

A. GEOGRAPHICAL SETTING

Described below are some of the important geographical features of the Imperial Valley that provide a basis for understanding the District's water system.

1. Location

The Imperial Valley is located in the southeast corner of California. Arizona borders on the east and Mexico on the south. As part of what was known as the Colorado Desert, this area of about 7,500 square miles is composed of sand, silt and sagebrush. Adjacent mountains to the northwest reach elevations of 10,000 feet. The desert extends southeasterly some 200 miles through the Coachella Valley, Imperial Valley and Mexicali Valley to the Gulf of California. It is bounded on the east by the Colorado River. The Imperial Irrigation District is located in the geographical center of this area within the Imperial Valley.

The Valley consists of the southern end of the depression known as the Salton Basin. This basin was formed by a gradual depression of the area by block faulting. At the same time, encroachment of the Colorado River Delta from the east and south covered the area with sediments originating in the several states comprising the Colorado River Watershed. Most of the irrigated land in the Valley is below sea level. The lowest lands border the Salton Sea at an elevation of -235 feet [235 feet below mean sea level (msl)].

The gross area of the District is 1,062,290 acres. About 465,000 acres in the central part of the District, termed "Imperial Unit," are irrigated. Slightly over 500,000 acres of land receive water when cities, towns, recreation and other nonagricultural users are included.

Imperial Valley contains nine cities and towns. El Centro, the County Seat with a 1984 population of about 26,000, is located in the southwestern part of the District about 60 miles west of Yuma, Arizona, and 120 miles east of San Diego, California. Brawley, the second largest city, lies 14 miles north of El Centro; Calexico, the third largest city, is located 10 miles southeast of El Centro on the Mexican border.

2. Topography

The flatness of the Imperial Valley belies its extremely active present and past geology. Several million years ago Imperial Valley was part of an inland sea, which included the present Gulf of California, and extended through the Imperial and Coachella Valleys north through the San Joaquin and Sacramento Valleys, and beyond. A tremendous upthrust gave birth to the mountain ranges seen around the Imperial Valley, and the entire area emerged from the sea. There was a gradual settling of the central portion of the area now occupied by the Imperial and Coachella Valleys. The Colorado River began depositing silt eroded from the 240,000 square miles of its drainage area, including the Grand Canyon. Gradually the delta was extended for hundreds of miles southerly into the Gulf of California, westerly and northerly through the Mexicali Valley, and into the Imperial Valley. (It is not known how deep the river silt is in Imperial Valley; it has a depth of as much as 2,000 feet in places.)

The central developed portion of Imperial Valley is a relatively flat plain, sloping from mean sea level at the Mexican border to about -235 feet at the edge of the present Salton Sea. The bottom of the Salton Sea, estimated to be lower than -270 feet, is one of the lowest points in North America. The eastern portion of Imperial Valley, known as the East Mesa, is a broad expanse of desert sloping gently east to west. Similarly, the West Mesa slopes west to east toward the cultivated area of the Valley.

The Colorado River flows north to south through the Colorado Desert forming the California-Arizona border; at Imperial Dam, it is about 180 feet above msl. The elevation of the River near Yuma, Arizona, is about 150 feet. The River channel continues southerly along the crest of its delta through Mexico to the Gulf of California.

South of Imperial Valley in Mexico, the Colorado River delta contains a broad ridge, or saddle, running southwesterly from Algodones (near Yuma, Arizona) to Cerro Prieto, Mexico, at which point the ground elevation is about 40 feet above msl. North and west of this saddle, runoff and drainage flow through the Mexicali and Imperial Valleys toward the Salton Sea. South and east, drainage is into the Gulf of California.

The Laguna and Jacumba Mountains and other mountains to the west of the Valley exceed elevations of 4,000 feet. They are part of the California Coast Range. The Chocolate Mountains to the east are not as high, reaching elevations of about 2,000 feet at the highest.

North of the Salton Sea several other mountain ranges containing the highest peaks in Southern California, over 10,000 feet, enclose the Valley. The area was once known as the Salton Sink. The total Salton Sea watershed covers about 8,360 square miles.

3. Soils

Imperial Valley contains relatively recent deposits of water-transported soil. The central irrigated area served by the District generally lies below sea level and has fine-textured silts rather than coarser soils usually associated with desert areas. Above mean sea level within the East and West Mesas, sandy soils predominate, which is typical of most of the deserts in the southwest United States. Furthermore, there is no topsoil in the usual sense, nor do any well-defined horizons exist. Instead of being several inches, the soils are thousands of feet deep.

Generally, the soils are highly variable and complex. The upper soil profile, prior to development, has been reworked by flooding of New and Alamo Rivers and numerous washes from the East and West Mesas. Surface soils have also been reworked by wind erosion.

The most recent soil survey for Imperial Valley was conducted between 1962 and 1975 by federal, state and local agencies. This study is reported in "Soil Survey of Imperial County, California, Imperial Valley Area," published by the National Cooperative Soil Survey, October 1981. This study identifies six major soil types which predominate in the developed lacustrine basin portion of Imperial Valley, the 425,000 acres served by the District. It is a broad perspective and not intended to show the detail necessary for planning the management of a farm or field.

The six broad soil types, described on the General Soil Map, (Exhibit II.1) are given as:

(1) Imperial: Nearly level, moderately well-drained silty clay in the lacustrine basin

(2) Imperial-Holtville-Glenbar: Nearly level, moderately well-drained and well-drained silty clay, silty clay loam and clay loam in the lacustrine basin

(3) Meloland-Vint-Indio: Nearly level, well-drained fine sand, loamy very fine sand, fine sandy loam, and silt loam in the lacustrine basin and on low alluvial fans

(4) Niland-Imperial: Nearly level, moderately well-drained gravelly sand, fine sand, silty clay, and silty clay loam at the edges of the lacustrine basin

(5) Glenbar-Imperial: Nearly level, well-drained and moderately well-drained silt loam, clay loam, silty clay loam, sand, fine sand, and silty clay predominantly in basins on the West Mesa

The survey also contains a table showing all of the soil types identified, reproduced herein as Table II.1. From this information, it is apparent that the following three soil series dominate in the developed area of the Valley:

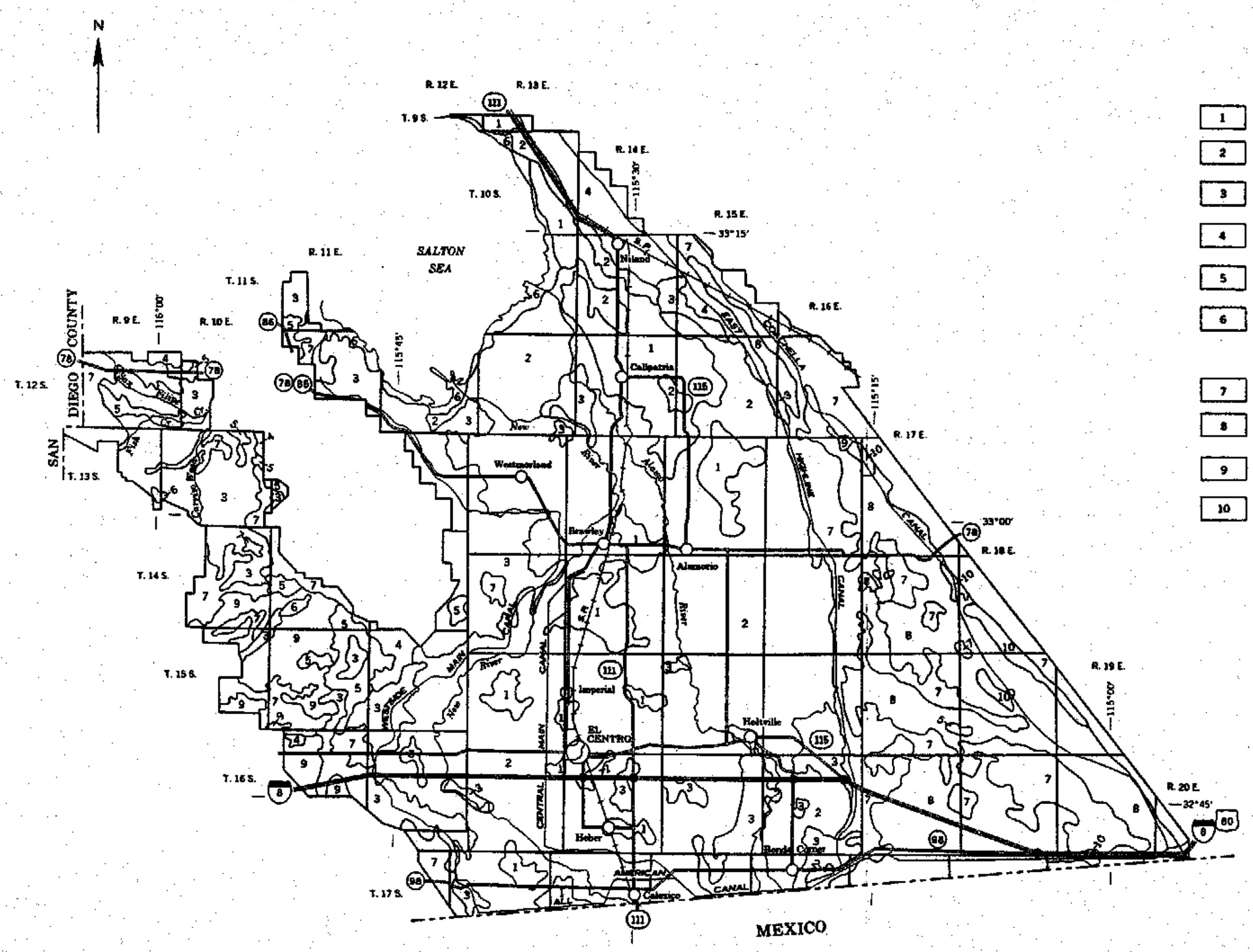
Imperial - over 300,000 acres
Holtville - about 80,000 acres
Meloland - about 40,000 acres

4. Seismicity

Numerous earthquake faults, many of them active, traverse Imperial Valley and the Salton Trough. The most noteworthy fault is the San Andreas, which extends from Mexico to Northern California.

More than 60 earthquakes of Richter Scale magnitude 5.0 and greater have been recorded in the Salton Trough area since 1900. Hundreds of smaller quakes have been recorded. The largest recorded quake registered 7.1 on the Richter Scale and occurred in May 1940 along the Imperial Fault. The epicenter was located east of Calexico on the International Border. The fault could be traced for nearly 50 miles from Volcano Lake in Mexico through the Valley to an area north of Brawley. A horizontal movement of over 14 feet was observed across the newly completed All-American Canal.

Several lives were lost in the 1940 earthquake, which caused severe damage to most of the towns in the Valley. The earthquake also caused extensive damage to the District's canals and drains. The major impact was to the canal system in Mexico where several miles of the Solfatara Canal were completely destroyed, and the large flume across New River was damaged beyond repair. At the time, the water supply to the Valley was routed through Mexico. The entire water supply to the District's system had to be cut off for several days. District personnel and equipment worked day and night to repair the damage. The All-American Canal had been completed from the Central Main Canal to the Westside Main Canal and was put into service to supply the west side of the Valley with water from the Central Main Canal, thus saving probable loss of crops in that area.



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

MAP UNITS*

WELL DRAINED TO POORLY DRAINED SOILS DOMINANTLY IN THE LACUSTRINE BASIN

1 — Imperial: Nearly level, moderately well drained silty clay in the lacustrine basin

2 — Imperial-Holtville-Glenbar: Nearly level, moderately well drained and well drained silty clay, silty clay loam, and clay loam in the lacustrine basin

3 — Meloland-Vint-Indio: Nearly level, well drained fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam, loam, and silt loam in the lacustrine basin and on low alluvial fans

4 — Niland-Imperial: Nearly level, moderately well drained gravelly sand, fine sand, silty clay, and silty clay loam at the edges of the lacustrine basin

5 — Glenbar-Imperial: Nearly level, well drained and moderately well drained silt loam, clay loam, silty clay loam, sand, fine sand, and silty clay dominantly in basins on West Mesa

6 — Fluvaquents: Nearly level, poorly drained soils of undifferentiated texture in the lacustrine basin

WELL DRAINED AND SOMEWHAT EXCESSIVELY DRAINED SOILS DOMINANTLY ON EAST MESA AND ON WEST MESA

7 — Rositas: Nearly level to moderately steep, somewhat excessively drained sand, fine sand, and silt loam in alluvial basins and on fans and sandhills

8 — Rositas-Superstition: Nearly level, somewhat excessively drained loamy fine sand or fine sand on alluvial terraces and fans

9 — Antho-Superstition-Rositas: Nearly level, well drained and somewhat excessively drained fine sand and loamy fine sand in alluvial basins and on alluvial fans and terraces

10 — Holtville-Antho: Nearly level, well drained loamy fine sand, loam, silty clay loam, and silty clay on alluvial terraces

*Texture refers to surface layer

Compiled 1979

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

IMPERIAL COUNTY, CALIFORNIA, IMPERIAL VALLEY AREA

Scale 1: 443,520

1 0 1 2 3 4 5 6 7 MILES

Exhibit II.1

TABLE II.1
ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

SOIL NAME	Acres	Percent
Antho loamy fine sand	4,134	0.4
Antho-Superstition complex	8,416	0.9
Badland	4,390	0.4
Carsitas gravelly sand, 0 to 5 percent slopes	7,011	0.7
Fluvaquents, saline	12,262	1.2
Glenbar clay loam	2,951	0.3
Glenbar clay loam, wet	4,239	0.4
Glenbar complex	12,894	1.3
Holtville loam	2,804	0.3
Holtville silty clay	3,628	0.4
Holtville silty clay, wet	70,547	7.1
Holtville-Imperial silty clay loams	2,242	0.2
Imperial silty clay	1,405	0.1
Imperial silty clay, saline	5,679	0.6
Imperial silty clay, wet	123,401	12.5
Imperial-Glenbar silty clay loams, wet, 0 to 2 percent slopes	203,659	20.6
Imperial-Glenbar silty clay loams, 2 to 5 percent slopes	2,162	0.2
Indio loam	9,169	0.9
Indio loam, wet	13,625	1.4
Indio-Vint complex	29,643	3.0
Laveen loam	2,322	0.2
Meloland fine sand	10,748	1.1
Meloland very fine sandy loam, wet	41,734	4.2
Meloland and Holtville loams, wet	11,483	1.2
Niland gravelly sand	7,884	0.8
Niland gravelly sand, wet	9,820	1.0
Niland fine sand	2,846	0.3
Niland loamy fine sand	2,088	0.2
Niland-Imperial complex, wet	6,974	0.7
Pits	1,400	0.1
Rositas sand, 0 to 2 percent slopes	22,608	2.3
Rositas sand, 2 to 5 percent slopes	1,590	0.2
Rositas fine sand, 0 to 2 percent slopes	77,301	7.8
Rositas fine sand, 2 to 9 percent slopes	40,748	4.1
Rositas fine sand, 9 to 30 percent slopes	19,401	2.0
Rositas fine sand, wet, 0 to 2 percent slopes	22,626	2.3
Rositas loamy fine sand, 0 to 2 percent slopes	90,896	9.2
Rositas silt loam, 0 to 2 percent slopes	3,737	0.4
Rositas-Superstition loamy fine sands	11,373	1.2
Superstition loamy fine sand	12,887	1.3
Torriorthents-Rock outcrop complex, 5 to 60 percent slopes	462	*
Torriorthents and Orthids, 5 to 30 percent slopes	900	0.1
Vint loamy very fine sand, wet	31,545	3.2
Vint fine sandy loam	13,066	1.3
Vint and Indio very fine sandy loams, wet	15,462	1.6
Water	3,288	0.3
Total	989,450	100.0

*less than 0.1 percent.

The most recent major earthquake occurred in October 1979, having a magnitude of 6.5. This earthquake, along the Imperial Fault, caused severe damage to buildings, canal structures, and the All-American Canal, but no lives were lost. The epicenter was located 7 miles east of Calexico. Several miles of the All-American Canal were damaged, resulting in a settlement of up to 4 feet in the embankment. Fortunately, water demand was low at the time, and it was possible to reduce flows sufficiently to continue deliveries to the cities and towns in the Valley for the 3 or 4 days it took to rebuild the banks.

5. Climate

Imperial Valley has a typical southwestern desert climate with summer daytime temperatures exceeding 100°F for more than 100 days per year but with a mild climate the remainder of the year. Mean annual temperature (1914 to date) is 72.5°F, and average rainfall is 2.91 inches per year. The highest temperature of 119°F has been recorded four times since 1914. Daytime temperatures usually exceed 75°F. Summer (June - September, inclusive) average daily temperatures vary from 57.9°F to 113.8°F, with a mean exceeding 85°F during these four months. Winter (November - February, inclusive) average daily temperatures are between 30°F and 89°F, with a mean of 55°F. Even in January, the coldest month, daytime temperatures usually exceed 75°F. The lowest temperature of record, 16°F, occurred on January 22, 1937. However, hard frosts are uncommon, although nighttime temperatures between 26°F and 32°F are usual for a few days each year.

a. Rainfall

Besides being among the hottest areas, Imperial Valley is one of the driest spots in the United States. The rainy season is November through March, but some of the heaviest rains have occurred in August and September. Thunderstorms generated by moist air moving north from the waters off the Mexican coast produce summertime precipitation. Tropical Storm Kathleen, in August 1976, dropped 3.87 inches of rain at Imperial and much greater amounts in the surrounding mountains. In September 1977, Imperial recorded 2.84 inches of rain from Tropical Storm Doreen.

The heaviest rainfall recorded at Imperial since 1914 was 7.08 inches during one week in September 1939. This storm caused extensive flooding throughout Imperial Valley and severe damage to the District's irrigation and drainage systems, as well as farmland and crop damage.

As in the entire desert southwest, the air in Imperial Valley is relatively dry. During the summer, relative humidity is frequently below 30 percent, dropping sometimes to 20 percent and below as the temperature rises in the afternoon.

Winds are normally calm to light throughout much of the year. However, strong northwesterly winds do occur during the spring and fall months. In August, prevailing winds may be from the south or southeast, especially in association with tropical storms.

b. Storms

Imperial Valley is subject to infrequent but sometimes intense storms. When rainfall amounts in the Jacumba Mountains to the west and Chocolate Mountains to the east are large enough to produce heavy runoff, large flows run across the Yuha Desert on the West Mesa and spill into the Westside Main Canal causing varying degrees of damage to District canals and drains in the area. Similarly, runoff from the Chocolates flows partly down Mammoth Wash. Other washes north of Calipatria flow from the desert into the agricultural area of the Valley, spilling into the East Highline Canal, often causing considerable damage to the canals and drains in the northeast portion of the District. (In 1976 Tropical Storm Kathleen caused extensive flood damage, which was exceeded in 1977 by the damage from Tropical Storm Doreen.)

Although the District has considered some flood-control measures in these two areas, the canals are unlined earth construction and repair of damage is relatively rapid and inexpensive, even though hundreds of thousands of dollars have been expended over the years to make repairs due to storm damage. Usually, the most practical solution to reduce storm damage, as well as store stormwater for beneficial use, is the construction of detention reservoirs above the developed areas of the Valley. These reservoirs could hold runoff for an extended time, thereby making some water available for agriculture or other uses.

Additionally, certain District drains could be enlarged and protected to convey storm flows to New River in the case of the southwest area, and directly to the Salton Sea in the northeast area of the District. In and around the towns of Niland and Calipatria, drainage to homes and businesses in these communities could be provided. The District intends to investigate these potential projects by working with the U.S. Army Corps of Engineers, county, and state governments.

6. Colorado River

The Colorado River originates in the Rocky Mountains and is fed by melting snow from these great mountains. It is the third longest river in America, winding 1,700 miles through deep canyons of seven southwest states toward the Gulf of California in Mexico. Its drainage basin covers about 245,000 square miles, one-twelfth the area of the coterminous United States. The watershed of the Colorado River is shown in Exhibit II.2. Although the River has many tributaries in the Upper Basin, there are very few in the Lower Basin. Below Hoover Dam, there are only two major tributaries: the Bill Williams River entering Lake Havasu and the Gila River near Yuma, Arizona.

During the early exploration years, the River was called such things as dangerous, unruly, killer, majestic, mighty, etc., but the Spanish explorers named it "Colorado," which means "ruddy" or "nearly red," the color caused by the tremendous silt load once carried by the River. Some said the River was "too thick to drink, too thin to plow" and "not wet, just damp." Since construction and completion of the great dams on the River and its tributaries, beginning with completion of Hoover Dam in 1935, silt has been deposited in Lake Mead and the other reservoirs. Below Lake Mead the Colorado now runs slate blue in color. Much has been written about this River and its development; so only a brief summary will be presented here.

In the Upper Basin, development took place gradually, beginning about 1854 when Mormon settlers of the Green River in southwestern Wyoming began diversions for irrigation, and was hastened by the purchase of land from the Indians in 1873. In the 1880s farmers settled in the Uncompahgre Valley in Colorado. By 1905, about 800,000 acres were being irrigated. By 1920, nearly 1.4 million acres were irrigated, but the increase since then has not been significant and the acreage being irrigated in the Upper Basin today is about 1.6 million acres.

In the Lower Basin, development in the Gila area began in 1875, in 1887 in the Palo Verde Valley, and in the 1890s in the Yuma area. In 1901, development began in Imperial Valley, and in time it became the largest undertaking along the River.

After the Reclamation Act of 1902, the Yuma Reclamation Project was authorized in 1904. By 1910, the Reclamation Service had built Laguna Dam, Theodore Roosevelt Dam on the Gila in the Lower Basin, and the Uncompahgre and Strawberry Tunnels in Colorado and Utah.

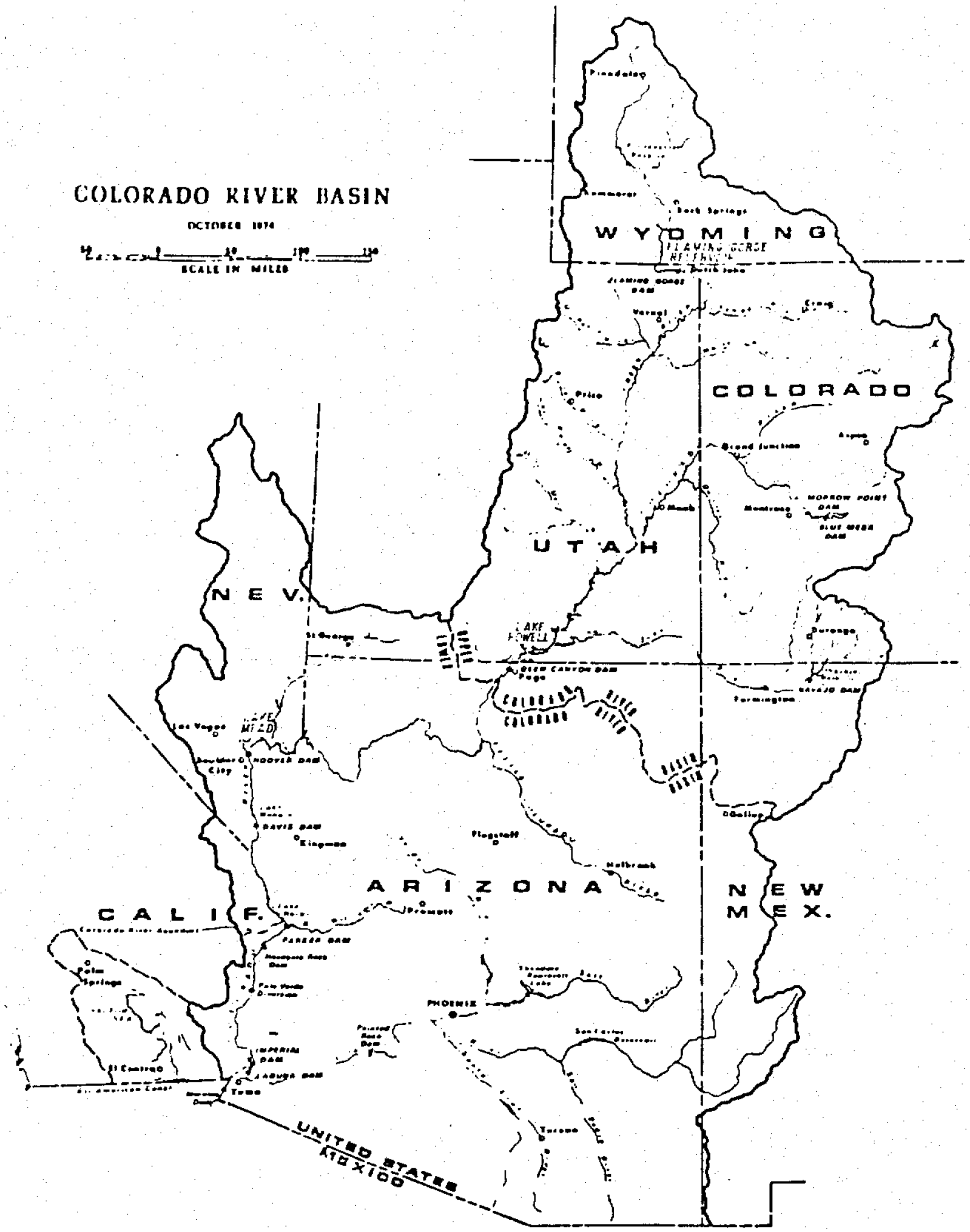

COLORADO RIVER BASIN
SCALE IN MILES
WYOMING
FLAMING GORGE RESERVOIR
COLORADO
UTAH
NEV.
LAKE POWELL
LAKE MEAD
HOOVER DAM
DAVIS DAM
ARIZONA
NEW MEX.
CALIF.
PARKER DAM
IMPERIAL DAM
PHOENIX
UNITED STATES
MEXICO

Exhibit II.2

Today, there are nine dams and reservoirs of significance on the Colorado River and its tributaries (excluding dams on Arizona tributaries) providing regulation and about 60 MAF of storage. These dams are listed in Table II.2.

TABLE II.2
SIGNIFICANT DAMS AND RESERVOIRS ON THE COLORADO RIVER

Dam	Location	Usable Storage Capacity (1,000 AF)
Fontelle	Green River	344
Flaming Gorge	Green River	3,749
Navajo	San Juan River	1,696
Morrow Point	Gunnison River	117
Blue Mesa	Gunnison River	830
Glen Canyon	Colorado River	25,000
Hoover	Colorado River	26,159
Davis	Colorado River	1,810
Parker	Colorado River	619
	Total Storage Capacity	60,324

"The Law of the River," as applied to the Colorado River, has evolved out of a combination of both federal and state statutes, interstate compacts, court decisions and decrees, contracts with the United States, an international treaty, operating criteria and administrative decisions. All of the foregoing have resulted in apportionment of Colorado River water among users thereof or the rights to the "consumptive use" of the Colorado River waters.

In the near future, the River will not yield a sufficient supply of water in dry and normal years to meet the increasing demands for its use without withdrawing water from storage.

When the Colorado River Compact was signed in 1922, allocations of Colorado River waters were based on runoff records during the two previous decades that would have accommodated 16 MAF in beneficial use annually. However, data for 20-year periods between 1906 through 1983 show virgin (undeveloped and unregulated) flows at Lee Ferry (Compact Point) between 13 to 17.7 MAF. The annual natural flow at Lee Ferry for the water years 1964 through 1983 is shown in Table II.3, with an average flow during this period being about 14.2 MAF. It can be seen from Table II.3 that 9 years were below the 14.2 MAF average, the lowest being 5.0 MAF in water year 1977, which also is the record low for the 1906-1984 period. A graphic presentation of Table II.3 is shown in Exhibit II.3.

TABLE II.3
ANNUAL NATURAL FLOW AT LEE FERRY
(COMPACT POINT) FOR WATER YEARS 1964-1983

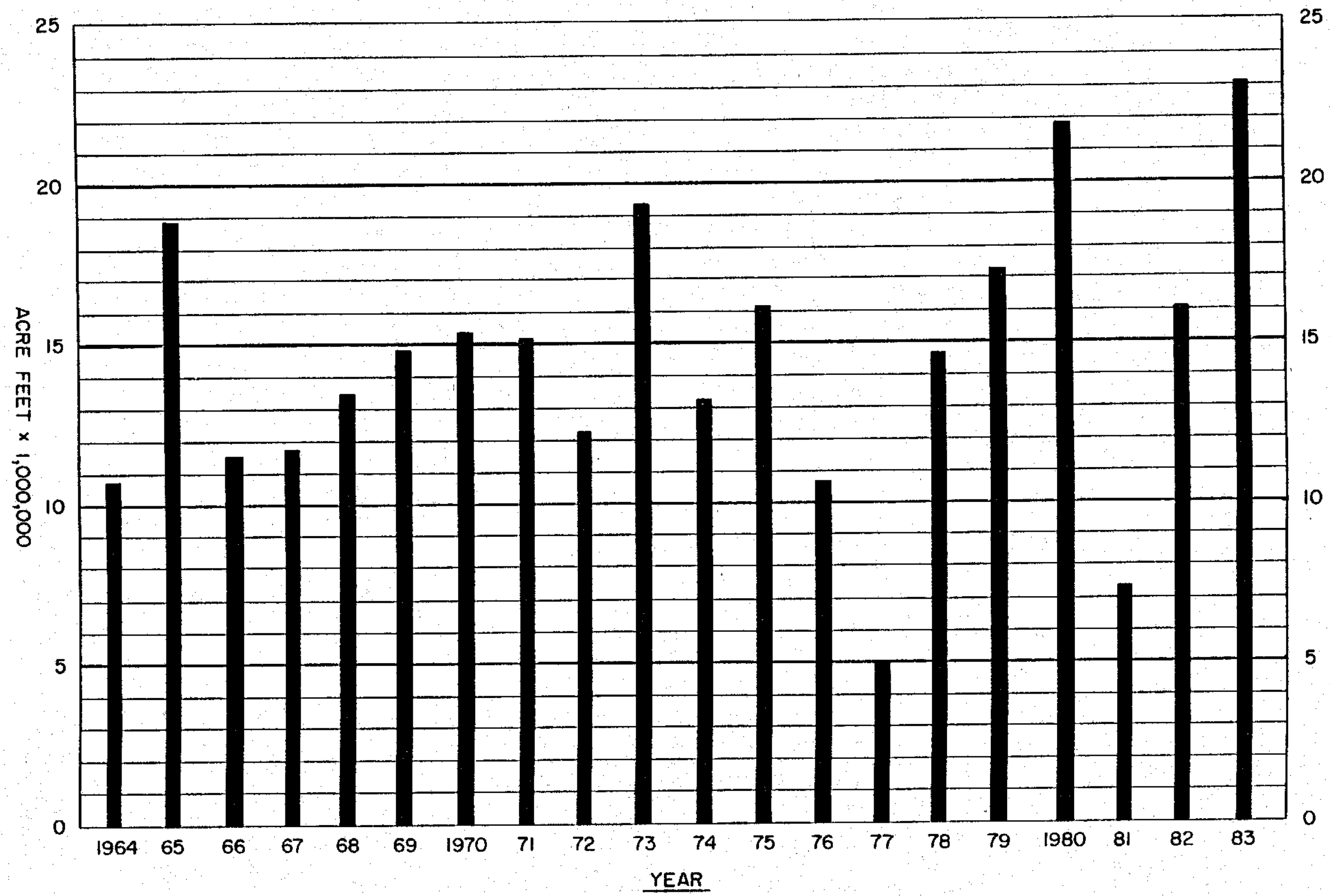
WATER YEARS	FLOW (1,000 AF)
1964	10,814
1965	18,881
1966	11,638
1967	11,834
1968	13,533
1969	14,877
1970	15,360
1971	15,225
1972	12,321
1973	19,435
1974	13,307
1975	16,150
1976	10,723
1977	5,023
1978	14,660
1979	17,337
1980	16,935
1981	7,433
1982	16,126
1983	23,140

Note: Average natural flow at Compact Point for Water Years 1964-1983 = 14,238

Virgin natural flow during 1982-1983 was estimated to be 23.1 MAF at Lee Ferry. Preliminary data for 1983-1984 indicate a new record runoff of nearly 25 MAF, two consecutive years with the highest combined natural flows. However, historic records indicate that dry years can be expected to occur.

Although the Colorado River no longer carries a heavy silt load in its lower reaches, it does carry significant amounts of dissolved salts and, during the past 50 years, salinity has become an acute problem. It is a problem for domestic users since salt in the water damages plumbing and appliances. To agricultural users, it can destroy cropland, reduce crop yields, and restrict the choices of crops to be grown.

Generally, the salinity of the Colorado River increases from its headwaters to its mouth. This increase is the result of two basic processes: salt loading (adding salts) and salt concentrating



COLORADO RIVER AT LEE FERRY

Exhibit II.3

(reducing water supply). Salt loading results from both natural conditions and human activity. Salt concentrating results when water is lost through evaporation, transpiration, or when water of lower salinity than that of downstream points is diverted out of the basin. The result is an increase in downstream salinity due to the remaining amount of salt being carried in reduced amounts of water. The principal constituents of the River's salinity are sodium, potassium, calcium, magnesium, carbonates, chlorides, sulfates and nitrates. Sodium and chloride ions are the most harmful to crops. Salinity is a term applying to the lump sum of all the dissolved mineral salts, measured as total dissolved solids (TDS) and expressed in parts per million (ppm) or milligrams per liter (mg/L).

Salinity in the Colorado starts out below 50 ppm in the mountain tributaries and has reached between 700 and 900 ppm at Imperial Dam during recent years. Projections have been made that salinity at Imperial Dam could reach 966 ppm by the year 2000. Recorded and projected levels of salinity, unless corrective is taken, are graphed in Exhibit II.4.

The USBR in 1983 estimated that 1982 economic losses in the Colorado River Basin averaged $113 million per year and could more than double (up to $267 million) by 2010 if no measures are taken. Economic damages to all users at Imperial Dam have been estimated to amount to $513,000 per ppm increase in concentration, annually.

In 1973, the seven Colorado River Basin states, acting through the Colorado River Basin Salinity Control Forum, adopted a policy of maintaining lower basin salinity at or below 1972 levels while the Upper Basin continues to develop its compact-apportioned water. In 1975, the Forum recommended, and the basin states subsequently adopted a basin-wide plan of implementation for salinity control and water quality standards for salinity, including the following criteria: 723 ppm below Hoover Dam, 747 ppm below Parker Dam, and 879 ppm at Imperial Dam. This represents the 1972 flow-weighted salinity concentrations at these locations as determined by the USBR. The state-adopted standards were approved by the Environmental Protection Agency. The numeric criteria have been reaffirmed by the states in 1978, 1981, and 1984.

By treaty signed on February 3, 1944, Mexico is entitled to 1.5 MAF of the Colorado River water each year. In years of low flow, any shortfall required to meet Mexican treaty rights will be made good in equal quantities by the Upper Basin States and the Lower Basin States.

Minute 242 of the International Boundary and Water Commission, signed in 1973 by the United States and Mexico, committed the United States to deliver to Mexico water with a salinity no greater than 115 ppm, plus or minus 30 ppm, over the salinity at Imperial Dam. To implement the provisions of Minute 242, Title I of Public Law (PL) 93-320, the Colorado River Basin Salinity Control Act of 1974, authorized construction of: (1) a major desalting plant near Yuma, Arizona, (2) a lined canal to convey the plant's brine to the Gulf of California, (3) concrete lining of part of the Coachella Canal, and (4) other related facilities.

Title II of PL 93-320 also provided for salinity control measures upstream of Imperial Dam to meet the salinity objectives adopted by the seven basin states. The 1974 Act authorized four units for construction and 12 units for planning studies. In 1984, Congress enacted PL 98-569, which contained much needed amendments to the 1974 Act. The original and amended Acts now authorize the construction of five salinity control units by the USBR:

(1) Paradox Valley Unit, Colorado
(2) Grand Valley Unit, Colorado
(3) Las Vegas Wash Unit, Nevada
(4) Stage I, Lower Gunnison River, Colorado
(5) McElmo Creek Unit, Colorado

The Meeker Dome Unit and Stage 1 (both part of the Grand Valley Unit) have been completed.

PL 98-569 also established a separate voluntary on-farm water management program with landowners to control salt contributions from agriculture. The amended act provides for state and local cost-sharing on the salinity control program. If fully implemented, the salinity control measures authorized by PL 98-569 are estimated to be sufficient to maintain the adopted numeric criteria through the year 2000.

The USBR (1985) stated that removal of 1.5 million tons of salt annually will allow the salinity standards to be met in the year 2000. The 6 units already completed or authorized for construction by USBR plus the 10 units authorized for construction by the U.S. Department of Agriculture (USDA) are projected to remove 1.5 million tons per year.

Recorded salinity levels at Imperial Dam with projections through the year 2010.

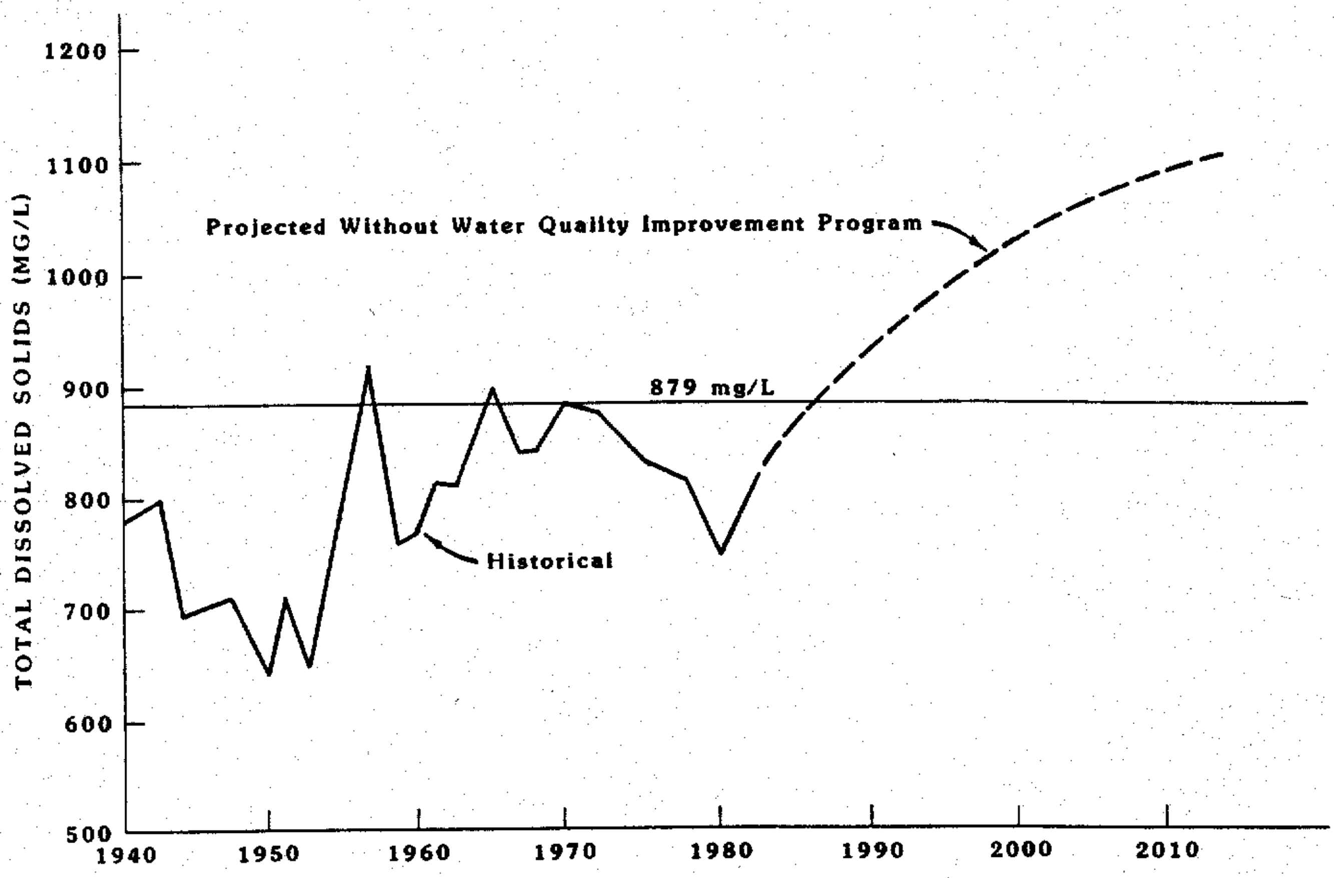


Exhibit II.4

7. Salton Sea

The Salton Sea, over 30 miles long and 10-15 miles wide, lies in the lowest portion of the Salton Trough (see Exhibit II.5). It is California's largest lake, having a surface area of 383 square miles, or 245,000 acres. The Sea receives drainage from an area of 8,360 square miles, including about 1,075 square miles, or 690,000 acres of irrigated lands in Imperial, Coachella and Mexicali Valleys.

a. Water Surface Elevations

On December 31, 1984, elevation of the water surface of the Salton Sea was -227 feet. In 1907, the water surface was 30 feet higher, being -195.9 feet, and the bottom of the Sea was -278 feet.

The Salton Sea is located in a closed basin and, therefore, has no outlet. Evaporation, varying with weather conditions, averages about 71 inches per year and is the only means of "outflow" from the Sea. Since both inflow and outflow are variable, and result from natural as well as manmade conditions, the water level and area of the Sea change with time.

After the Colorado River ceased flowing into the Salton Sea in 1907, evaporation greatly exceeded inflow and the water level rapidly declined until 1924. Increased development of irrigation and improvement of agricultural drainage systems caused inflow to exceed evaporation, which has resulted in a gradual and continual annual rise in the Sea since that time (see Exhibit II.6).

In 1907, when the Sea reached its highest level in this century, it covered more than 300,000 acres and contained approximately 15 MAF of water (see Exhibit II.7). In October 1984, the surface area covered about 245,000 acres and over 7 MAF of water (and silt) were in storage.

Year-end salinity of waters in the Salton Sea is shown in Exhibit II.8. The current salinity is about 39,500 mg/L, which is higher than the average salinity of ocean water (35,000 mg/L). For comparison, the Great Salt Lake and the Dead Sea have salinity concentrations of 200,000 mg/L or greater, i.e., 20-percent salt. The importance of the Salton Sea as a repository for agricultural drainage waters has long been recognized. In 1924, a Public Water Reserve was created setting aside public lands lying below elevation -244 feet for the purpose of creating a drainage reservoir at the Salton Sea.

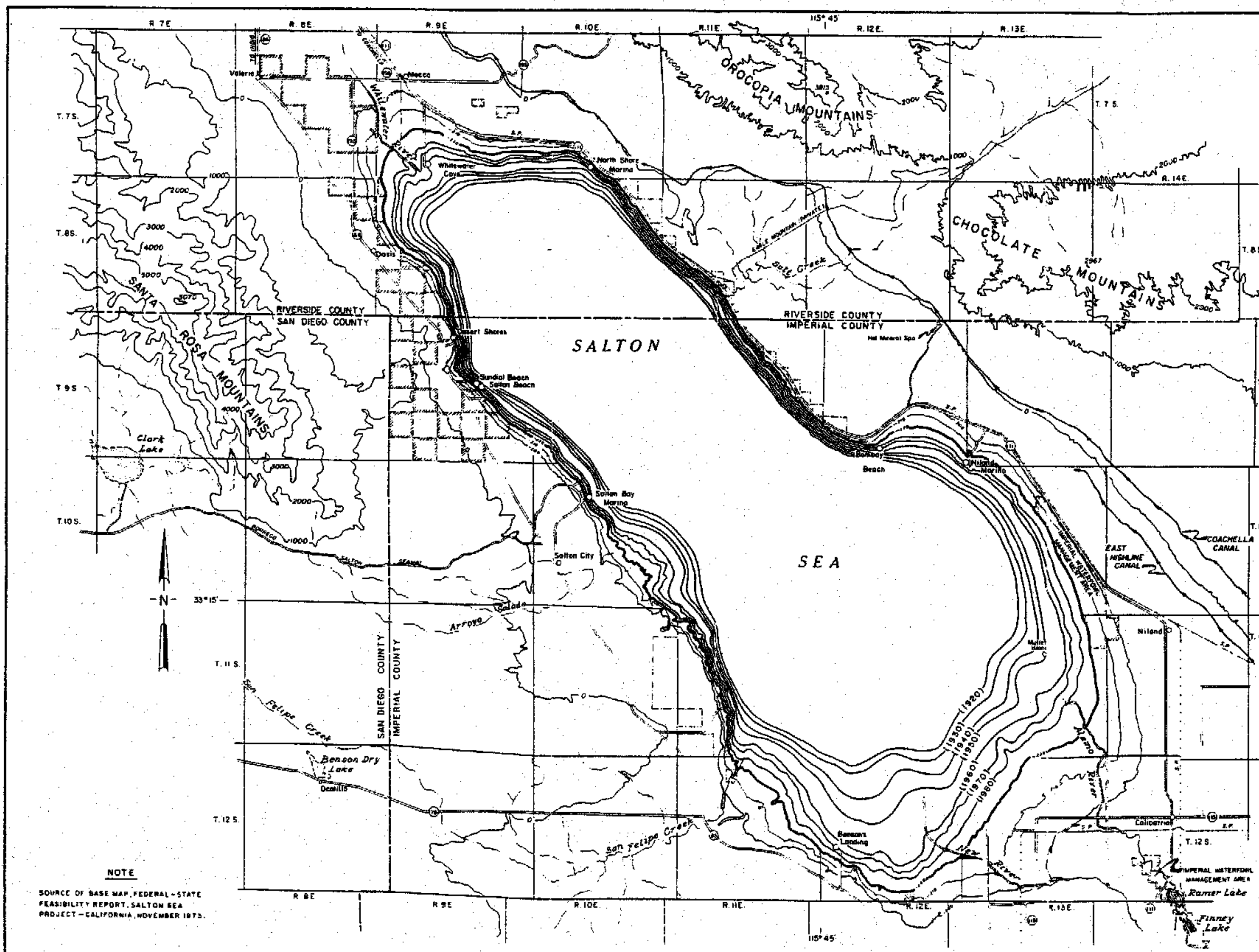
In 1927, the U.S. Geological Survey (USGS) undertook an investigation of the probable future stages of the Sea. It was estimated that 925,000 acres of land in Coachella, Imperial and Mexicali Valleys would be irrigated, with drainage, based on 1.5 AF per acre amounting to 1.388 MAF per year. Storm inflow to the Sea was assumed to be 500,000 AF per year and evaporation 5.8 feet per year. Based on these assumptions and estimates, the USGS report concluded that the Sea would stabilize at an average elevation of -228 feet, but during the occurrence of a very wet period the level could rise to -225 feet. As a result, President Coolidge extended the withdrawal of public lands to elevation -220 feet.

Additional studies by state and federal agencies, and by private consultants, have been made during the past 30 years, and most of them substantiate the fact that the Sea would stabilize at elevations in the range of -230 to -220 feet.

The District has acquired fee title to, or flooding rights on, the majority of private lands below the Salton Sea -230-foot contour line. In the early 1950s, private development of recreation and home sites started around the Sea. In 1957, Imperial County adopted an ordinance requiring developers to make public dedications for lands below elevation -220 feet, or raise their land to that elevation. Nevertheless, considerable development has taken place and most of those properties below elevation -226 feet have been inundated. Several lawsuits against the District and Coachella Valley Water District (CVWD) have been filed.

During the past several years, the elevation of the Salton Sea has risen in the spring and fallen in the summer and fall, usually ending each winter at an elevation higher than the previous year. Due to the fact that agricultural drainage from Imperial Valley is the largest element of inflow to the Salton Sea, those concerned about the rising level of Salton Sea suggest that the District should reduce its agricultural drainage to stabilize or lower the level of the Sea.

The engineering firm of Bookman-Edmonston has analyzed the records of inflow to the Salton Sea for the period 1976 through 1983. In an affidavit dated July 19, 1984, James L. Welsh of that firm described his analyses to compare normalized weather and other conditions, using a base period of 1960 to 1983, to actual conditions during 1976 to 1983, a period of abnormal



LOCATION MAP

LEGEND

MINUS 220 FOOT CONTOUR.

(1920) JANUARY 1 WATER SURFACE ELEVATION BY YEARS.

YEAR	JANUARY 1 WATER SURFACE ELEVATION
1920	−247.4
1930	−245.2
1940	−248.2
1950	−240.2
1960	−234.3
1970	−232.0
1980	−227.8

SALTON SEA
FLOODED AREAS
1920—1980

BOOKMAN–EDMONSTON ENGINEERING, INC.
GLENDALE, CALIFORNIA
SEPTEMBER 1983

SCALE OF MILES

EXHIBIT II.5

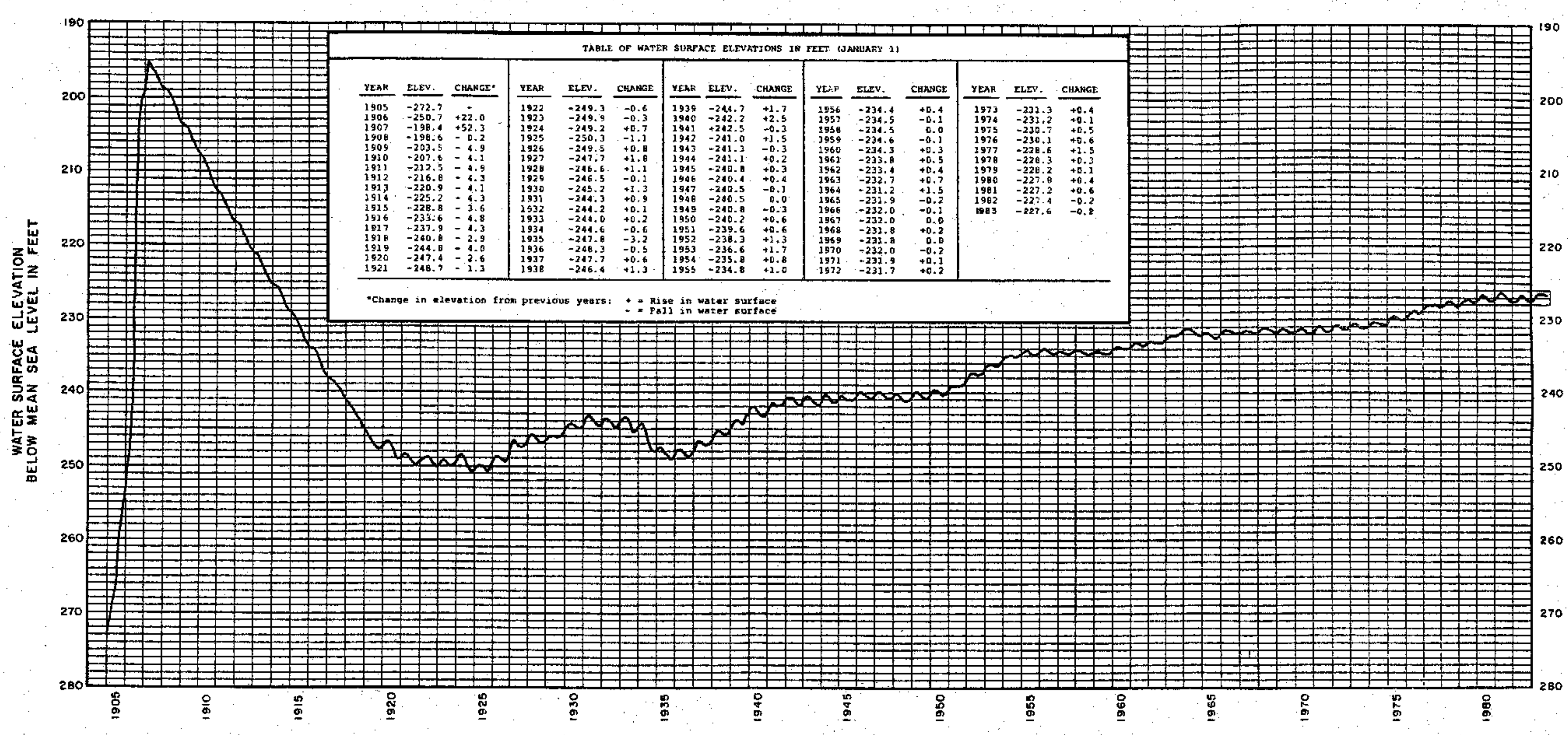


TABLE OF WATER SURFACE ELEVATIONS IN FEET (JANUARY 1)

YEAR	ELEV.	CHANGE*	YEAR	ELEV.	CHANGE	YEAR	ELEV.	CHANGE	YEAR	ELEV.	CHANGE	YEAR	ELEV.	CHANGE
1905	-272.7	-	1922	-249.3	-0.6	1939	-244.7	+1.7	1956	-234.4	+0.4	1973	-231.3	+0.4
1906	-250.7	+22.0	1923	-249.9	-0.3	1940	-242.2	+2.5	1957	-234.5	-0.1	1974	-231.2	+0.1
1907	-198.4	+52.3	1924	-249.2	+0.7	1941	+242.5	-0.3	1958	-234.5	0.0	1975	-230.7	+0.5
1908	-198.6	- 0.2	1925	-250.3	-1.1	1942	-241.0	+1.5	1959	-234.6	-0.1	1976	-230.1	+0.6
1909	-203.5	- 4.9	1926	-249.5	+0.8	1943	-241.3	-0.3	1960	-234.3	+0.3	1977	-228.6	+1.5
1910	-207.6	- 4.1	1927	-247.7	+1.8	1944	-241.1	+0.2	1961	-233.8	+0.5	1978	-228.3	+0.3
1911	-212.5	- 4.9	1928	-246.6	+1.1	1945	-240.8	+0.3	1962	-233.4	+0.4	1979	-228.2	+0.1
1912	-216.8	- 4.3	1929	-246.5	-0.1	1946	-240.4	+0.4	1963	-232.7	+0.7	1980	-227.8	+0.4
1913	-220.9	- 4.1	1930	-245.2	+1.3	1947	-240.5	-0.1	1964	-231.2	+1.5	1981	-227.2	+0.6
1914	-225.2	- 4.3	1931	-244.3	+0.9	1948	-240.5	0.0	1965	-231.9	-0.2	1982	-227.4	-0.2
1915	-228.8	- 3.6	1932	-244.2	+0.1	1949	-240.8	-0.3	1966	-232.0	-0.1	1983	-227.6	-0.2
1916	-233.6	- 4.8	1933	-244.0	+0.2	1950	-240.2	+0.6	1967	-232.0	0.0			
1917	-237.9	- 4.3	1934	-244.6	-0.6	1951	-239.6	+0.6	1968	-231.8	+0.2			
1918	-240.8	- 2.9	1935	-247.8	-3.2	1952	-238.3	+1.3	1969	-231.8	0.0			
1919	-244.8	- 4.0	1936	-248.3	-0.5	1953	-236.6	+1.7	1970	-232.0	-0.2			
1920	-247.4	- 2.6	1937	-247.7	+0.6	1954	-235.8	+0.8	1971	-231.9	+0.1			
1921	-248.7	- 1.3	1938	-246.4	+1.3	1955	-234.8	+1.0	1972	-231.7	+0.2			

*Change in elevation from previous years: + = Rise in water surface
- = Fall in water surface

SOURCE: IMPERIAL IRRIGATION DISTRICT

SALTON SEA
HISTORICAL WATER SURFACE ELEVATIONS

EXHIBIT II.6

BOOKMAN - EDMONSTON ENGINEERING, INC.

SEPTEMBER 1983

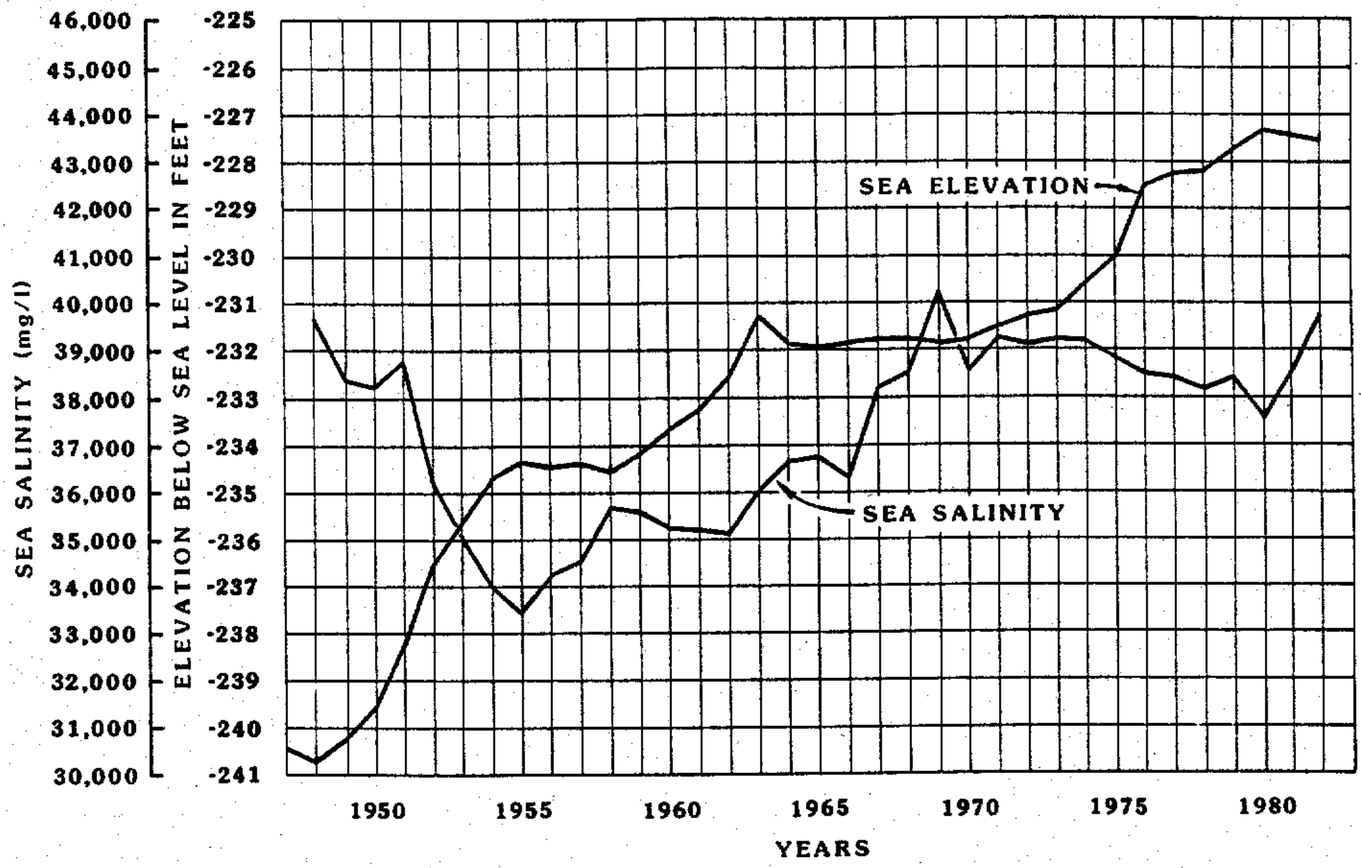
SALTON SEA AREA CAPACITY CURVES

00

ELEVATION (feet)	SURFACE AREA (acres)	CAPACITY (acre-ft)	GROSS EVAPORATION (acre-ft/yr) E=5.86 ft/yr)
-229.75	235625	6559250	1380750
-229.70	235750	6571100	1381500
-229.65	235875	6582950	1382250
-229.60	236000	6594800	1383000
-229.55	236125	6606650	1383750
-229.50	236250	6618500	1384500
-229.45	236375	6630350	1385250
-229.40	236500	6642200	1386000
-229.35	236625	6654050	1386750
-229.30	236750	6665900	1387500
-229.25	236875	6677750	1388250
-229.20	237000	6689600	1389000
-229.15	237125	6701450	1389750
-229.10	237250	6713300	1390500
-229.05	237375	6725150	1391250
-229.00	237500	6737000	1392000
-228.95	237650	6748950	1392875
-228.90	237800	6760900	1393750
-228.85	237950	6772850	1394625
-228.80	238100	6784800	1395500
-228.75	238250	6796750	1396375
-228.70	238400	6808700	1397250
-228.65	238550	6820650	1398125
-228.60	238700	6832600	1399000
-228.55	238850	6844550	1399875
-228.50	239000	6856500	1400750
-228.45	239150	6868450	1401625
-228.40	239300	6880400	1402500
-228.35	239450	6892350	1403375
-228.30	239600	6904300	1404250
-228.25	239750	6916250	1405125
-228.20	239900	6928200	1406000
-228.15	240050	6940150	1406875
-228.10	240200	6952100	1407750
-228.05	240350	6964050	1408625

ELEVATION (feet)	SURFACE AREA (acres)	CAPACITY (acre-ft)	GROSS EVAPORATION (acre-ft/yr) E=5.86 ft/yr)
-228.00	240500	6976000	1409500
-227.95	240625	6988100	1410225
-227.90	240750	7000200	1410950
-227.85	240875	7012300	1411675
-227.80	241000	7024400	1412400
-227.75	241125	7036500	1413125
-227.70	241250	7048600	1413850
-227.65	241375	7060700	1414575
-227.60	241500	7072800	1415300
-227.55	241625	7084900	1416025
-227.50	241750	7097000	1416750
-227.45	241875	7109100	1417475
-227.40	242000	7121200	1418200
-227.35	242125	7133300	1418925
-227.30	242250	7145400	1419650
-227.25	242375	7157500	1420375
-227.20	242500	7169600	1421100
-227.15	242625	7181700	1421825
-227.10	242750	7193800	1422550
-227.05	242875	7205900	1423275
-227.00	243000	7218000	1424000
-226.95	243150	7230250	1424875
-226.90	243300	7242500	1425750
-226.85	243450	7254750	1426625
-226.80	243600	7267000	1427500
-226.75	243750	7279250	1429375
-226.70	243900	7291500	1429250
-226.65	244050	7303750	1430125
-226.60	244200	7316000	1431000
-226.55	244350	7328250	1431875
-226.50	244500	7340500	1432750
-226.45	244650	7352750	1433625
-226.40	244800	7365000	1434500
-226.35	244950	7377250	1435375
-226.30	245100	7389500	1436250
-226.25	245250	7401750	1437125

Exhibit II.7



NOTES

1. END OF YEAR ELEVATIONS NEAR FIG TREE JOHN. (I.I.D. DATA)
2. AVERAGE OF SAMPLES AT FOUR OR FIVE STATIONS TAKEN IN MAY AND NOVEMBER BY I.I.D. (1982 ANNUAL REPORT, PAGE 32)

Exhibit II.8

HISTORICAL CHANGE IN SALTON SEA'S SALINITY AND ELEVATION

rainfall and other weather conditions. Welsh stated in his affidavit:

> "From 1976 to 1983, precipitation on the Sea averaged 4.83 inches, reaching a high of 8.10 inches in 1983. The inflow from Mexico increased to 245,000 acre-feet in 1983 from an average of 125,000 acre-feet. The increase is largely due to excess flow in the Colorado River reaching Mexico.
>
> "If normalized conditions had existed during 1983, the Sea would have declined nearly half a foot. Thus, in 1983 the excess inflow caused an increase in Sea elevation of about 1.5 feet.
>
> "During this same period, Imperial Irrigation District inflow contributions decreased from 1,002,000 acre-feet in 1976 to 784,000 acre-feet in 1983, due in large measure to the actions of IID and water users to reduce system losses. The water balance for 1983 demonstrates this and the continuing reduction of water losses as well as the increase in efficiency of water use. The reduction in IID contributions to the Sea during this period has resulted in a lower Sea level than otherwise would have existed."

Exhibit II.9, entitled "Components of Inflow to Salton Sea" (attachment 22 to Welsh's affidavit) for the period 1960-1983 shows that inflow from the District has generally declined since 1975. This is the period of implementation of the District's current water conservation program.

Exhibit II.10 is a graph entitled "Salton Sea Water Surface Elevation, Historic and Normalized" prepared by Mr. Welsh. It depicts the elevation of the Salton Sea as it actually occurred from 1975 through 1983, compared to elevations under normalized conditions, which assumes long-term average inflow and outflow from sources other than Imperial Valley.

Welsh concludes in his affidavit:

> "The data documents that the general period of 1976 through 1983, when the Salton Sea rose from an elevation of 230 feet to 226.95 feet below msl, was a period of substantially above long-term normal conditions of rainfall and storm runoff and inflow from Mexico. Inflow

from IID, however, substantially declined during this same period."

The graph clearly demonstrates the effects of tropical storm Kathleen in 1976 and above-normal rainfall (8.10 inches) added to the increased flow from Mexico.

In a report to the District, John D. Hess stated (Hess Geotechnical Corp.):

> "The conclusions derived thus far indicate that the prime mover for the abnormal rise of the Salton Sea was heavy rainfall between the years 1975 - 1980, inclusive. Imperial Irrigation District contributions to the Sea during this period may be considered normal and inconsequential insofar as the rise in sea level is concerned. Mexico input to the Sea has increased threefold within the past 20 years and, to some extent, this increase is governed by inflow to the Colorado River below regulating structures on the River."

b. Salinity Control

Recognizing that salinity was increasing in the Salton Sea and that the Sea had become a valuable center of recreational activity, a joint state-federal investigation was begun in 1969 to seek means to preserve the threatened sport fishery and recreational uses of the Sea. It was also recognized, however, that the primary use of the Sea would be to serve as a repository for agricultural drainage.

Following the reconnaissance study, a feasibility investigation was accomplished and the report entitled "Salton Sea Project, California, Federal-State Feasibility Report" was issued in April 1974. This report concluded, among other findings, that:

(1) Any one of four alternatives presented would be justified by substantial net benefits, and would effectively control the Sea's salinity.

(2) The best plan would be the least expensive - diked, impoundment (see Exhibits II.11 and II.12).

(3) Further studies would be required to determine the optimum size of the impoundment and the best methods of construction.

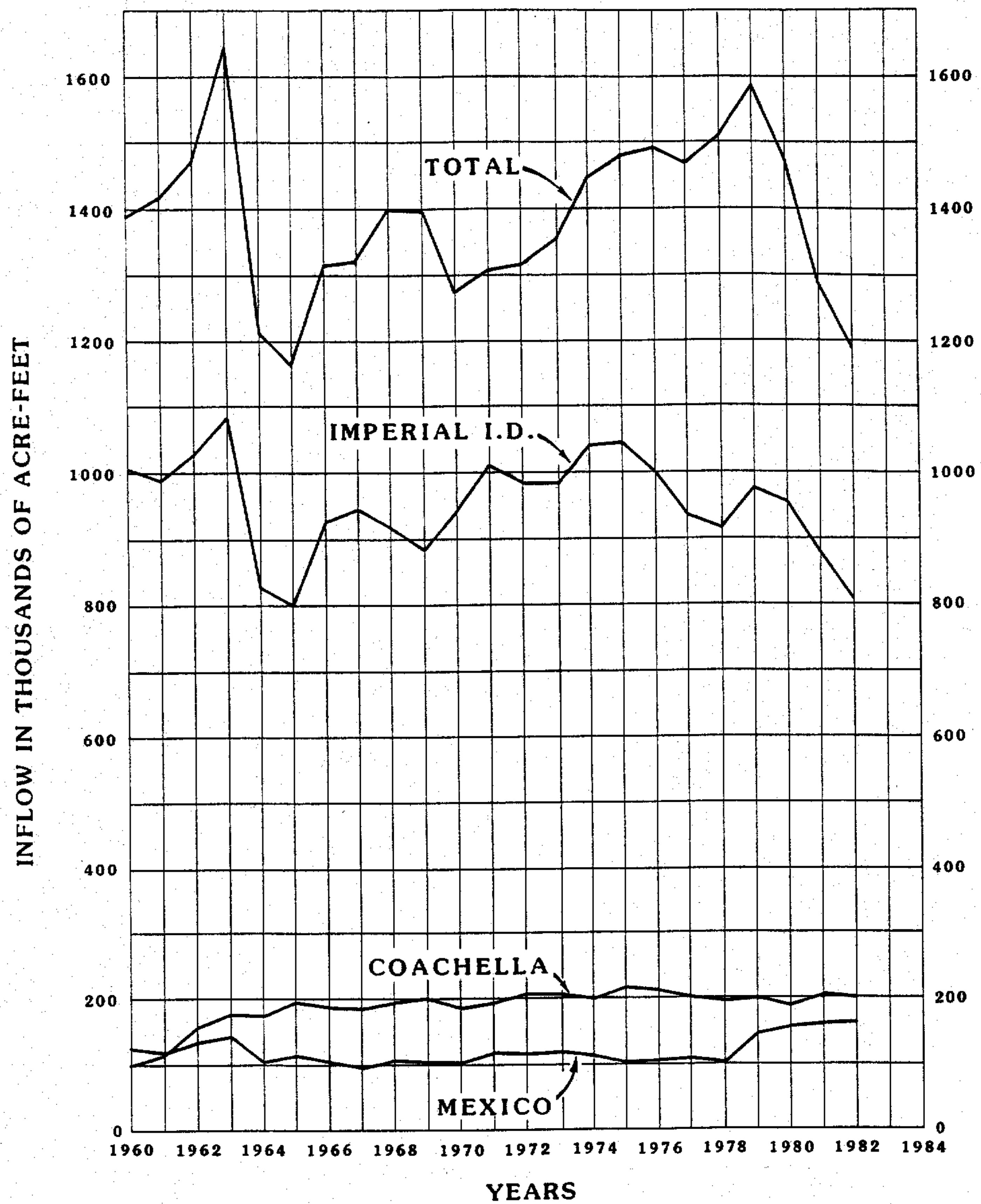


Exhibit II.9

COMPONENTS OF INFLOW TO SALTON SEA

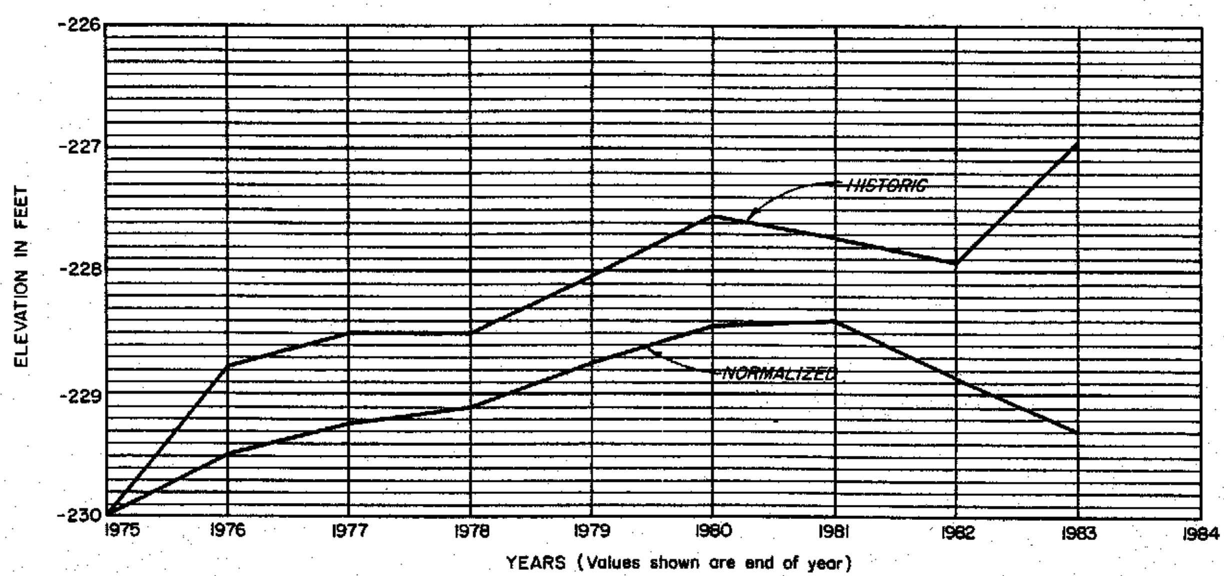
Table of Data

Inflow Normalized	
Mexico	125,000 AF
Coachella	185,000 AF
Other surface and subsurface	141,000 AF
Precipitation on Sea	2.70 inches
Outflow Normalized	
Evaporation from Sea	5.83 feet

Annual Inflow to Sea
(1000 AF)

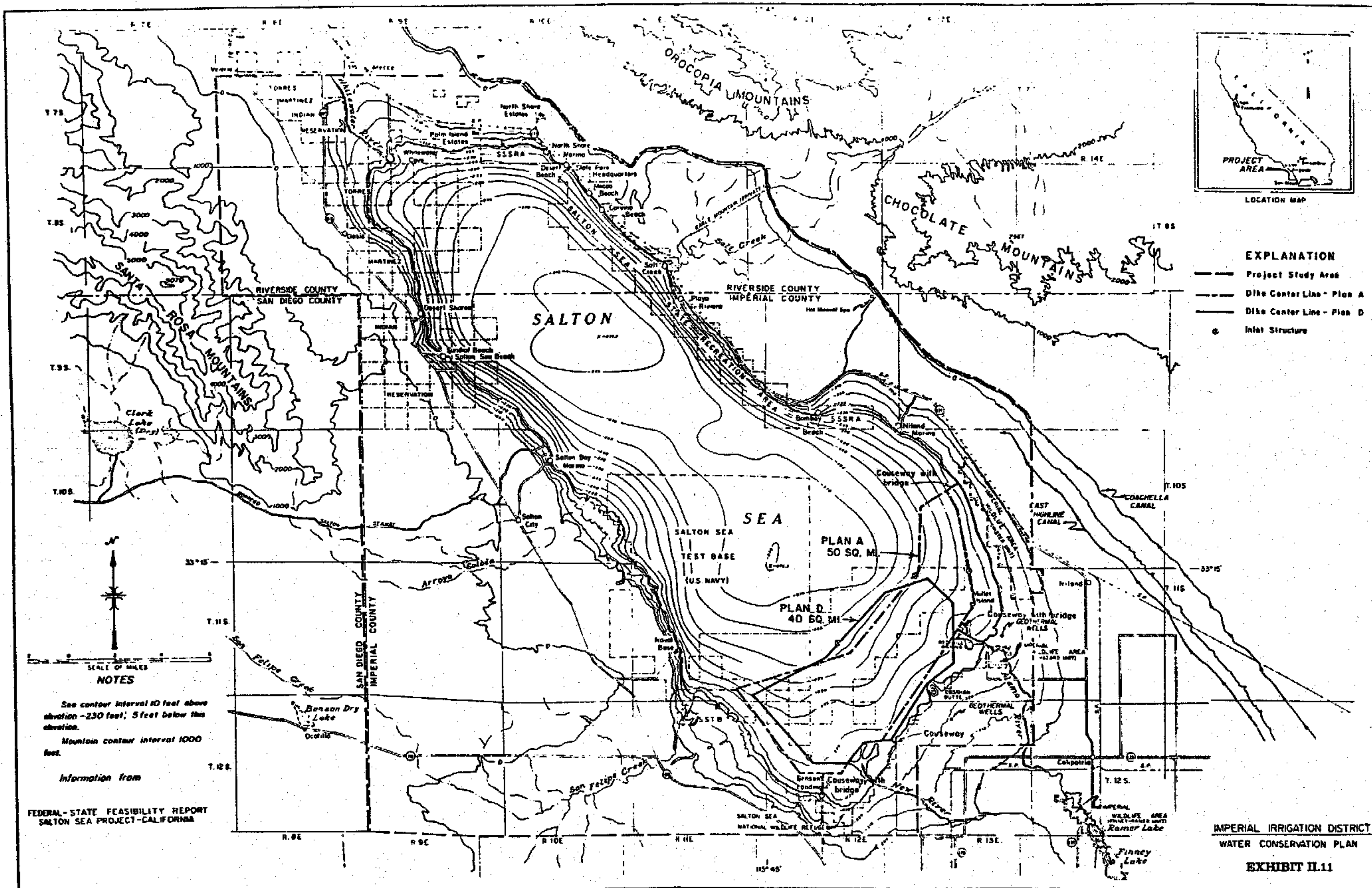
Year	I.I.D.	Mexico Coachella and Other	Rainfall on Sea	Total
1976	1002	451	53	1506
77	938	451	54	1443
78	913	451	54	1418
79	974	451	54	1479
1980	960	451	54	1465
81	880	451	54	1385
82	806	451	54	1311
83	784	451	54	1289

NOTE:
Salton Sea levels normalized by adjusting inflow and outflow data to a 1960 - 1983 base period except for Imperial Irrigation District.
Source: "Supplemental Data on Water Operations," 1960 through 1982, updated for 1983.

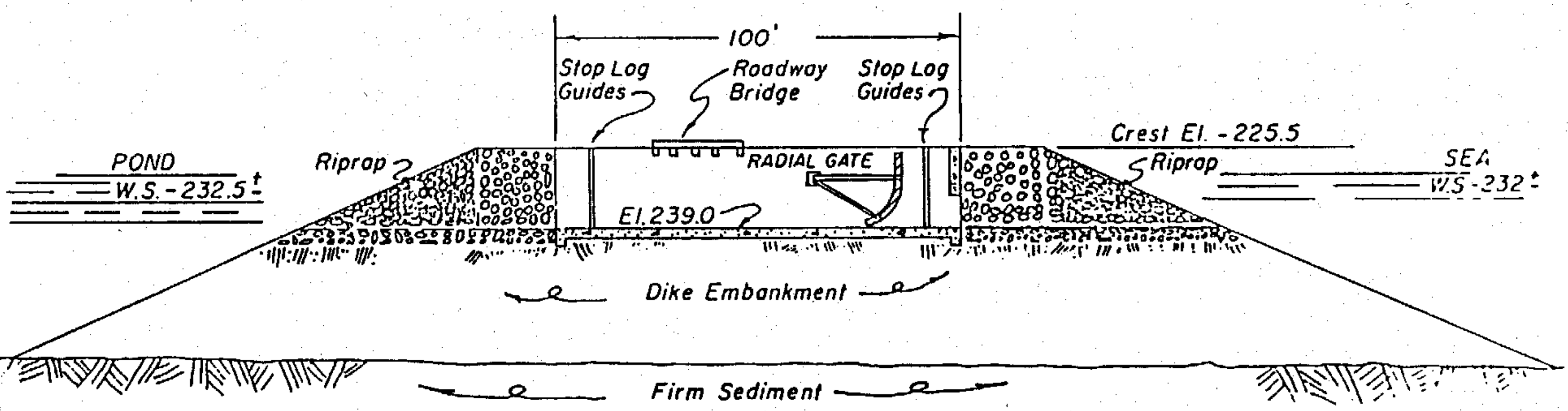


SALTON SEA WATER SURFACE ELEVATION
Historic and Normalized

EXHIBIT II.10



IMPERIAL IRRIGATION DISTRICT
WATER CONSERVATION PLAN
EXHIBIT II.11
EXPLANATION
Project Study Area
Dike Center Line - Plan A
Dike Center Line - Plan D
Inlet Structure
LOCATION MAP
PROJECT AREA
NOTES
See contour interval 10 feet above elevation -230 feet; 5 feet below this elevation.
Mountain contour interval 1000 feet.
Information from
FEDERAL-STATE FEASIBILITY REPORT
SALTON SEA PROJECT-CALIFORNIA
SCALE OF MILES
SALTON
SEA
PLAN A
50 SQ. MI.
PLAN D
40 SQ. MI.
SALTON SEA
TEST BASE
(U.S. NAVY)
OROCOPIA MOUNTAINS
CHOCOLATE MOUNTAINS
SANTA ROSA MOUNTAINS
RIVERSIDE COUNTY
SAN DIEGO COUNTY
RIVERSIDE COUNTY
IMPERIAL COUNTY
SAN DIEGO COUNTY
IMPERIAL COUNTY
SALTON SEA STATE RECREATION AREA
SSSRA
COACHELLA CANAL
EAST HIGHLINE CANAL
Salt Creek
San Felipe Creek
Arroyo Salada
New River
Alamo River
Whitewater River
Clark Lake (Dry)
Benson Dry Lake
Ocotillo
Salton City
Salton Bay Marina
Desert Shores
Salton Sea Beach
North Shore Estates
North Shore Marina
Palm Island Estates
Desert Beach
Bombay Beach
Niland
Niland Marina
Calipatria
Naval Base
Causeway with bridge
Causeway
GEOTHERMAL WELLS
Ramer Lake
Finney Lake
SALTON SEA NATIONAL WILDLIFE REFUGE
TORRES
MARTINEZ
INDIAN
RESERVATION
115°45'
33°15'



NOT TO SCALE

NOTE

Crest elevation to be increased from 40 feet wide to 120 feet wide at inlet structure

Information from

FEDERAL-STATE FEASIBILITY REPORT
SALTON SEA PROJECT-CALIFORNIA

IMPERIAL IRRIGATION DISTRICT

WATER CONSERVATION PLAN

Exhibit II.12

In the report, federal authorization and construction by the Interior Department were recommended. Such authorization was never granted and the Feasibility Report was shelved. It remains a project which should be reviewed again for possible implementation in the near future.

B. HISTORICAL SETTING

1. General

The Imperial Irrigation District was organized in July 1911 under the California Irrigation District Act to acquire the rights and properties of the then-bankrupt California Development Company (C. D. Company) and its Mexican subsidiary company. Leaders in the Valley decided that a public district could best cope with the numerous problems - silt, drought, floods and litigation - that had led to the failure of the C. D. Company. As organized, the District included 513,368 acres within its boundaries, 65,000 acres more than that covered by the mutual water companies' stock.

Much has been written about the early development of Imperial Valley and the problems confronting those early developers; a brief summary is given here. The idea of diverting the Colorado River to irrigate the desert wastes of the Valley was perceived before the Civil War. Dr. O. M. Wozencroft was probably the first to recognize the possibility as he crossed the Colorado Desert in 1849 en route to San Francisco in search of gold. He died in 1887 without seeing his dream fulfilled, but he had stirred up considerable interest. In 1895, several water appropriations were filed by individuals to divert Colorado River water to irrigate lands in "that portion of San Diego County - known as New River Country."

The C. D. Company was formed in 1896 after 4 years of extensive investigation and surveys by C. R. Rockwood. Efforts to finance the project developed by Rockwood were unsuccessful until George Chaffey agreed to take charge. Mr. Chaffey, the developer of Etiwanda and Ontario, had declined in 1882 to work with Dr. Wozencroft on the plan because he thought white men could not withstand the summer heat in the desert. He changed his mind after his experience in irrigation development in Australia. Rockwood and his associates in the C. D. Company decided to call the area various names such as Colorado Desert, Salton Basin and New River Country; the name we know today is Imperial Valley.

Excavation of a canal and construction of headworks on the Colorado River near Pilot Knob began in 1900, and in 1901 the first diversions were made to serve about 1,500 acres of crops. The Imperial Canal, also known as the Alamo Canal, ran through Mexico about 40 miles before crossing into the United States east of present-day Calexico. Within about 3 years, silting of the headworks and upper reaches of the Canal led to the excavation of a temporary bypass channel without a headgate structure about 4 miles downstream in Mexico.

Unseasonable flood water on the Colorado and Gila Rivers in the fall of 1904 broke into the bypass and down the Alamo Canal, and for almost 2 years practically the entire flow of the Colorado River poured into the Salton Sink forming the Salton Sea. By February 1907, the Southern Pacific (S.P.) Company was successful in returning the Colorado to its normal channel. S. P. Company, being the largest creditor, then took over operations of the C. D. Company and its Mexican subsidiary company.

During the next several years, physical, financial, international complications and legal problems plagued the project. The settlers decided the best solution was to form a public state agency, resulting in formation of the District in 1911. But the formation of the District did not solve all of the immediate problems. In fact, it was not until 1916 that financial and legal problems were settled so that the District could acquire the properties of the C. D. Company and its Mexican subsidiary from the S. P. Company. Operations of the canal system were financed by the proceeds of the First Bond Issue of 1915 in the amount of $3.5 million. A new Mexican company "Compania de Terrenos y Aguas de la Baja California, S. A." (Compania) was formed. The capital stock of Compania was placed in the names of the District board members who acted as trustees.

Some of the important actions of the District between 1915 and 1984 are listed below:

<u>Highlights: 1915 to 1984</u>

1915 Inclusion of 70,700 acres making total District area 584,068 acres

1916 Report No. 1 by Consulting Board (G. G. Anderson and C. E. Grunsky) recommending a new headgate and main canal improvements

1917 Report No. 2 listed 43 items including those in Report No. 1 for 2-year improvement program

Second Bond Issue sold in amount of $2.5 million. Much of the planned work, including construction of Rockwood Heading, was accomplished in 1917-1918

1918 Two more reports submitted and adopted. Sold Third Bond Issue, also for $2.5 million, and work accomplished through 1921 included improvements at Andrade, River levee work in Mexico, and the canal system both in Mexico and Imperial Valley

1920 Drainage study funded by portion of Third Bond Issue

1922 Fourth Bond Issue (the last issue of District General Obligation Bonds), in amount of $7.5 million, sold between 1922 and 1925 to purchase the Mutual Water Companies ($5 million) and construct a deep drainage system

Absorption by the District of all existing Mutual Water Companies was completed by March 1923 at a total cost of $4.7 million

1923 District solely responsible for:

(1) The protective levee system

(2) The diversion, transportation, distribution and delivery of water from the Colorado to individual water users, including cities and towns, within a service area of about 540,000 acres

(3) Construction, operation and maintenance of irrigation and drainage systems

(4) Operations of Compania in Mexico

1917-28 District constructed 234 miles of deep drains using Fourth Bond Issue Funds plus General Funds

1929 First tile drains installed

1930 Drainage system comprised 234 miles of deep drains, 740 miles of lateral drains. Individual farmers had installed 10 miles of tile drains

1935 First storage of water behind Hoover Dam

1936 District entered power business to develop hydroelectric potential on All-American Canal

1938 Imperial Dam, located on Colorado River 10 miles northeast of Yuma, Arizona, completed

1942 All-American Canal became sole source of water for Imperial Valley

1947 Control of All-American Canal west of Pilot Knob turned over to District

1947 The USBR and the District entered into an agreement whereby the District would undertake to determine the potential of East Mesa lands for agricultural use

1952 District assumed control of remainder of All-American Canal, from Imperial Dam to Pilot Knob, and first 50 miles of Coachella Branch

1961 District ends 50-year operation in Mexico by selling holdings to Mexican government

1964 U.S. Supreme Court Decree in the Arizona-California suit apportions 2.8 MAF of Colorado River water to Arizona, 4.4 MAF to California, and 300,000 AF to Nevada, subject to availability

1967 District taxes on land discontinued. Board also voted to pay off property bonded indebtedness (irrigation bonds) of $2,932,000

1971 Favorable judgment rendered in 160-acre land limitation suit in U. S. District Court

1976 First water regulating reservoir, located on East Highline Canal, placed in service

1977 Second reservoir, located on Westside Main Canal, added to system early in the year

1979 U.S. Supreme Court Supplemental Decree defined IID's present perfected rights in part as "water necessary to supply the consumptive use required for irrigation of 424,145 acres and for satisfaction of related uses...."

1980 Third regulating reservoir, located on Central Main Canal, put into service

In a unanimous opinion, the U.S. Supreme Court in June 1980 exempted Imperial Valley from the 160-acre limit, overcoming a 1977 Ninth Circuit Court of Appeals ruling and ending 10 years of legal action

1982 Drop No. 5 Hydroelectric Plant on line - other hydroelectric plants scheduled for construction

1983 Fourth regulating reservoir, located on Rositas Supply Canal, completed

1984 Two hydroelectric plants added to the four existing plants on All-American Canal

On December 1, 1932, the District executed the "Contract for Construction of Diversion (Imperial) Dam, Main Canal and Appurtenant Structures and for Delivery of Water" with the United States. During the 1930s, while Hoover Dam, Imperial Dam and the All-American Canal were being constructed, the District struggled with very severe financial difficulties, but by 1940 the District's position began to improve. However, due to those difficulties, the District's canal and drainage systems deteriorated, and it took several years to get them back in shape.

A severe storm in September 1939 and the intense earthquake of May 18, 1940, caused extensive damage throughout the Valley. Considerable time and expense were incurred in repairing damaged District facilities.

Gradual improvement of the irrigation and drainage systems took place during the three decades from 1950 to 1980. In 1947, the District signed an agreement with Imperial County providing for installation and/or replacement of road crossings of the District's systems. The agreement, still in effect today, provided that the District make the installation of pipe culverts (siphons) and the County pay for materials. Agreements were also signed during this period with the Southern Pacific Railroad Company and several cities concerning the installation of pipe.

2. Financial Background

The District's budget for 1985 projected total expenditures of nearly \$104 million, about \$23 million for water operations and \$81 million for power. Total combined revenue was projected to be slightly over \$105 million. The three major sources of revenue are sales of water, water availability charges, and sales of electrical energy. Additional sources are special assessments on excess tailwater, charges for gate tampering, rents, interest, and several miscellaneous sources.

The anticipated revenue is given below for 1985 Water Department operations, estimated in late 1984:

Water Service Charges - 2.2 MAF @ $9.00/AF	$19,800,000
Water Availability Charges: 536,000 acres @ $1.90/acre	1,018,500
Water Conservation Charges	700,000
Pipe Charges and Small Acreage	175,000
Rentals	563,200
Interdepartmental Charge (50% of All-American Canal payment of $750,000, less 8% of Net Power Proceeds)	334,500
Interest Income @ 8.75%	750,000
Other Revenue	100,000
Total Estimated Revenue	$23,441,200

The actual revenues are given below to operate the Water Department during 1983:

Source	1983	1984
Water Sales	$19,649,000	$22,042,000
Water Availability Charge	1,000,000	2,056,000
Interdepartmental Charge	334,000	334,000
Power Sales	(418,000)	(347,000)
Miscellaneous	842,000	317,000
Totals	$21,407,000	$24,402,000

As of August 31, 1983, the water rate (Schedule No. 1, "General Agricultural and Municipal Service") is $9.00/AF. The current Water Availability Charge (Schedule No. 6, "Standby Service") is $1.90 per acre.

The basic water rate has been increased over threefold during the past 10 years, from $2.70/AF in 1974 to $9.00/AF at present, mainly due to inflation but also resulting from expansion of the District's water conservation program and repair of extensive damage to District facilities resulting from two tropical storms and the 1979 earthquake. Finally, an unexpected problem arose when, in 1977, the noxious aquatic weed, hydrilla, was discovered in the All-American Canal and Westside Main Canal and lateral system. Although the District has received substantial financial aid from the state and federal governments to help eradicate this dangerous weed, District expenditures in personnel and equipment have been significant.

Traditionally, the District Board of Directors has established the water rate structure to meet anticipated expenditures, primarily to operate and maintain the irrigation and drainage systems so that water can be delivered to meet water users' orders at reasonable costs.

Funding of past and current projects related to water conservation has been accomplished using a portion of revenues from water sales, i.e., water tolls. For example, in June 1975, the Board adopted Resolution 35-75 which, among other things, established an Irrigation Capital Improvement Fund into which a $0.50 charge for each acre-foot of water sold was to be deposited. This fund was to be used "for the concrete lining program and for no other purpose."

In July 1976, the Board adopted Resolution 49-76 which established a Water Conservation Fund into which a $0.50 charge for each acre-foot of water sold was to be deposited, with moneys from this Fund to be used for the 13-Point Water Conservation Program as set forth in Resolution 45-76. In January 1979, Resolution 1-79 combined the two funds described above into one, retaining the Water Conservation Fund (i.e., $1.25/AF).

In May 1981, Resolution 26-81 provided for an increase in water rates of $1.00/AF, all revenue derived from said increase to be deposited in a "Special Water Conservation Fund" specifically to cover costs of an expanded water conservation program.

In 1984, the two funds were consolidated, and today all water conservation projects are paid for from the "Water Conservation Fund." On December 31, 1984, the Fund contained $3.0 million.

In a normal year, when water sales of 2.5 MAF are expected, revenues from the $1.75/AF allocated to the Water Conservation Fund will amount to $4.375 million.

Water funds held by the District in various accounts totaled $12.6 million as of December 31, 1984, compared to $9 million one year earlier.

3. Cultural Development

The economy of Imperial Valley is almost entirely dependent on irrigated agriculture, but only 84 years ago the Valley was a desert. Spanish explorer Juan Bautista de Anza, in his trek through the area, called it "La Jornada de Los Muertos," the Journey of the Dead.

Although the idea of reclaiming the desert with Colorado River water was conceived before the Civil War, actual development did not begin until 1900. The first water was diverted to the Valley in June 1901. For the first 40 years or so, much of the farming was speculative due to drought, floods, silt, salt and economic conditions.

With electrification in the late 1930s and the development of the evaporative cooler, living conditions improved, stimulating rural home building as well as growth in the towns and cities.

By 1960, the population of Imperial County was 72,105, increasing to 92,100 in 1980. El Centro is the largest city, with Brawley as the second largest.

Historical and projected population is shown in Table II.4 for the seven cities and towns in Imperial Valley and the County totals. The projection for the year 2000 was furnished by the Imperial County Planning Department, with the breakdown by cities based on projected percentages.

Trends in employment, from U. S. Census Bureau data, are shown in Table II.5. Unemployment in Imperial County has been running extremely high in recent years, being in the range of 30 to 40 percent.

Gross income from agriculture, as determined annually by the County Agricultural Commissioner, has been approaching $1 billion for several years, hitting a peak of $837 million in 1979. The County ranks as one of the top farming counties in the United States.

The 1984 gross agricultural income was $762,291,000. Agriculture continues to be highly diversified with more than four dozen crops grown. Livestock, especially cattle, contributes about one-third to the total agricultural economy.

Table II.6 shows yearly gross agricultural income for 1981 through 1983, taken from the 1983 Report of the Imperial County Agricultural Commissioner. The values are for the entire County, including a small portion of the Palo Verde Valley and the Bard-Winterhaven area.

Several other facts and figures for 1980, furnished by Imperial County, which add to the understanding of socioeconomic characteristics are shown in Table II.7.

TABLE II.4

HISTORICAL AND PROJECTED POPULATION
CHARACTERISTICS OF IMPERIAL COUNTY, CALIFORNIA

	1960	1980	2000	Percent Change 1960 to 1980	Percentage of 1980 County Population
Communities:					
Brawley	12,703	14,946	22,000	18	16
Calexico	7,992	14,412	21,000	80	16
Calipatria	2,548	2,636	4,000	3	3
El Centro	16,811	23,996	35,000	43	26
Holtville	3,080	4,399	6,000	43	5
Imperial	2,658	3,416	5,000	29	4
Westmorland	1,404	1,590	2,000	13	2
Unincorporated Imperial County	25,000	26,715	39,000	7	29
Imperial County	72,105	92,110	134,000	28	100

Sources: 1960 and 1980 data from the U. S. Department of Commerce, Bureau of the Census.

2000 data from the Imperial County Planning Department

TABLE II.5

INDUSTRY EMPLOYMENT TRENDS BY PERCENTAGE OF LABOR FORCE
IMPERIAL COUNTY, CALIFORNIA

Industry	1960	1970	1980
Agriculture	39	19	38
Mining	0	0	0
Construction	3	5	3
Manufacturing	6	7	5
Transportation, Communication, and Public Utilities	8	9	3
Trade Industries	18	24	18
Finance, Insurance, and Real Estate	2	3	2
Services	17	24	9
Government	7	9	22

Source: U. S. Department of Commerce, Bureau of the Census.

TABLE II.6
IMPERIAL COUNTY AGRICULTURE CROP REPORT

1983[a]
Gross Income

	1982	1983	1984
Apiary Products	2,676,000	2,792,000	2,800,000
Field Crops	241,614,000	*258,988,000	268,007,000
Fruit and Nut Crops	4,360,000	5,794,000	11,632,000
Livestock and Dairy	216,875,000	*245,407,000	226,807,000
Seed and Nursery	28,712,000	26,275,000	26,097,000
Vegetable Crops	267,743,000	219,611,000	226,948,000
Total	761,980,000	*758,867,000	762,291,000

*Adjusted Total

Million Dollar Crops - 1984

Cattle	$ 214,434,000	Onions (Processor)	$ 5,632,000
Alfalfa Hay	101,565,000	Watermelons	5,499,000
Lettuce	87,506,000	Asparagus	4,419,000
Wheat	47,299,000	Cotton Seed	3,899,000
Sugar Beets	37,402,000	Cabbage	3,645,000
Cotton	35,607,000	Dates	3,362,000
Cantaloupes	32,043,000	Lemons	3,133,000
Carrots	28,030,000	Cauliflower	3,065,000
Alfalfa Cube & Dehydrated	21,388,000	Certified Seeds	2,931,000
Broccoli	13,987,000	Melons-Misc	2,866,000
Bermuda Grass Seed	11,117,000	Alfalfa Seed	2,714,000
Total Pastures	9,015,000	Fish	2,569,000
Mixed Vegetables	8,401,000	Wheat Seed	2,150,000
Honeydew Melons	8,271,000	Baled Straw	1,971,000
Sudan Grass Hay	8,083,000	Honey	1,914,000
Onions (Market)	7,739,000	Oranges	1,844,000
Sheep	7,411,000	Lettuce (Other)	1,655,000
Vegetable, Flower Seed and Nursery Stock	6,645,000	Grapefruit	1,411,000
Tomatoes (Processor)	6,396,000	Wool	1,291,000
Tomatoes (Market)	5,798,000	Squash	1,178,000
		Misc. Livestock	1,102,000

[a]From 1983 annual crop report of Imperial County Agricultural Commissioner.

TABLE II.7

SOCIOECONOMIC FACTS AND FIGURES IN 1980
IMPERIAL COUNTY, CALIFORNIA

Item	Rate
Annual Growth Rate	2.3%
Percent of State Population	0.4%
Percent Hispanic Population	55.8%
Percent White Population	38.3%
Civilian Labor Force	42,637
Percent of Private Land Ownership	40.0%
Percent of Government Land Ownership	60.0%
Industrial Acreage	1,500
Median Household Effective Buying Income	$15,531

Source: County Administrative Office and El Centro Chamber of Commerce.

CHAPTER III
DESCRIPTION OF WATER SYSTEM

CHAPTER III

DESCRIPTION OF WATER SYSTEM

A. INTRODUCTION

This chapter discusses the District's water conveyance system, and the on-farm agricultural systems. Imperial Valley farmers use in excess of 98 percent of the water delivered through the District conveyance system. A brief description of municipal, industrial, and recreational water uses is also presented.

B. DISTRICT SYSTEM

1. Facilities

a. Irrigation System

Imperial Dam serves as a diversion structure for Colorado River water delivered to users in California, Arizona and Mexico. Water is conveyed from the Colorado River to Imperial Valley via the All-American Canal. Prior to being discharged into the All-American Canal, water is passed through desilting basins to clarify the water. The three desilting basins are each 540 feet wide and 770 feet long with 72 scrapers designed to remove 70,000 tons of silt per day.

The 80-mile-long All-American Canal was built by the Bureau of Reclamation in the 1930s. Excavation began in 1934, after many years of lobbying by local residents. The first scheduled delivery of water by the new Canal was in October 1940, and by 1942 the Valley was drawing its entire supply from the All-American Canal. The Canal has a capacity of 15,155 cubic feet per second (ft^3/s) at Imperial Dam, a maximum width of 232 feet at water surface, a 160-foot bottom width, and a depth of 20.6 feet. The system operates by gravity. The water surface elevation at Imperial Dam is 181 feet above sea level; whereas, Calexico near the western end of the Canal, is at sea level.

Over the past 10 years, the District has diverted an average of 2.75 MAF of water annually (Table III.1). The average water conveyance efficiency for that period was 90.7 percent. Several main canals feed off the All-American Canal: the East Highline, Central Main, Westside Main and New Briar Canals. Service to Imperial Valley is provided via these four main District canals or directly from the All-American Canal (Exhibit III.1).

Table III.1

IMPERIAL IRRIGATION DISTRICT

Table : Distribution of Water Within Imperial Unit

1974 - 1983

	ACRE-FEET X 1,000										
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	10-Year Average
To IID at Drop #1	3072	3001	2784	2693	2672	2808	2769	2769	2516	2417	2,750
Loss, Drop #1 to EHL	75	58	33	22	24	8	34	23	19	28	32
Loss, EHL to USM	15	9	19	18	23	12	30	21	17	28	19
Gross A.A.C. Loss (2+3)	90	67	52	40	47	20	64	44	36	56	52
Canal Loss and Regulation	198	222	207	190	170	194	172	219	228	180	198
Total IID Losses (4+5)	288	289	259	230	217	214	236	263	264	236	250
Spill for System Regulation	5	7	7	6	10	11	8	6	4	1	7
Total Loss & System Regulation (6+7)	293	296	266	236	227	225	244	269	268	237	256
Total Deliveries to Users (1-8)	2779	2705	2518	2457	2445	2578	2525	2500	2248	2180	2,494
Water Conveyance Efficiency (100x9/1)	90.46	90.14	90.45	91.24	91.50	91.97	91.19	90.29	89.35	90.19	90.69
Gross Acres of Crops	573.5	585.5	613.0	565.0	567.0	576.5	588.0	600.5	594.5	501.8	576.53
Net Acres Irrigated	450.0	456.5	458.5	460.0	452.0	460.0	460.5	464.5	465.5	445.9	457.34

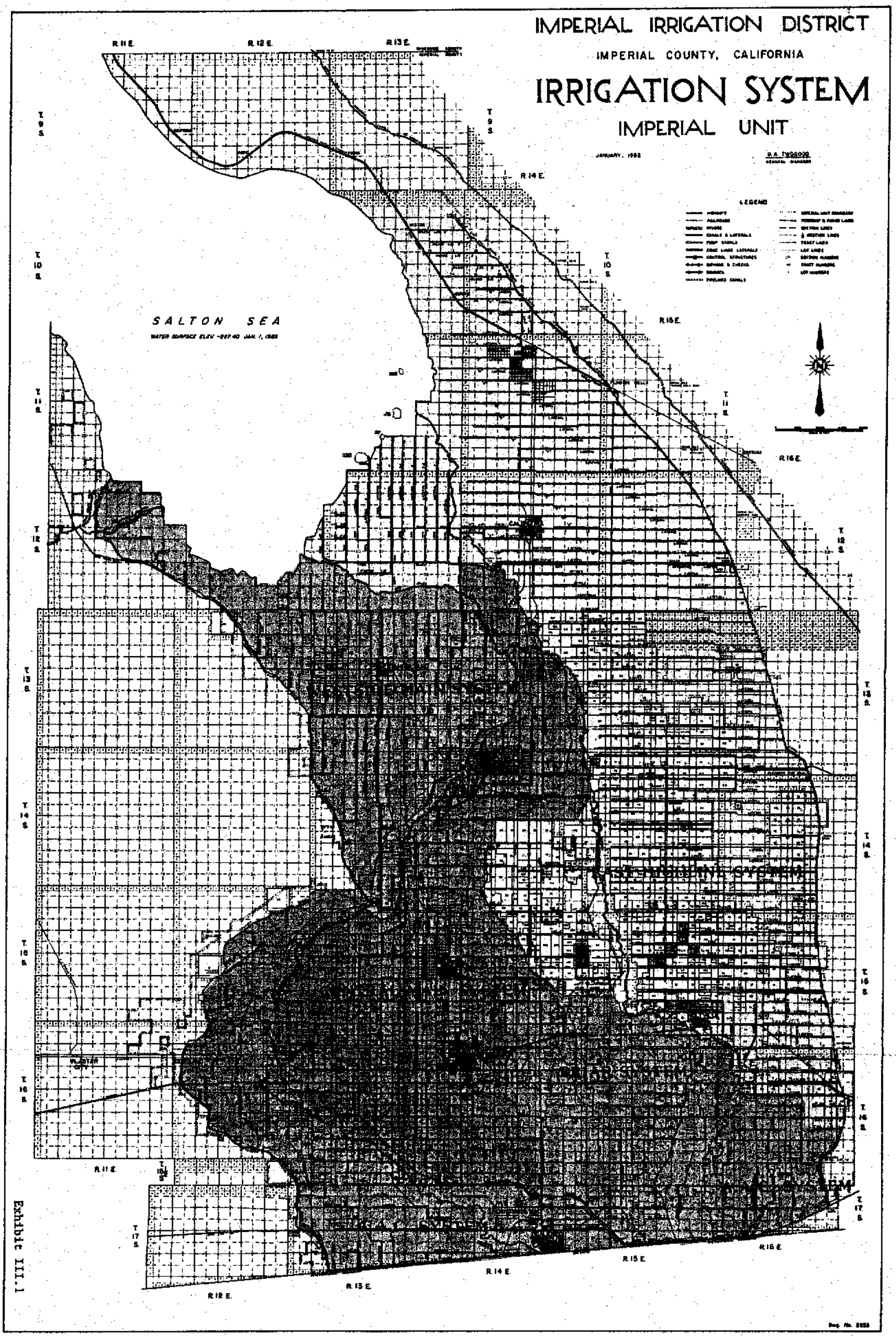


Exhibit III.1

Delivery of water to the eastern portion of the Imperial Valley is made through the East Highline Canal. Starting at the All-American Canal 12 miles east of Calexico, the East Highline Canal runs northwest along the edge of the sand dunes and base of the Chocolate Mountains to a point approximately 10 miles south of the Riverside County Line. No portion of the East Highline Canal is concrete lined. Together with the Rositas Supply Canal and Vail Supply Canal, approximately 250,000 acres are served from the East Highline Canal. This area generally slopes west to the Alamo River.

Between the Alamo River and New River, the Central Main Canal serves approximately 103,000 acres of the central portion of the Imperial Valley. Commencing at the All-American Canal with a capacity of 1,300 ft^3/s, the Central Main Canal extends to a point 1 mile south of the Brawley city limits, for a total distance of 26.5 miles. There it comprises the heading of the Rockwood Canal. The Vail Supply Canal at the North End Dam is the terminus of the Rockwood Canal. The Central Main Canal is completely unlined. This area is generally flat, necessitating laterals that are constructed above the natural surface in order to provide sufficient water flows.

West of the New River the agricultural area is serviced by the Westside Main Canal. It has a capacity of 1,300 ft^3/s and has no concrete lining throughout its 45.4-mile length. Commencing at the terminus of the All-American Canal, the Westside Main Canal extends to the head of the Trifolium Extension Canal, a point approximately 6 miles west of Westmorland. At the south end of the system, the land is generally flat necessitating the placement of laterals above the natural surface. Grade slopes in the northern part of the area increase. Approximately 95,000 acres are served by the Westside Main Canal.

In the south central portion of the Valley, water is delivered by the New Briar Canal. With a capacity of 320 ft^3/s and a total length of 5.3 miles, it serves 48,000 acres. This area is relatively flat and also requires that laterals be constructed above the natural surface grade for adequate delivery water flows.

Two areas at the south end of the Valley receive water directly from the All-American Canal. At the west end, 28,500 acres are served by the Woodbine, Wistaria and Wormwood Canals; and at the east end, 28,500 acres are served by the Holt, Hemlock, South

Alamo Canals and Mesa Laterals. Both areas have relatively flat slopes requiring the construction of laterals above the natural surface.

The District also operates four regulating reservoirs (Table III.2) located at key points along the main canals. These locations were selected to conserve operational spill. Kakoo Singh Reservoir regulates the East Highline Canal and is located 1.5 miles south and 9 miles east of Calipatria at the Vail Supply Heading. Oscar Fudge Reservoir is located approximately 1.5 miles southwest of the terminal end of the Central Main Canal and Rockwood Heading. Herman "Red" Sperber Reservoir is located at the end of the Rositas Supply Canal. To the west, the J. Melvin Sheldon Reservoir was built at approximately the midpoint of the Westside Main Canal.

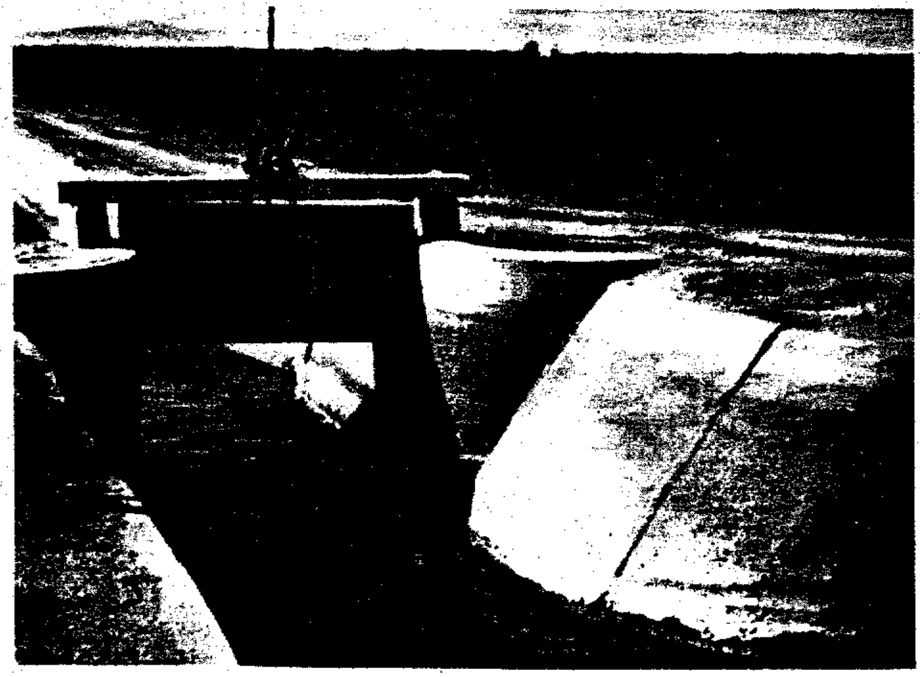
Photographs of typical District facilities are shown as Exhibits III.2, III.3, III.4 and III.5. Other District facilities are listed in Tables III.3, III.4 and III.5.

b. Drainage System

As part of the operating system, the District maintains an extensive drainage system. Surface drains are used to collect excess surface flows from the fields (tailwater), tile drain discharges, and spills from the canals and laterals (Exhibit III.6 and Table III.6). Over 1,453 miles of surface drains can be divided into three main areas: Alamo River System, New River System, and drains that flow directly into the Salton Sea (Exhibit III.7). The District maintains the New and Alamo Rivers. Control structures have been installed to prevent erosion in these waterways (Table III.7).

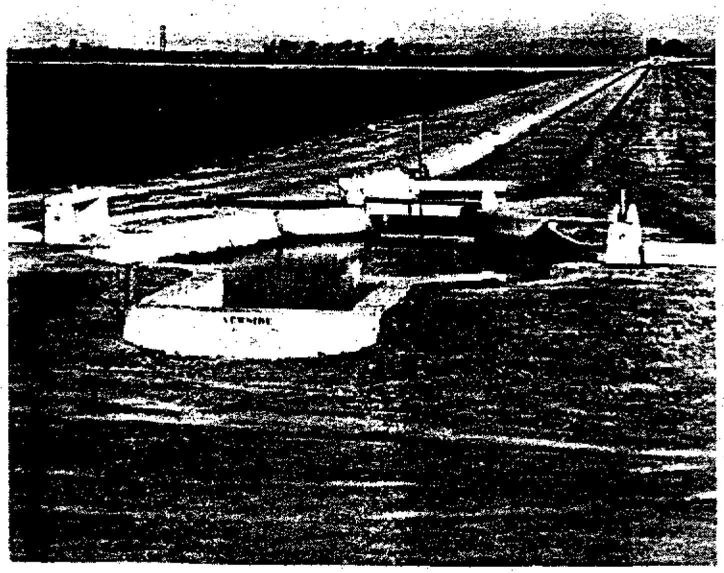
The lateral drain system is laid out to provide a drainage outlet for each 160-acre plot, and the drains usually parallel the canals. The District provides sufficient depth at each outlet to accept tile drain discharge if possible. Tile drains are located in the fields at a depth of 6 to 10 feet. Excess water derived from percolated surface flows is drawn off in order to prevent the water table from encroaching into the root zone. Where the drain cannot be maintained at sufficient depth, a sump pump is provided and maintained by the District.

Erosion in the steeper drains is reduced by the installation of control structures.



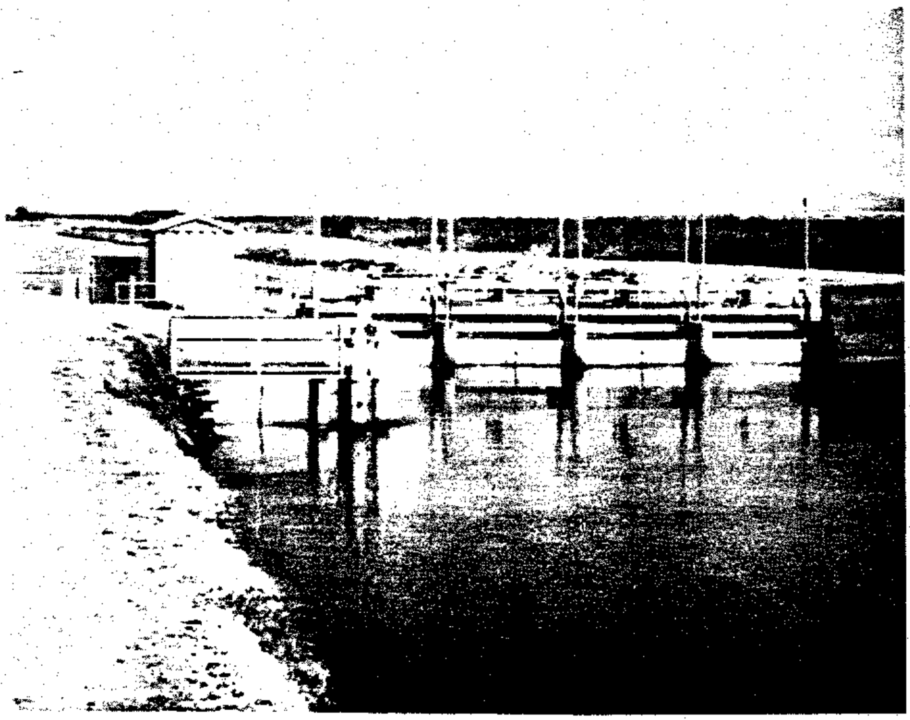
95 PERCENT OF THE 3,411 CHECKS IN THE DISTRICT ARE CONCRETE STRUCTURES.

EXHIBIT III.2



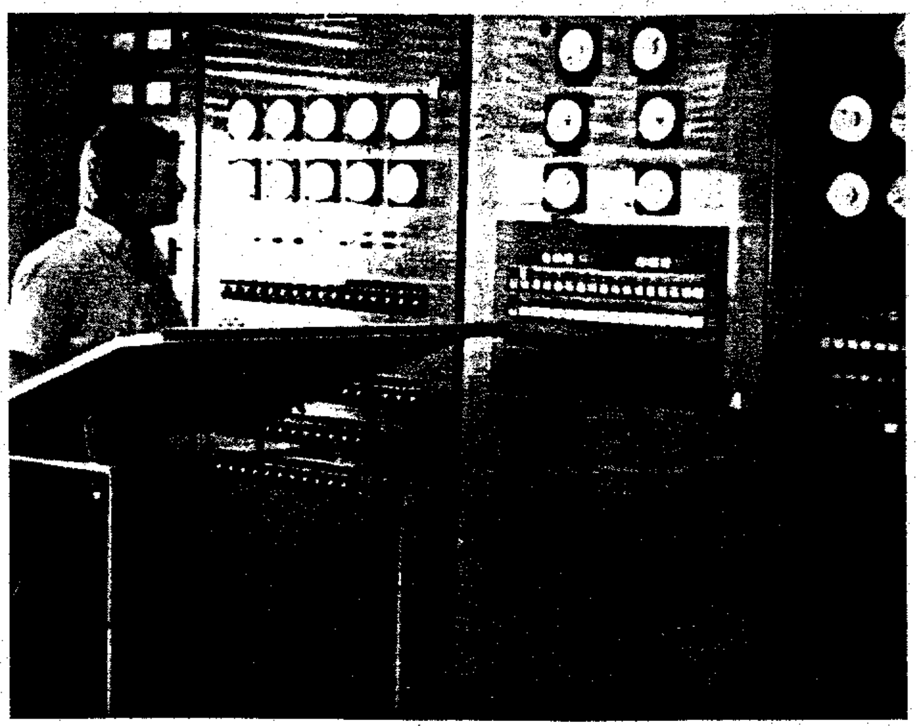
56 PERCENT OF THE DISTRICT'S LATERALS ARE CONCRETE LINED.

EXHIBIT III.3



TWENTY-TWO STRUCTURES ARE REMOTELY CONTROLLED FROM DISTRICT HEADQUARTERS IN IMPERIAL.

EXHIBIT III.4



THE TELEMETERING PANEL IN IMPERIAL IS MANNED 24 HOURS A DAY.

EXHIBIT III.5

TABLE III.2
EXISTING REGULATORY RESERVOIRS

	RESERVOIR			
	Singh	Sheldon	Fudge	Sperber
Date of Completion	01-20-76	03-29-77	02-26-82	05-01-83
Capacity (acre-feet)	323	476	300	470
Area (acres)	32	50	37.5	64.6
Maximum depth (feet)	11	10	10	9
Inlet/Outlet flow capacity (ft^3/s	100	100	100	100 Inlet 2 @ 100 Outlet
Inlet control	Automatic Hydraulic	Automatic Hydraulic	Automatic Hydraulic	Automatic Hydraulic
Outlet control	Remote Control	Remote Control	Remote Control	Remote Control
Cost ($1,000)	48.25	598.8	1,140.4	1,155.3

TABLE. III.3

CANAL AND DRAIN MILEAGE AS OF DECEMBER 31, 1984

	Total Miles	Miles Earth Section	Miles Concrete Lined	Miles Pipelined
All-American Canal - Canals	82.17	79.57	2.60	0.00
All-American Canal - Drains	51.64	37.51	0.00	14.13
Main Canals	153.46	144.52	8.94	0.00
Lateral Canals	1 445.19	578.25	858.15	8.79
Drains	1 400.44	1 300.08	0.40	99.96
Totals	3 132.90	2 139.93	870.09	122.88

TABLE III.4
LATERAL CANAL MILEAGE AS OF DECEMBER 31, 1984
BY DIVISIONS

Division	Total Miles	Miles Earth Section	% Earth Section	Miles Concrete Lined	% Concrete Lined	Miles Pipelined	% Pipelined
Holtville	291.01	66.37	22.81	224.28	77.07	0.36	0.12
El Centro-Calexico	227.65	111.34	48.91	115.81	50.87	0.50	0.22
Imperial	199.44	61.75	30.96	136.65	68.52	1.04	0.52
Brawley	241.91	107.61	44.48	128.36	53.06	5.94	2.46
Westmorland	196.28	50.28	25.62	146.00	74.38	0.00	0.00
Calipatria	288.90	180.90	62.62	107.05	37.05	0.95	0.33
Totals	1,445.19	578.25	40.01	858.15	59.38	8.79	0.61

TABLE III.5
INVENTORY OF STRUCTURES WITHIN THE DISTRICT

December 31, 1984

Conveyance System	Concrete	Rubble	Wood	Others	Total
Main Canals Division					
Deliveries	193	13	2	-	208
Checks	57	2	-	-	59
Lateral Headings	133	8	-	-	141
Control Structures	97	4	1	-	102
Bridges	5		22	4	31
Siphons	24	1	-	-	25
Moss Pipes	5	-	-	2	7
Storm Spillways	4	4	-	-	8
Flumes	-		-	1	1
Subtotal Division	518	32	25	7	582
All-American	145	-	-	-	145
Total Main Canals	663	32	25	7	727
Lateral Canals-Division					
Deliveries	5 231	127	25	1	5 384
Checks	3 173	163	19	-	3 355
Lateral Headings	326	24	1	-	351
Control Structures	689	48	19	2	758
Bridges	29	4	27	1	61
Siphons	125	2	-	4	131
Moss Pipes	118	-	4	1	123
Flumes	1	-	-	-	1
Storm Spillways	32	4	-	-	36
Total Lateral Canals	9,724	372	95	9	10,200
Drains					
Control Structures	422	9	12	2	445
Bridges	2		33		35
Siphons	1 304	11	5	39	1 359
Flumes	3	-	35	1	39
Outlets	214	-	-	-	214
Spillways	21	-	-	-	21
Maintenance Crossings	351	-	-	-	351
Deliveries - Pump	2	-	-	-	2
Deliveries	4	-	-	-	4
Checks	1	-	-	-	1
Total Drains	2,324	20	85	42	2,471

TABLE III.6
DRAIN MILEAGE AS OF DECEMBER 31, 1984
(By Division)

Division Drains	Total Miles	Miles Earth Section	% Earth Section	Miles Concrete Lined	% Concrete Lined	Miles Pipelined	% Pipelined
Holtville	117.33	98.15	83.65	0.40	0.34	18.78	16.01
El Centro-Calexico	79.83	73.07	91.53	0.00	0.00	6.76	8.47
Imperial	70.36	65.12	92.55	0.00	0.00	5.24	7.45
Brawley	219.27	216.24	98.62	0.00	0.00	3.03	1.38
Westmorland	136.12	133.82	98.31	0.00	0.00	2.30	1.69
Calipatria	281.02	261.06	92.90	0.00	0.00	19.96	7.10
Subtotals (division)	903.93	847.46	93.75	0.40	0.04	56.07	6.21
Main Drains	496.51	452.62	91.16	0.00	0.00	43.89	8.84
All-American	51.64	37.51	72.64	0.00	0.00	14.13	27.36
Total	1,452.08	1,337.59	92.12	0.40	0.03	114.09	7.85

TABLE III.7
CONTROL DROPS IN ALAMO RIVER AND NEW RIVER

Control Drop	Location	Year of Installation
Alamo River		
2	Near center NE 1/4 Section 12, 12-14	1959
3	Northwest corner Section 29, 12-14	1960
3-A	Northwest corner Section 29, 12-14	1967
4	Near east line Tract 170, Section 3, 13-14	1966
5	Northwest corner Tract 180, Section 12, 13-14	1960
6	Southwest corner Section 30, 13-15	1961
6-A	Southwest corner Tract 155, Section 18, 14-15	1974
7	Near center Tract 55, Section 30, 14-15	1958
8	Center E. 1/2 SW 1/4, Section 5, 15-15	1958
9	SE 1/4, NE 1/4 Section 20, 15-15	1958
10	SE 1/4, NE 1/4 Section 20, 15-15	1958
12	Tract 72, Section 26, 15-15	1967
13	Southwest corner Tract 65, Section 36, 15-15	1967
New River		
2	Center Tract 139, Section 9, 13-14	1973
3	Northwest corner Tract 92, Section 21, 13-14	1964
4	Near west line Lot 4, Section 32, 13-14	1965

2. Operations

a. Water Operations

The Water Control Section of the Water Department is responsible for the transmission of water through the main canal system and its diversion to the laterals for distribution to the users. Water dispatching through the main canal system is accomplished by remote and local control coordinated by the dispatching unit of Water Control on a 24-hour basis. These operations are carried out from the Water Control Office located at the District Headquarters in Imperial.

Scheduling District water on a long-term basis is a complicated task. Each December an estimate of the amount of water the District will need for the following calendar year is given to the USBR. Then each week during the year an order for weekly requirements is submitted by the District to the USBR. On Wednesday of each week, an order for the following week of Monday through Sunday is phoned to the District's River Division and later verified by letter from the District Watermaster. All diversion structures at the head of the All-American Canal are under the direction of the USBR and operated by District River Division personnel. The USBR accumulates the orders from all water users of the Lower Colorado River and prepares a Master Schedule of flows for the Colorado River. The amount of water scheduled on the Master Schedule is the quantity of water the District will receive unless it is revised by the District Watermaster at least 72 hours in advance.

The originator of the water demand is the ultimate user. Water orders from the water users are accumulated by the six operating divisions within the District. These are located in Holtville, El Centro, Imperial, Brawley, Westmorland and Calipatria (Exhibit III.8). Orders for next-day delivery are accepted until 12:00 noon. Soon thereafter, they are relayed to the Water Control Section, stating the total amount of water orders and the number of "carry-overs." Carry-overs are undelivered orders because of insufficient water allotment by the District Water Control Dispatcher the day before. By 1:00 p.m., the Water Control Office allots all available water back to the six divisions in the amount necessary to keep their carry-over percentages nearly equal. In addition, by 1:00 p.m., a firm order is placed with the River Division for the following day, and changes in the Master Schedule for the fourth day following are made.

Using the total amount allotted, the six divisions call in the order for each lateral heading to the Water Control Section. The dispatcher at the Water Control office then prepares a water plan for the following day, scheduling changes throughout the main canal system in order to have the correct amount of water at the right place and time the following morning. These changes are given to the Water Control operator to execute. Water is transported through the main canal system by remote control from a panel located in the Water Control Office with the help of night patrolmen in radio-equipped vehicles. The following morning, under the direction of the Operations Unit of the Water Control Section, the hydrographer releases and measures this water into the head of each lateral scheduled to receive water.

Approximately 75 percent of this water is measured by the head pressure method with the remainder being measured with a current meter or a prerated gate.

The division water clerks log each order for the following day by lateral and individual zanjero run. Highest priority for service goes to those orders already running, then orders carried over from the previous day, and finally the current water orders based on the time received. Total orders are determined and compared with the amount estimated by Water Control. The division water clerk then calls Water Control to verify the estimated order or request a change. Water Control, after analyzing similar data from all the divisions and taking into consideration the current capabilities of the system, notifies each division of its revised allotment. The division then allocates the revised allotment among the various canals. Division water clerks then make any final adjustments to individual deliveries for the following day.

The water distribution system within each division is divided into "runs." A specific area within a portion of main canals, a set of laterals, and customer turnouts assigned to each zanjero comprise a "run." Zanjeros are responsible for water deliveries to farmers within their delegated run.

The zanjeros, under the direction of the six divisions, divert the water through the lateral canal system, open the water users' headgates, and measure the water in the proper amounts. Flow rate is determined by setting the gate opening in relation to the difference in water elevation upstream and downstream of the gate. Rating curves have been developed so that the zanjero can set the proper gate opening to deliver the ordered head. The following day, the amount of water delivered to a water user for the past 24 hours is given to the Accounting Department for billing.

Water releases from Hoover Dam require approximately 6 days of travel time before arriving at the users' headgates. The physical path followed by a hypothetical water order can be followed in Exhibit III.9.

The hydrographers and zanjeros are also responsible for checking the tailwater structure of each delivery. In this way, the assessment phase of the District's Water Conservation Program is put into operation. The physical integrity of the irrigation system is preserved by maintenance crews assigned to each division.

b. Drainage Operations

The drainage system provides a drainage outlet for each 160-acre parcel of land serviced by the District. The District's Rules and Regulations governing the construction, operation and maintenance of its drainage system clearly delineate the various items of drainage operation.

Maintenance of the many open-channel drains, pipeline drains, and sump-pump systems is a task that requires a major commitment of labor and equipment each year. Specific items of work include removal of silt deposits, weed control and removal, repair and replacement of drainage structures and sump pumps, and grading of drainage canal banks (Exhibits III.10 and III.11).

Although the drainage system is essentially complete, a small percentage of the 160-acre irrigated parcels has not been provided with direct drainage outlets. New drains are constructed when it is desired to connect these areas to the drainage system. Reconstruction is also necessary to accommodate changes such as revisions to the County Road System and construction activities associated with the building of geothermal power plants.

In addition to having maintenance and construction responsibilities, the District must design structures to be placed or replaced in the District's drainage system. Primary considerations in the design include hydraulic capacities and flow characteristics, resistance to structural loading and erosion control. Close communication with the water users and with the appropriate public agencies is essential.

Other drainage work performed by the District includes logging soil profiles, seepage studies, drainage flow source investigations, design of tile drain systems, inspection of drainage construction work performed by private contractors, and the monitoring of activities of water users to check for compliance with the District's Rules and Regulations. Extensive records are kept relating to all facets of the drainage system.

C. AGRICULTURAL USES

The Imperial Valley's capacity to produce a wide variety of crops in a desert environment is made possible by the application of modern farming techniques. All phases of farming, including land preparation, fertilizing, seeding, irrigating, and cultivating, etc., are designed to overcome the harsh desert conditions that are natural to the area. Local farmers overcome obstacles such as extreme temperatures, soil salinity, low humidity, and relatively marginal farming soils. Most of these can be alleviated by an adequate supply of water.

More than 120 types of crops are grown locally. Table III.8 gives a breakdown of the acreages planted for each major crop in 1983. It must be noted that the cropping pattern in the Imperial Valley is dynamic, reflecting socioeconomic pressures, government programs, and developments in agricultural technology.

1. Water Quality - Leaching Requirements

Being at the "end of the River," the District and other water users diverting at or below Imperial Dam receive water that contains a large percentage of return flow, i.e., water that was diverted upstream and conveyed through channels and canals. Much of it is applied to land or run through municipal and industrial facilities, and the nonconsumed portion is returned, picking up salts, minerals, and other matter in the process. The Colorado River itself picks up elements from the soil through which it and its tributaries flow. Some of these constituents are settleable solids. Desilting basins at Imperial Dam reduce silt content (Table III.9).

The salinity of Colorado River water has been increasing gradually during the past several decades. During the past few seasons, large flood-protection releases from storage have diluted the Colorado River, and salinity has been lower as a result, ranging from 700 to 800 ppm during 1983 and 1984 at Imperial Dam.

The District has maintained water salinity records of the All-American Canal below Drop No. 1 for many years. The average t.a.f. (tons per

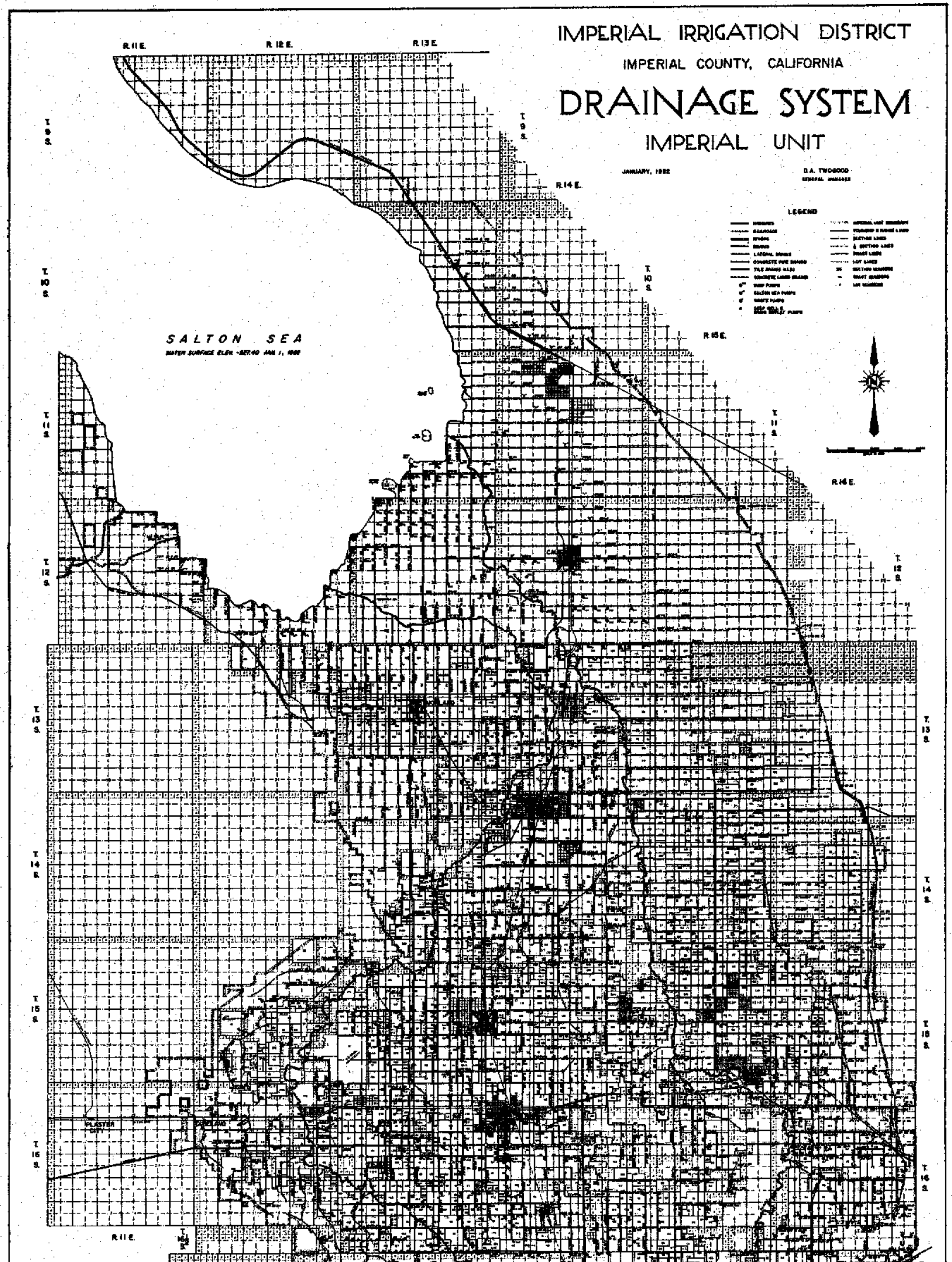


Exhibit III.6

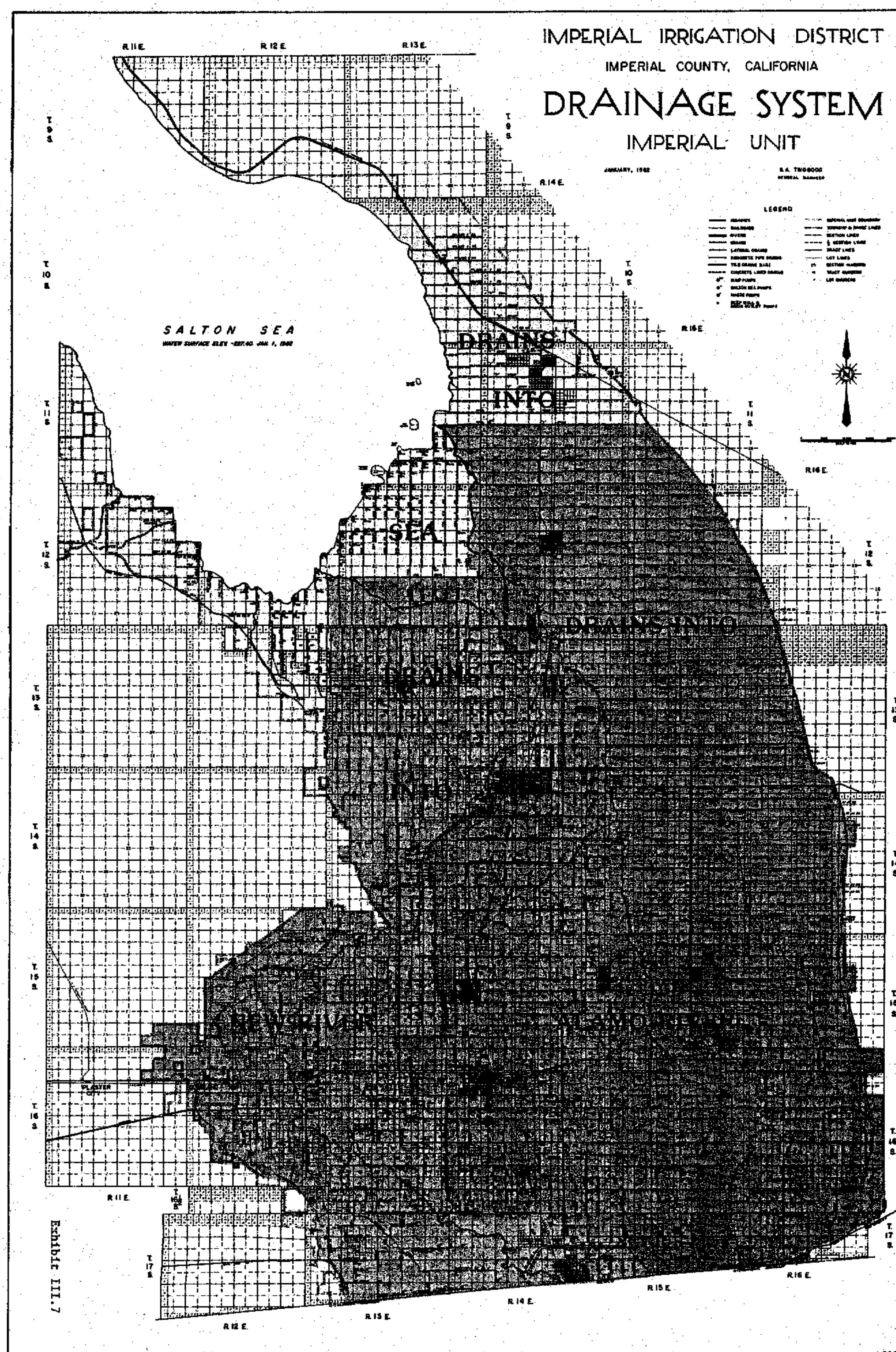


Exhibit III.7

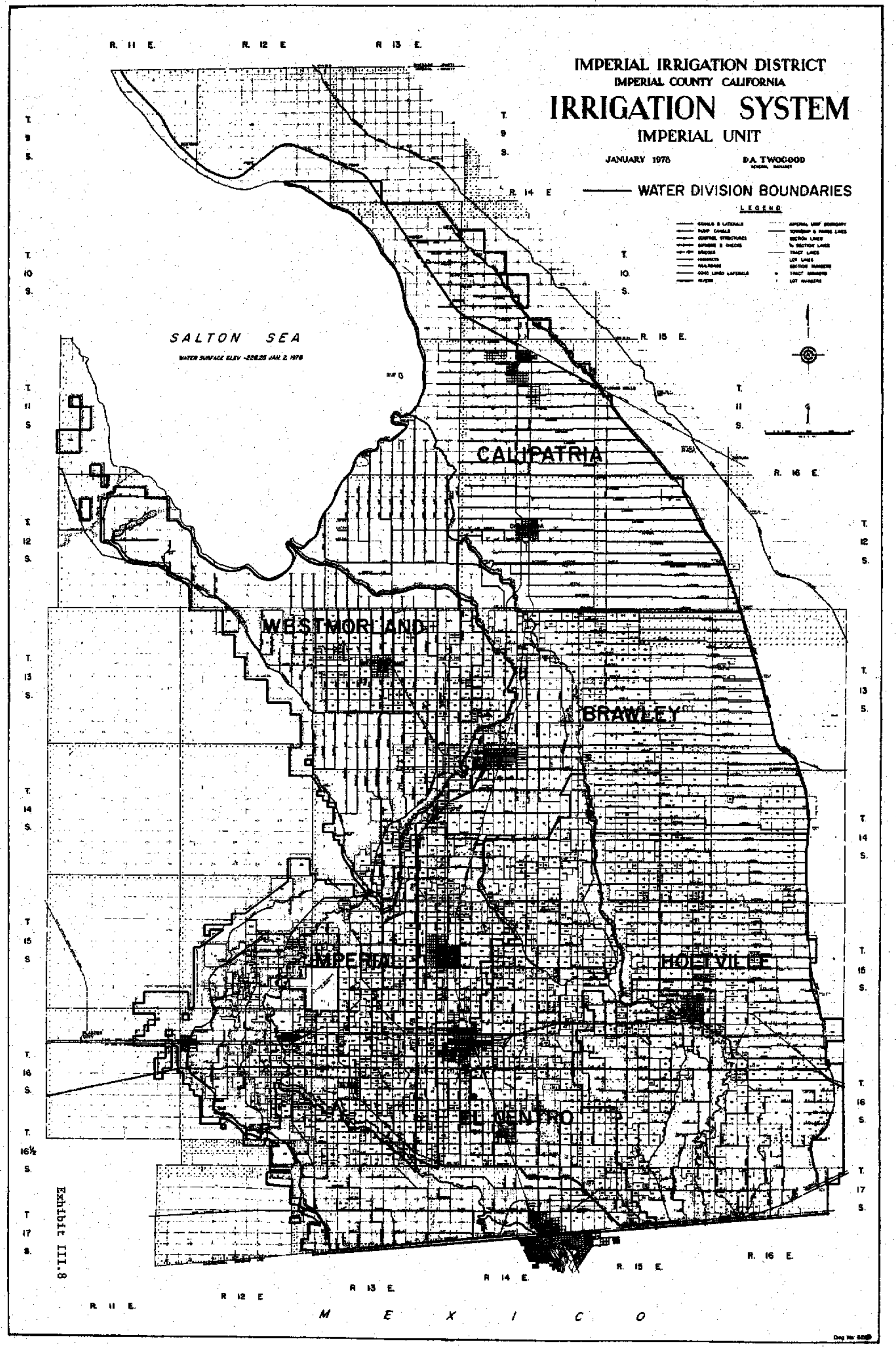


Exhibit III.8

IMPERIAL IRRIGATION DISTRICT

WATER TRANSPORTATION

HOOVER DAM TO USER

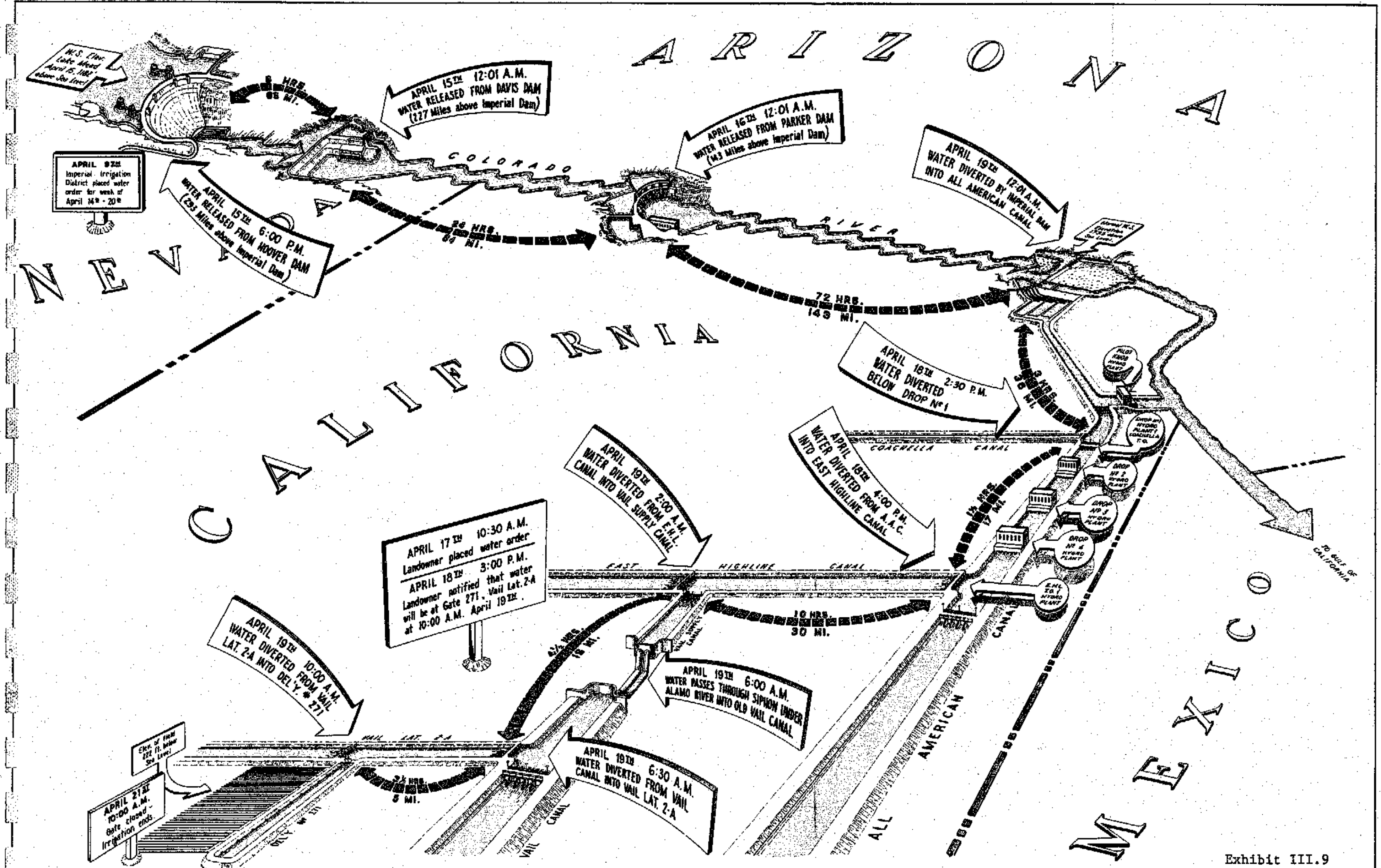


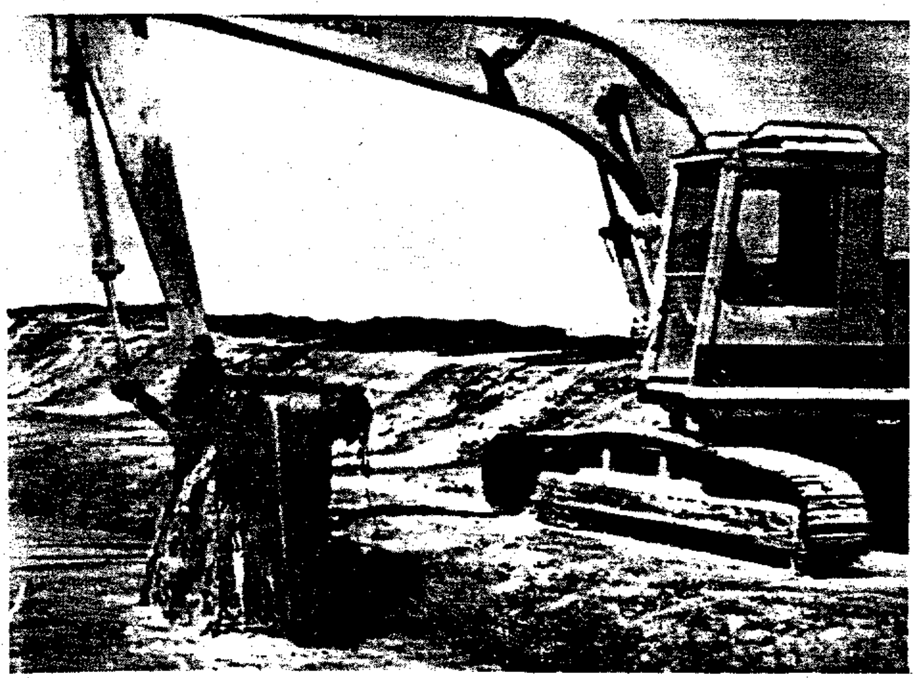
Exhibit III.9

G.A. Ord - May 1959 Revised Feb. 1986 - E.L.C.

Dwg. No. 8402

A DISTRICT DRAIN BEING CLEANED.

EXHIBIT III.10



HYDRILLA WAS FIRST DISCOVERED IN THE DISTRICT'S SYSTEM IN 1977. A TEAM OF BIOLOGICAL SCIENTISTS WAS HIRED TO COMBAT THIS AQUATIC WEED, WHICH THREATENS TO CHOKE OFF THE FLOW OF WATER IN ITS CANALS.

EXHIBIT III.11

TABLE III.8

Corrected Copy

IMPERIAL IRRIGATION DISTRICT
ANNUAL INVENTORY OF AREAS RECEIVING WATER
YEARS 1984, 1983, 1982

I CROP SURVEY

GARDEN CROPS	ACRES 1984	1983	1982
Beans	0	79	165
Blackeyed Peas	0	85	0
Broccoli	5 050	4 427	2 306
Broccoli (Seed)	258	258	40
Cabbage	350	31	444
Cabbage, Chinese	9	32	22
Cabbage (Seed)	0	37	198
Carrots	10 053	7 402	8 917
Carrots (Seed)	36	104	218
Cauliflower	942	151	84
Cauliflower (Seed)	27	27	20
Celery	383	161	533
Chicory	0	0	6
Collards	0	0	25
Cucumbers	146	137	155
Ear Corn	809	510	658
Eggplant	0	18	2
Endive (Seed)	0	18	18
Fava Beans	0	27	54
Fennel	0	3	3
Flowers	262	187	229
Flowers (Seed)	79	79	0
Garlic	523	376	306
Herbs, Mixed	51	55	52
Herbs (Seed)	111	67	26
Lettuce	26 772	26 086	31 086
Lettuce, Chinese	35	0	0
Lettuce (Seed)	382	382	77
Melons			
Cantaloupes, Fall	5 110	5 319	6 547
Cantaloupes (Seed)	157	141	44
Cantaloupes, Spring	10 216	7 944	7 473
Casaba, Fall	23	18	41
Casaba, Spring	152	170	0
Crenshaw, Fall	578	366	873
Crenshaw, Spring	94	49	50
Honeydew, Fall	2 185	1 046	2 547
Honeydew (Seed)	24	0	0
Honeydew, Spring	140	388	370
Kava Melons	4	21	10
Mixed, Fall	953	860	662
Mixed, Spring	115	270	135
Watermelons	4 656	4 972	5 354
Watermelons (Seed)	240	200	25
Mung Beans	0	0	33
Mustard	19	38	148
Mustard (Seed)	25	60	209
Okra	146	96	188
Okra (Seed)	43	96	466
Onions	7 887	7 248	10 013
Onions (Seed)	1 715	2 886	2 371
Parsley	77	72	20
Parsley (Seed)	0	0	79
Parsnips	0	0	20
Peas	65	0	15
Peas (Seed)	141	137	54
Peppers, Hot	0	0	8
Peppers, Sweet	179	120	12
Radishes	27	11	149
Radishes (Seed)	123	167	28
Rappini	123	184	156
Rutabagas	0	36	40
Sesame (Seed)	15	15	2
Spinach	48	16	0
Squash	1 009	797	1 286
Squash (Seed)	127	0	34
Swiss Chard	6	0	1
Swiss Chard (Seed)	2	0	30
Tomatoes, Fall	0	0	18
Tomatoes, Spring	4 604	2 822	3 053
Turnips	0	105	205
Vegetables, Mixed	687	402	4
Vegetables, Mixed (Seed)	249	0	35
Waterlilies	16	16	17
Total	88 258	77 827	88 469
FIELD CROPS			
Alfalfa	216 687	205 138	202 190
Alfalfa (Seed)	4 516	2 685	833
Alicia Grass	14	50	52
Barley	259	259	232
Bermuda Grass	2 786	2 816	3 684
Bermuda Grass (Seed)	13 175	16 428	7 849
Clover	150	150	20
Clover (Seed)	90	0	349
Cotton	27 316	18 079	42 217
Dichondra Grass	20	20	38
Field Corn	388	294	0
Grass, Mixed	11	30	276
Oats	464	274	717
Rape	0	267	0
Rye Grass	6 717	2 540	4 892
Rye Grass (Seed)	86	185	188
Sali Cornia	0	10	0
Sesbania	75	75	0
Sesbania (Seed)	0	0	38
Sorghum Grain	1 572	1 616	2 335
Sorghum Silage	861	552	582
Soy Beans	5	0	181
Spirulina Algae	32	12	0
Sudan Grass	24 311	10 410	8 013
Sudan Grass (Seed)	115	228	0
Sugar Beets	38 102	39 525	37 607
Triticale Grain	0	0	58
Wheat	97 043	99 507	175 047
Total	434 795	401 150	487 398
PERMANENT CROPS			
Asparagus	3 541	2 992	2 459
Citrus			
Grapefruit	353	464	444
Lemons	1 045	710	671
Mixed	203	390	191
Oranges	355	356	353
Tangerines	51	113	75
Dates	103	132	53
Duck Ponds (Feed)	8 866	12 908	8 169
Fish Farms	784	1 196	754
Fruit, Mixed	3	21	21
Grapes	30	30	0
Guar Beans	0	0	1 892
Jojoba	3 005	3 005	3 062
Nursery	0	0	5
Palms	9	13	11
Pasture, Permanent	473	449	386
Peaches	38	40	24
Pecans	33	40	32
Total	18 892	22 859	18 602
Total Acres of Crops	541 945	501 836	594 469

Note: Crops are listed for the year in which they are predominately harvested.

SUMMARY

	1984		1983		1982	
Number of Farm Accounts		6 866		6 997		6 933
Number of Owner-Operated Farm Accounts	(29.0%)	1 996	(32.0%)	2 225	(30.5%)	2 119
Number of Tenant-Operated Farm Accounts	(71.0%)	4 870	(68.0%)	4 772	(69.5%)	4 814
Average Acreage of Farm Accounts		71.53		73.67		70.83

II SUMMARY OF AREA SERVED

	ACRES 1984	1983	1982
Field Crops	434 795	401 150	487 398
Garden Crops	88 258	77 827	88 469
Permanent Crops	18 892	22 859	18 602
Total Acres of Crops	541 945	501 836	594 469
Total Duplicate Crops	96 223	61 089	133 113
Total Net Acres in Crops	445 722	440 747	461 356
Area Being Reclaimed: Leached	4 271	5 178	3 959
Net Area Irrigated	449 993	445 925	465 315
Area Farmable but not Farmed during Year (Fallow Land)	31 678	52 592	16 618
Total Area Farmable	481 671	498 517	481 933
Area of Farms in Homes, Feed Lots, Corrals, Cotton Gins, Experimental Farms, and Industrial Areas	13 771	13 646	13 903
Areas in Cities, Towns, Airports, Cemeteries, Fairgrounds, Golf Courses, Recreational Parks, Lakes, and Rural Schools, Less Area Being Farmed	16 308	16 047	14 508
Total Area Receiving Water	511 750	528 210	510 344
Area in Drains, Canals, Rivers, Railroads, and Roads	74 056	74 018	73 513
Area below -230 Salton Sea Reserve Boundary and Area Covered by Salton Sea, Less Area Receiving Water	39 417	39 481	39 417
Area in Imperial Unit not Entitled to Water	63 933	63 933	63 933
Undeveloped Area of Imperial, West Mesa, East Mesa, and Pilot Knob Units	286 105	269 619	288 054
Total Acreage Included - All Units	975 261	975 261	975 261
*Acreage Not Included - All Units	87 029	87 029	87 029
Total Gross Acreage within District Boundaries	1 062 290	1 062 290	1 062 290

IMPERIAL IRRIGATION DISTRICT

JRWilson

J. R. WILSON, Manager
Water Department

*Acreage within District Boundaries that is not Included in District.

TABLE III.9
TONS OF SEDIMENT REMOVED BY DESILTING BASINS AT IMPERIAL DAM

Year	Total Annual Sediment (tons)	High Month	Monthly Total (tons)	Low Month	Monthly Total (tons)
1961	196,553	July	58,635	December	144
1962	337,927	July	81,120	December	338
1963	515,033	July	100,802	December	551
1964	392,573	July	120 565	December	331
1965	433,468	August	143,109	January	439
1966	542,921	July	180,225	January	455
1967	318,777	August	92,033	December	259
1968	459,410	March	130,290	December	481
1969	467,052	April	98,337	December	264
1970	445,798	April	180,957	November	858
1971	441,146	April	122,157	January	1,088
1972	439,086	April	138,713	December	1,351
1973	481,774	April	181,326	February	1,169
1974	626,447	April	201,486	January	1,103
1975	470,161	April	132,456	November	994
1976	556,506	April	199,599	January	1,276
1977	530,026	July	150,466	December	1,651
1978	522,696	July	154,504	January	461
1979	646,766	July	201,383	January	176
1980	3,535,757[a]	July	1 331,953[a]	January	1,436
1981	455,671	August	145,520	October	75
1982	39,475	April	100,176	December	75
1983[b]	1,104,265[a]	May	389,891	March	1,406
1984[c]		-	-	-	-

[a]Caused by extreme high River release.
[b]July - Because of high water in Colorado River, the sediment pipes were submerged and no samples were taken.
[c]Because of continued high River releases during 1984, no samples could be taken.

acre-foot) of dissolved salts in the District's water supply (1 t.a.f. is equivalent to 735 ppm) is shown in Table III.10. A record of salinity of water supply (Drop No. 1) and drainage discharge waters, including a summary of salt balance, is shown in Table III.11. The impact of high salinity water is important to review. At high concentrations, it can prevent plant growth, corrode iron and brass plumbing, and concentrate in the soil.

The effect of other constituents in the water supply is also of significance. The constituents of a water sample from the All-American Canal below Drop No. 1 are given in Exhibit III.12. Each of these constituents can affect crop growth or adversely modify the soil structure. Water quality is as important as water quantity, and it is directly related to leaching requirements, drainage, and the types of crops that can be grown economically.

To maintain a favorable salt balance, water in excess of the consumptive use requirement must be utilized; this is called the leaching requirement. It is very important because of the magnitude of excess water that it requires. Typical values vary from 8 to 42 percent of total applied water. These values assume that the soil profile has been thoroughly reclaimed, i.e., excess salinity has already been leached out. In many areas of the Valley, the soil is still being reclaimed, so actual leaching requirements can exceed the theoretical, based on salt balance considerations. Exhibit III.13 illustrates tile line being installed.

Soil salinity is a continuing problem, but it has been reduced by installing leach lines throughout the Imperial Valley. In order to operate a leaching system properly, adequate amounts of water must be introduced. This is discussed in Chapter IV.

2. Consumptive Use

Consumptive use is a term that refers to the amount of water used by crops to build up plant tissue, transpired from the plant surface, and evaporated from the soil surface. Consumptive use will vary dramatically for the various crops and crop varieties, and it is affected by soil, climatic conditions, and the method of water application.

3. On-Farm Water Use

The actual on-farm use of water may be derived by adding the consumptive use and leaching requirements, and then dividing by the on-farm application efficiency. Table III.12 lists by major crops,

TABLE III.10
SALINITY OF WATER BELOW DROP NO. 1 ON ALL-AMERICAN CANAL

Year	Average[a] t.a.f.	Total Tons (millions)	Year	Average[a] t.a.f.	Total Tons (Millions)
1954	1.01	3.1	1970	1.27	3.5
1955	1.17	3.4	1971	1.27	3.7
1956	1.27	3.7	1972	1.24	3.5
1957	1.22	3.4	1973	1.18	3.5
1958	1.00	2.7	1974	1.19	3.7
1959	1.00	2.9	1975	1.19	3.6
1960	1.06	3.2	1976	1.17	3.3
1961	1.13	3.3	1977	1.13	3.0
1962	1.15	3.4	1978	1.08	2.9
1963	1.13	3.4	1979	1.15	3.2
1964	1.19	3.3	1980	1.10	3.1
1965	1.30	3.4	1981	1.15	3.2
1966	1.30	3.7	1982	1.16	2.9
1967	1.22	3.3	1983	1.05	2.5
1968	1.21	3.4	1984	1.00	2.7
1969	1.00	2.7			

[a]Weighted average, salt concentrations.

TABLE III.11
SUMMARY OF SALT BALANCE
EXCLUDING WATER AND SALT FROM MEXICO

	INFLUENT[a]				EFFLUENT					
Year	Total Discharge (AF)	Salt Brought Into the Area (tons)	Weighted Average[b] T.A.F.	Weighted Average[b] ppm	Total Discharge (AF)	Salt Removed (tons)	Weighted Average[b] T.A.F.	Weighted Average[b] ppm	Positive Salt Balance (tons)	% Gained
1958	2,730,876	2,723,153	1.00	735	974,045	3,341,376	3.43	2,521	618,223	22.70
1959	2,840,173	2,852,019	1.00	735	1,020,963	3,401,652	3.33	2,448	549,633	19.27
1960	2,983,860	3,162,485	1.06	779	1,059,804	3,558,534	3.36	2,470	396,049	12.52
1961	2,957,200	3,330,087	1.13	831	1,050,700	3,572,808	3.40	2,499	242,721	7.29
1962	2,951,266	3,399,464	1.15	845	1,088,965	3,806,946	3.50	2,573	407,482	11.99
1963	2,991,429	3,378,583	1.13	831	1,153,827	4,050,087	3.51	2,580	671,504	19.88
1964	2,770,474	3,284,284	1.19	875	905,153	3,635,121	4.02	2,955	350,837	10.68
1965	2,624,363	3,406,457	1.30	955	882,962	3,819,255	4.33	3,183	412,798	12.12
1966	2,817,912	3,650,447	1.30	955	1,004,685	4,148,874	4.13	3,036	498,427	13.65
1967	2,719,861	3,306,261	1.22	897	1,027,970	4,139,477	4.03	2,962	833,216	25.20
1968	2,806,124	3,408,548	1.21	889	1,001,027	4,012,009	4.01	2,947	603,461	17.70
1969	2,675,833	3,396,105	1.27	933	962,639	3,754,477	3.90	2,867	358,372	10.55
1970	2,754,898	3,488,023	1.27	933	1,020,503	3,780,732	3.70	2,719	292,709	8.39
1971	2,883,969	3,666,277	1.27	933	1,092,571	3,900,990	3.57	2,624	234,713	6.40
1972	2,846,613	3,541,248	1.24	911	1,063,537	3,886,592	3.65	2,683	345,344	9.75
1973[c]	2,956,013	3,492,199	1.18	867	1,065,414	3,980,338	3.74	2,749	488,139	13.98
1974[c]	3,072,327	3,669,832	1.19	875	1,123,492	4,204,158	3.74	2,749	534,326	14.56
1975[c]	3,001,207	3,581,043	1.19	875	1,128,268	4,196,407	3.72	2,734	615,364	17.18
1976[c]	2,783 630	3,263,454	1.17	860	1,084,993	4,361,658	4.02	2,955	1,098,204	33.68
1977[c]	2,693,030	3,039,155	1.13	831	1,020,797	4,187,227	4.10	3,014	1,148 072	37.78
1978[c]	2,671,798	2,897,906	1.08	797	995,674	3,824,323	3.84	2,823	926,417	31.97
1979[c]	2,803,166	3,216,228	1.15	843	1,056,652	3,998,131	3.78	2,781	781,903	24.31
1980[c]	2,769,495	3,058,785	1.10	812	1,043,241	3,988,611	3.82	2,810	929,826	30.40
1981[c]	2,769,112	3,192,402	1.15	847	962,925	3,825,050	3.97	2 920	632 648	19.82
1982[c]	2,515,637	2,918,781	1.16	853	888,575	3,608,490	4.06	2 985	689 709	23.63
1983[c]	2,416,885	2,538,349	1.05	772	867,835	3,333,260	3.84	2 822	794 911	31.32
1984[c]	2,647,285	2,654,712	1.00	737	895,034	3,360,256	3.75	2 759	705 544	26.58

Note: Part of the water in Alamo River from Mexico was used for irrigation in the United States prior to January 4, 1958. Prior to January 1, 1970, all salt concentrations were obtained by evaporation and drying at 105°C. Subsequent to January 1970, concentrations were obtained by drying at 180°C.

[a]Based on weekly samples at All-American Canal Station 2963 (East Highline Check) 1958 through 1972

[b]ppm = 735 x T.A.F.

[c]Based on weekly samples at All-American Canal below Drop No. 1.

IID-442H
(R3 2-70)

LABORATORY CERTIFICATE
IMPERIAL IRRIGATION DISTRICT

Constituents of Water at Drop No. 1
Testing Laboratory
Imperial, California

LABORATORY
NO. 100042

Date Received November 7, 1984

Date Sampled November 7, 1984

Date Tested November 13, 1984

Sampled By Gawat & Granado

Description AAC Below Drop #1

Discharge 1645 c.f.s.

Time 9:30 a.m.

Temperature 62°

DETERMINATIONS

Total Dissolved Solids (Dried @ 180° C.) T.A.F. 0.91 p.p.m. 666
$K \times 10^6$ @ 25° C. 1010
pH 8.8

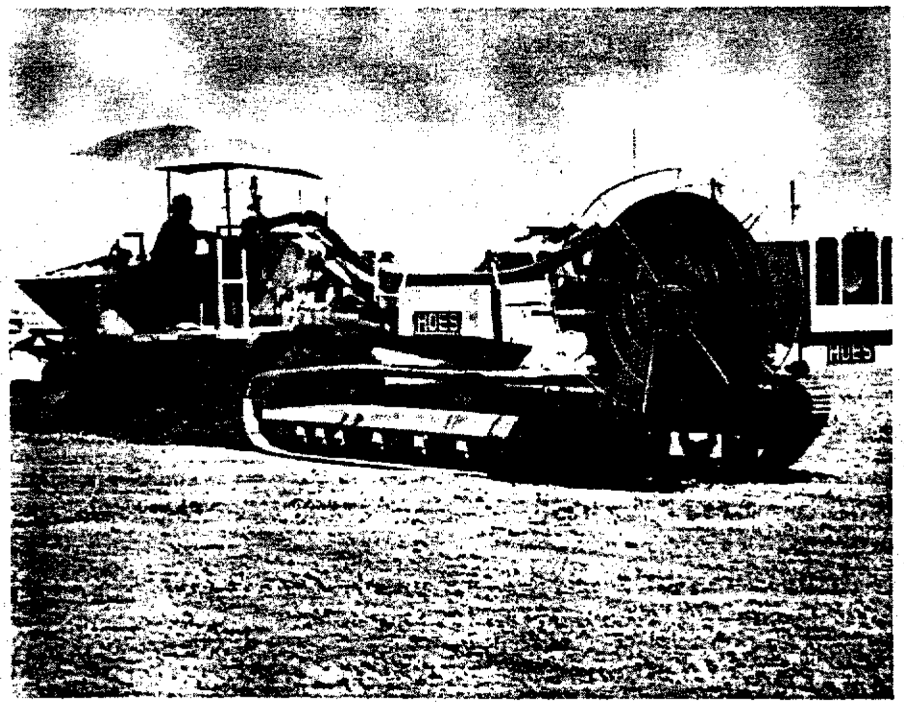
S.A.R. = 1.84

	p.p.m.		e.p.m.	% e.p.m. Cations
Ca	79		3.96	40
Mg	33		2.68	33
Na+K	77		3.36	33
		189		

	p.p.m.		e.p.m.	% e.p.m. Anions
HCO_3	107		1.76	18
SO_4	237		4.94	49
Cl	117		3.30	33
		461		
		650		
$-1/2\ HCO_3$		53		
		597		

Eng. Files
LAB21

Exhibit III.12



28,971 MILES OF TILE HAVE BEEN INSTALLED TO LEACH OUT ACCUMULATING SALTS.

EXHIBIT III.13

TABLE III.12
TOTAL AGRICUTURAL WATER USE

Crop	(1) Acreage, 1974 - 1983 (Acres X 1000) Range	Mean	(2) Consumptive Use (Acre-Feet Per Acre)	(3) Leaching Requirement (Acre-Feet Per Acre)	Total Requirement, Assuming 100% Application Efficiency (Acre-Feet Per Acre)
Alfalfa	158 - 208	181.0	6.0	1.1	7.1
Barley	0 - 7.5	3.5	1.8	0.2	2.0
Cotton	18 - 138	69.5	3.6	0.3	3.9
Sorghum, Grain	1.5 - 31.5	11.5	2.5	0.3	2.8
Sudan	6.5 - 26	16.0	2.5	0.3	2.8
Sugar Beets	36.5 - 74	51.5	3.7	0.3	4.0
Wheat	67.5 - 175	129.0	2.1	0.2	2.3
Misc. Field Crops	8.5 - 23.5	15.5	2.5	0.4	2.9
Melons	11 - 24	16.5	2.3	1.2	3.5
Lettuce	26.5 - 48.5	40.0	1.4	0.5	1.9
Carrots	4.5 - 9	7.0	1.3	0.6	1.9
Tomatoes	1.5 - 6	3.5	2.3	0.4	2.7
Misc. Garden Crops	11 - 21.5	16.0	1.7	0.4	2.1
Citrus	1.5 - 2.5	2.0	3.8	2.6	6.4
Misc. Permanent Crops	11.5 - 21	14.0	4.2	2,9	7.1
TOTAL ACREAGE		576.5			
AVERAGE			3.7	0.6	4.3

(1) = Rounded to nearest 500 acres.

(2) = Kaddah, M. T. and Rhoades, J. D., 1976, Salt and Water Balance in Imperial Valley, California Soil Science Society of American Journal, v. 40, No. 1, pages 93-100.

(3) = Based on 10-year average EC of incoming irrigation water of 1.22 mmhos/cm, and the EC of soil saturation extract that will reduce crop yield, by not more than 10% from Drainage of Agriculture edited by J. V. Schilfgaarde, p. 73, and U.S.D.A. Bulletin No. 283, pages 10-12.

the minimum, maximum, and mean values of acreages, consumptive use, and leaching requirements as determined by local studies.

4. Agricultural Practices

a. Land Preparation

(1) Cultural Practices: Cultural practices vary for different crop categories (i.e., grains, vegetables, melons, etc.) as well as with individual growers and various locations within the District boundaries. However, general practice includes the use of a stubble disk to incorporate previous crop residue into the soil for decomposition and to aid in smoothing the surface for subsequent tillage operations for row crops. A moldboard plow (or a subsoiler), a vertical shank which is drawn through the soil, is then used to promote aeration and water penetration for the following crop. This operation is necessary because of the contents of clay strata in the soil profile and compaction from various cultivation and harvesting operations of the previous crop.

The next step is usually the use of a disk harrow, with the disk operation done in two steps, the second phase being at an angle to the first. This operation is performed to further incorporate previous crop residues into the soil and to reduce clod size to a more desirable and uniform surface texture.

The next operation usually consists of minor leveling by a "floating" or "planing" process. This step results in a more uniform surface gradient and furthers the process of reducing clod size, permitting a more even distribution of irrigation water during subsequent cropping.

The next operation usually consists of constructing borders and irrigating by flood method, prior to planting the crop. This is done for various reasons: germination of weed seeds, decomposition of organic matter in the soil, and production of a more desirable surface texture for the seed bed.

If the crop is to be furrow irrigated, rows are then constructed and a mechanical incorporator is used frequently to apply herbicides and prepare the seed bed. The seed is then placed in the soil and either sprinkled or furrow irrigated to germinate the crop.

(2) Deep Tillage: Soil compaction is a common problem in the Valley. Deep tillage must be done frequently to break up the compacted layers. Three basic types of deep tillage are used in the Valley: chiseling, slip plowing, and deep plowing.

Chiseling is normally done once each year to break up the compacted 30 inches of the topsoil. This procedure is accomplished by pulling three shanks 3 feet apart through the soil at a depth of 30 inches.

In some soils, it is desirable to restructure the soil stratum by use of a "slip plow," which is designed to bring coarse soil particles up through the finer soil layers to enhance water and root penetration. This operation is usually done not more than twice on any given area to produce the desired effects.

Deep plowing to a depth of 5 feet is done to mix the fine and coarse soil particles in order to improve soil structure and water and root penetration. This operation is only done once on any given area.

(3) Land Leveling: In addition to the seasonal methods previously mentioned, there is usually at least one major leveling process conducted with large earthmovers to produce a finished grade, determined by soil texture and future intended use of the area being leveled. Most of the leveling is now done using laser beams to control the operation. Laser leveling makes it possible to level the field with 0.1 of an inch precision (see Exhibit III.14).

Many farmers have bought their own laser equipment, and "touch up" their fields each year to maintain precision leveling in order to evenly distribute and conserve water.

b. Irrigation Practices

Because less than 3 inches of rain fall annually in the Valley, irrigation is the most important management practice of the farmer. Crops grown in the Valley vary all the way from field crops to vegetables, and the methods used to irrigate these crops vary accordingly:

(1) Sprinkler Irrigation: Sprinklers are used mainly in the Valley to germinate vegetable crops by providing a microclimate around the young seedling that is conducive to

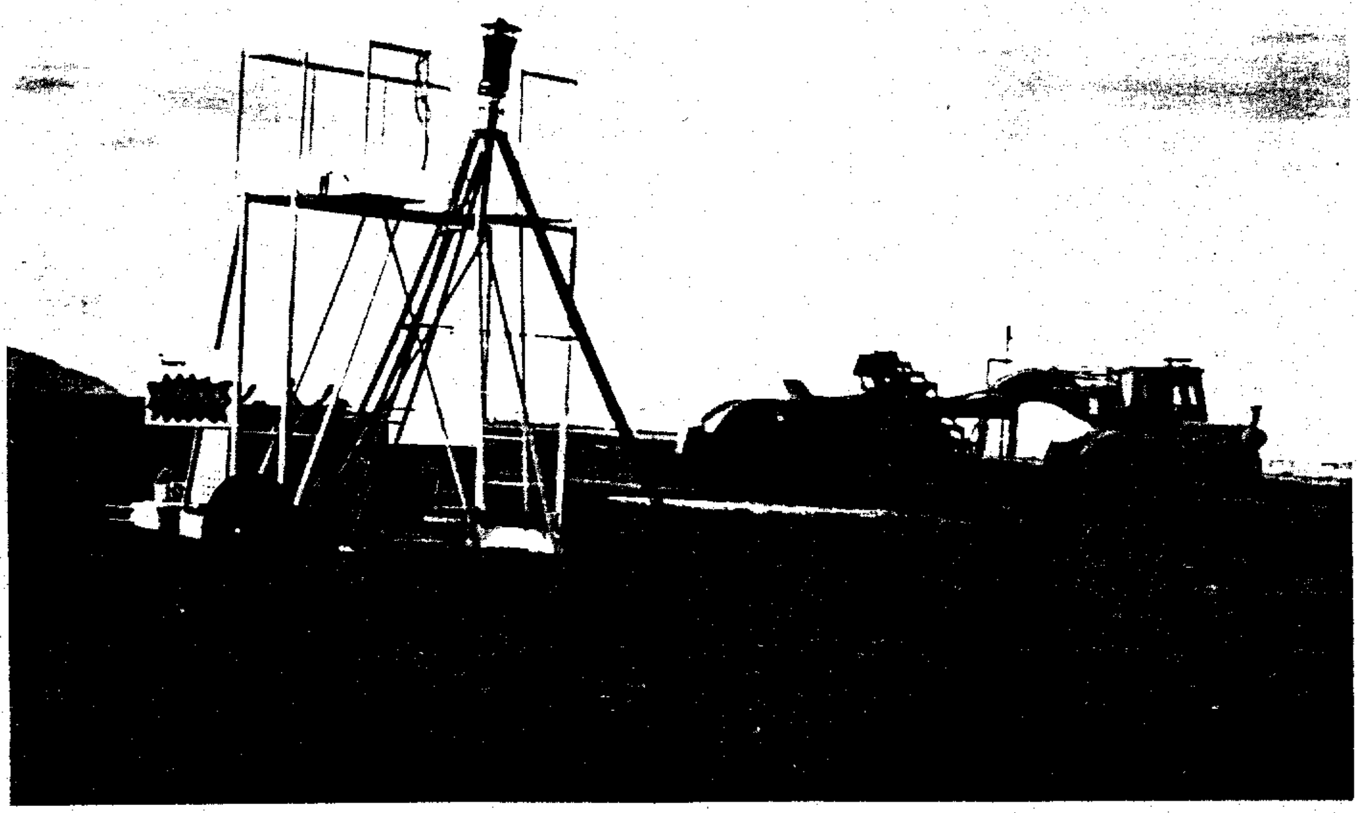
early growth. Potential irrigation efficiency using sprinklers on Valley soils is only 65-75 percent because of the distribution uniformity problems inherent in sprinklers and very high evaporation losses. After establishing a stand, more efficient methods such as furrow irrigation are used.

(2) Furrow Irrigation: Furrow and border irrigation are the two most widely used methods of irrigating in the Valley. Furrow irrigation is accomplished by running water in small channels (furrows) down or across the slope of the field. The water infiltrates the bottom and sides of the furrows to provide the desired soil wetting. Land leveling to provide uniform slopes is required to achieve high efficiencies in furrow irrigation.

Furrows are particularly suitable for irrigating crops that are susceptible to injury if the crown or stems become submerged. In contrast to flooding, furrow irrigation does not wet the entire soil surface; therefore, more time must be allowed for the water to soak in. Labor in this method is greater than border irrigation, but much less than sprinkler or drip irrigation.

(3) Border Irrigation: Border irrigation uses parallel earth levees or borders to guide a sheet of water as it moves down the slope. The land between two levees is called a border strip. Border strips vary from 10-150 feet in width and from 1,000-5,000 feet in length. This method is often the most efficient for irrigation of densely growing crops such as alfalfa and wheat. It is essential that the land has very little side fall, and the surface must be even to achieve high irrigation efficiencies.

(4) Corrugation Irrigation: In corrugation irrigation, the water flows down the slope in small furrows called corrugations or rills. This method is used on steep ground for irrigating crops such as small pasture and alfalfa. The corrugations are V- or U-shaped channels about 2-3 inches deep, spaced 12-40 inches apart. The entire soil surface is wetted as the water moves laterally through the soil. This method of wetting the soil is commonly used to germinate crops that have been drill or broadcast seeded, because it minimizes the crusting effect on the surface. Flood irrigation is then used after the plants become established.



LASER LAND LEVELING IMPROVES WATER APPLICATION UNIFORMITY AND EFFICIENCY.

EXHIBIT III.14

(5) Basin Irrigation: Basin (or dead-level irrigation) is relatively new to the Valley, but it is the simplest in principle of all methods, and labor is minimal. Levees (dikes or borders) are constructed around the areas forming basins. However, land is removed from production, and levees interfere with the movement of farm equipment. The land inside the basin is level or has a very small amount of fall. A 70-acre field will normally be divided into six individual basins. Many different crops are irrigated by this method. Plants that would be damaged by submergence are grown on beds, and the water flows in the furrows.

Dead-level irrigation is aptly named. About 80 percent of the Valley soils are heavy clays and seal over when wetted (USDA/SCS, 1981). Because of very slow infiltration rates, if excess water is applied or if a storm occurs after an irrigation, water will pond on the surface for long periods of time. In most cases, this will seriously injure or kill the crop. Extremely careful water management is necessary on clay soils with basin irrigation.

(6) Drip Irrigation: The application of water to the soil through small orifices is known as drip, trickle, spitter or dribble irrigation. The orifices normally deliver water through emitters to a specific area at rates of 0.25 to 2 gallons per hour. Water is delivered through small plastic pipes to the orifices laid on the ground or buried. Water is normally applied at short intervals to meet the consumptive use needs of the crop. Drip systems must have screens and filters to remove aquatic vegetation debris and suspended particles, which would plug the small emitters. Fertilizer is usually injected into the system. The plugging of emitters can be a problem and requires constant checking to ensure that all of the plants are receiving enough water.

Drip irrigation is used on sandy soils and on some citrus and high cash crops in the Valley. Salt accumulation at the perimeter of the wetted area occurs and must be leached from the root zone, either by overapplication through the drip system or periodic flooding of the soil. Extreme caution must be exercised during rainstorms. Rains can cause the accumulated salts to migrate back into the root zone, and severe crop damage or failure can occur. It is a general practice to run water through the drip system during a storm to prevent the migration of the salts back into the root zone. This obviously reduces the efficiency of the drip system. A storage reservoir is required when using a drip system.

(7) Tailwater Return: Tailwater return, sometimes referred to as pumpback, can be used with most of the preceding methods of irrigation. Tailwater (the excess water that collects at the lower end of the field) is normally stored for a few hours and pumped back to the upper end of the field where it is mixed with incoming water and used to irrigate other portions of the field. Careful water management is important when using a pumpback system.

c. Irrigation Scheduling Methods

When to irrigate and how much to apply are two basic questions asked by the irrigator. Irrigations must be scheduled often enough to keep the plant alive and producing well. The amount of water applied during each irrigation is a function of the soil type, system efficiency and irrigation frequency.

There are four basic methods used to schedule irrigations in the Valley. They range from observing the plants to complex computer modeling. Each method has advantages and disadvantages:

(1) Crop Appearance Method: Crop appearance has been used to schedule irrigations for many years. It is based on a change in plant appearance or color when associated with stress. For some crops, this method has been somewhat successful; however, by the time some plants show signs of stress, it is too late and yield is reduced. This method gives some indication when to irrigate but not how much to apply.

(2) Calendar Method: The crop is irrigated at a set frequency on a certain number of calendar days. Scheduling with this type of system is very simple. Unfortunately, irrigation efficiency and production can suffer under this type of system. This method does not indicate how much water should be applied and could result in overapplication of water or severe plant stress between irrigations.

(3) ET (evapotranspiration) Method (Water Budget Method): This method involves determining the daily ET loss for each crop and subtracting that amount from the available soil moisture in the plant root zone. This accounting (or budget) method allows the grower to keep track of the soil moisture

conditions in each field and predict several days in advance when an irrigation is needed and how much water to apply.

Various methods have been developed to estimate the amount of water used each day by a crop at a specific site. Some methods involve incoming radiation, wind speed, temperature and humidity measurements. One relatively simple approach has been to relate a crop's daily consumptive use to the evaporation loss from a Class A Weather Bureau evaporation pan. Daily pan evaporation values are listed in the local newspaper each day.

The Water Budget Method must be closely correlated with soil type, salinity, fertilization and stage of growth. It is a good method for scheduling irrigation but must be continually compared to the actual conditions existing in the field.

(4) Allowable Soil Moisture Depletion Method: Soils will only hold a certain amount of water that is available for plant use. This is usually referred to as the available water-holding capacity (AWC) of the soil and is closely related to texture (Table III.13). In the Allowable Depletion Method, a certain percentage of this moisture is allowed to be depleted from the plant root zone before an irrigation is scheduled. The amount of water to be replaced during each irrigation is the amount depleted from the soil since the last irrigation.

One way of estimating the soil moisture content is by the "feel" method (Table III.14). Other more accurate methods of estimating soil moisture depletion involve the use of tensiometers, conductance cells, oven-drying soil samples, and the neutron soil moisture probe. The District currently has a demonstration irrigation scheduling program using the neutron probe. The unit irrigation efficiency in this demonstration program is currently 86 percent.

D. OTHER WATER USES

1. Municipal Water Use

The District delivers water to a variety of ultimate users, not only to farmers. Nine cities and towns are delivered water on a wholesale basis directly from canals to each town's treatment facility (Table III.15).

TABLE III.13
IRRIGATION WATER MANAGEMENT

Conservation irrigation water management is the act of controlling or regulating irrigation water applications in a way that will satisfy the water requirements of the crop without the waste of either water or soil. It involves applying water in accordance with crop needs, in amounts that can be retained in the soil for crop use, and at rates that are consistent with the intake characteristics of the soil and the erosion hazard of the site.

The table below gives the general range of available moisture-holding capacities of the various soil textures when unaffected by salts.

Soil Texture	Available Moisture 1/ Range In./Ft.	Available Moisture 1/ Average In./Ft.
Very Coarse to Coarse Textured Sand	0.4 - 1.00	0.80
Moderately Coarse Textured Sandy Loams and Fine Sandy Loams	1.00 - 1.50	1.20
Medium Texture - Very Fine Sandy Loams to Silty Clay Loam	1.50 - 2.30	2.00
Fine and Very Fine Texture - Silty Clay to Clay	1.50 - 2.00	1.80
Peats and Mucks	2.00 - 3.00	2.50

Soil textures existing in your fields can be found in your conservation plan. If you do not have one, check at the local Soil Conservation Service office.

The available moisture in saline soil should be reduced according to the table below:

ESTIMATING REDUCTION OF AVAILABLE MOISTURE IN SALINE SOILS 2/

Conductivity of Soil Saturation extract Millimhos/cm (EC x 10^3)	0	2	4	6	8	10	12	14	16
Approximate Reduction in Available Moisture = percent	0	5	11	19	28	38	52	68	84

1/ Revised in accordance with Technical Note, Soils-15, dated June 1969 with attachments dated May 20, 1976.

2/ From "A Proposed Method for Estimating Reduction of Available Moisture in Saline Soils" by Robert E. Fox, USDA-Soil Conservation Service, Soil Science, Vol 83 page 453, June 1957.

CAL. - 7-L-14000-141
(Revised Dec. 1977)

TABLE III.14

GUIDE FOR ESTIMATING AVAILABLE SOIL MOISTURE BY THE "FEEL" METHOD

Available soil moisture remaining	Feel or appearance of soil Coarse Texture	Moderately Coarse Texture	Medium Texture	Fine and Very Fine Texture
0 to 25 percent	Dry, loose, single grained, flows through fingers	Dry, loose, flows through fingers	Powdery dry, sometimes slightly crusted but easily broken down into powdery condition	Hard, baked, cracked, sometimes has loose crumbs on surface
25 to 50 percent	Appears to be dry, will not form a ball with pressure 1/	Appears to be dry, will not form a ball 1/	Somewhat crumbly but holds together from pressure	Somewhat pliable, will ball under pressure 1/
50 to 75 percent	Appears to be dry, will not form a ball with pressure	Tends to ball under pressure but seldom holds together	Forms a ball, somewhat plastic, will sometimes slick slightly with pressure	Forms a ball, ribbons out between thumb and forefinger
75 percent to field capacity (100%)	Tends to stick together slightly, sometimes forms a very weak ball pressure	Forms weak ball, breaks easily, will not slick	Forms a ball, is very pliable, slicks readily if relatively high in clay	Easily ribbons out between fingers, has slick feeling
At field capacity (100%)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand

1/ Ball is formed by squeezing a handful of soil very firmly.

TABLE III.15
MUNICIPAL WATER CONSUMPTION (1983)

Town or City	Water Delivered Acre-Feet	Population	Gallons/ Capita/Day
Calexico	5,110.0	15,838	288
Holtville	1,516.4	4,637	292
El Centro	6,239.8	26,402	211
Imperial	2,067.0	3,708	498
Brawley	7,960.0	17,160	414
Westmorland	1,102.0	1,718	573
Calipatria	1,337.0	2,706	441
Niland	789.0	1,042	676
Seeley	346.0	1,058	292
Heber	345.0	2,221	139
U.S. Naval Air Station	811.5	2,315	313
TOTALS	27,623.7	78,805	

Note: Population figures are from Imperial Irrigation District's Community and Special Services Section, February 1984. Official Preliminary 1983 Census Results are from the County Planner.

Farmers in rural areas and rural communities also receive water directly from the canal system, treating it as necessary. Water charges are made annually. There are 19,479 residents living in the nonurban areas of the District's water service area using approximately 8,400 AF of water per year. Since water deliveries to rural customers are not measured, this quantity is based on the average county-wide usage rate.

2. Industrial Water Use

Almost all industry in Imperial Valley, excluding geothermal developments, is located within urban areas. The industrial users of water include: Holly Sugar Corporation, various cotton gins and compresses, chemical/fertilizer producers, and a steam turbine electrical generating station. The approximate annual industrial water use is 1,000 AF.

The development of geothermal resources requires water for cooling and reinjection. Imperial County requires reinjection to reduce the possibility of land subsidence. Currently there are three 10-MW pilot plants operating in Imperial Valley; two 50-MW plants are near completion, south of Heber. The water use for 1984 was 1,100 AF.

The initial development stages indicate that water usage by geothermal power plants varies with the temperature of the resource but will average 60 AF per year per megawatt of plant capacity under normal operating conditions. Development to the predicted 3,000 MW will require about 180,000 AF. If steam condensate is not used for cooling throughout the Valley, adverse impacts to water availability and quality could occur. However, if steam condensate is used for cooling at full field development for the entire geothermal resources and less than 100-percent reinjection is permitted, no outside sources of cooling water will be required, and no adverse water supply impacts will occur (ICPD, 1977).

3. Recreational and Wildlife Water Use

Recreational use of water outside of city boundaries includes lakes, parks and golf courses. The approximate annual water use by recreational facilities follows:

Location	Acre-Feet per Year
Wiest Lake and Park	726
Sunbeam Lake and Park	1,034
Finney Lake	1,614
Ramer Lake	1,696
Del Rio Country Club	994
Barbara Worth Country Club	695
International Country Club	382
Total	7,141

Wildlife use consists mainly of wetlands habitat enhancement areas. The California Department of Fish and Game maintains approximately 1,400 acres of waterfowl habitat and 360 acres of fish hatcheries. The District also maintains a 100-acre pond in the New River bottom for wildlife habitat. The approximate annual water use for these fish and habitat areas is 13,000 AF in evaporation and seepage per year. Other bulk users of water in the rural areas of Imperial County include schools and cemeteries. Approximate usages are listed below:

User	Acre-Feet per Year
Riverview Cemetery	269
Memorial Park Cemetery	39
Central Valley Cemetery (Holtville)	16
Central Valley Cemetery (El Centro)	27
Imperial Valley College	400
Meadows Union School	120
Westside School	84
Mulberry School	110
McCabe School	120
Pine Union School	60
Total	1,245

E. SUMMARY

The development of the Imperial Irrigation District as described in previous chapters has culminated in a continually improving system. Wherever possible, improvements are made on the structural elements of both the irrigation and drainage systems. Operational improvements are also incorporated to take advantage of the changing aspects of the system. Rules and Regulations have been adopted and enforced to maintain operational efficiency. These include special water conservation measures put into effect within the last 10 years.

The District has looked at system-wide water usage and has focused on its largest customer, the agricultural user. Irrigation practices have been investigated and, wherever feasible, improvements have been encouraged. Other water users, including municipalities and industry, are being monitored and have been taken into consideration in this description of the water systems of the Valley.

CHAPTER IV
PAST WATER CONSERVATION PROGRAMS

CHAPTER IV

PAST WATER CONSERVATION PROGRAMS

A. INTRODUCTION

The District must deliver a reliable water supply to a user in the quantity required. The agricultural water user must satisfy complex and variable climatic, crop, soil, salinity and operational requirements. Improvement of water use efficiency accomplishes several purposes, at the District or water user level, and may involve operational and physical changes. However, any action that improves the forecasting of the water need increases the reliability of the water supply, decreases operation and maintenance needs in an economical manner, contributes to effective water management and use, and conserves water. The District and its users have a long history of improving water use efficiency.

Major water conservation programs that are followed by an irrigation district usually require changes in routine at the policy and management level, at the operation and maintenance level, and at the water user level. Changes must be accomplished in a well-planned and orderly fashion, especially in a large and complex district such as Imperial, where large quantities of water are handled. Lands are located far from the water source and are irrigated 12 months out of the year. High-value crops are produced that are often highly sensitive to management of soil, moisture and salinity. Any program measure that disrupts established practices and procedures, or attempts to implement structural changes to existing distribution systems more rapidly than District personnel and landowners can adapt, may well result in an overall failure of the water conservation program. The degree of failure can be measured in crop losses, excessive District costs, and poor relations between the District and the landowners it serves.

The benefits of some water conservation programs that are desirable both to water users and the District are difficult to quantify. The District's canal-lining program falls in this category. In addition to reducing seepage losses, which cannot be quantified readily, lined canals are more economical to operate and maintain than dirt ditches. Farmers prefer lined canals because they reduce seepage damage to adjacent lands, reduce the lands needed for rights-of-way, and increase land available for farming. Where farmers are responsible for maintenance, costs are reduced. The rate at which mutually financed programs can proceed is influenced by available funds, canal delivery schedules, and availability of contractors to do a timely job.

Operational changes and administrative decisions that result in water conservation, such as some of the District's 13-Point and 21-Point Programs described herein, can be made without cost-benefit analysis. These conservation measures will succeed only if done gradually. They include educational and training sessions of both District's operating personnel and water users and provide for effective communications between the District's supervising and operating personnel and the water users.

The historic water conservation programs described in this chapter demonstrate the long-term commitment by the District to water conservation and to continued improvement of its system and operational procedures to increase efficiencies of delivering water to its farmer constituents. Also, water users have gradually and continuously improved their irrigation and farming practices, which has resulted in increased on-farm water use efficiencies and optimum crop production.

Past and present water conservation programs, coupled with many suggestions offered by individuals and groups, provide a valuable data bank that should be supplemented as new ideas are presented. A periodic review made of the data bank indicates the probable effectiveness of any proposal or opportunity stored in the bank. These suggestions are described in Chapter V.

B. SCOPE

This chapter presents the historic water conservation activities of the District and its water users from the District's formation in 1911 to the present time. Water conservation efforts through the 1940s are discussed under Section C, Early Development.

District activities from the 1950s are then discussed under separate headings:

Overview of Water Conservation
Water Measurement Program
Structural Programs
Operational Programs
Administrative Programs
Tailwater Reduction Program
Educational Programs
Cooperative Programs
On-Farm Water Conservation Practices
Planning for Water Conservation
Accomplishments of Water Conservation Program

The current water conservation activities and plans are discussed in Chapter VI.

C. EARLY DEVELOPMENT

Securement of a reliable water supply, rather than reducing water, was the goal of the early developers and District engineers during the first few decades of construction of the irrigation and drainage systems. However, the many improvements to the irrigation system during more than three decades have resulted directly in water conservation, because the improvements have contributed to increased system efficiency.

The need for extensive improvements and repairs to the canal system, as well as for work on the Colorado River levees in Mexico, was among the first tasks faced by the District after its formation in 1911. In 1915, bonds were sold for $3.5 million, mainly to purchase the Southern Pacific properties, with only $500,000 being allocated for improvements. By 1916, construction was completed of a new headgate in the Volcano Lake levee and the Cerro Prieto Canal (in Mexico).

In 1916, the Board of Directors appointed a board of consulting engineers to recommend solutions to the very serious problem of maintaining an adequate water supply. With $2.5 million provided by the Second Bond Issue in 1917, construction of the Rockwood Heading and Intake Canal (an extension of the Alamo Canal) was accomplished. Other expenditures were:

(1) Purchase of locomotive, steam shovel, and dump cars for use in the Andrade quarry and River levees.

(2) Construction of Solfatara Canal.

(3) Improvements to Levee System and Alamo Canal.

(4) Construction of a number of canal headings and small sluiceways, both in Mexicali and Imperial Valleys.

It was not until 1919, after sale of the Third Bond Issue for $2.5 million, that additional improvements were made to the canal systems in Mexicali and Imperial Valleys.

The need for drainage became apparent as the 1920s approached. Because of the closed nature of the basin and the need to dispose of agricultural drainage water, the Salton Sea was declared a repository for irrigation drainage by the federal government. After studies of potential Salton Sea levels by the USGS in 1927, President Coolidge set aside about 120,000 acres of land below elevation -220 feet under public domain. This area, coupled with land and flood easements subsequently owned by the District, effectively covers nearly all of the land below elevation -220 feet.

District resources, both financial and physical, were expended during the late 1920s to construct an open drainage system, and, by the end of 1930, 234 miles of deep drains and 740 miles of lateral drains had been completed. At that time, the District was operating and maintaining about 1,600 miles of earth-lined irrigation canals and laterals in Imperial Valley, basically the same system in operation today. In addition, through its Mexican company, it was operating and maintaining 130 miles of earth-lined canals and about 75 miles of protective levees along the Colorado River, 45 miles of which were equipped with a standard-gauge railroad. Silt removal from the canal system required much time and expense.

Recognizing the need to avoid excessive tailwater discharge by water users, the District has periodically adopted Resolutions, as well as Rules and Regulations, toward this purpose. Regulation No. 34 in District Rules and Regulations adopted in 1922 states:

> "... water users wasting water on roads or vacant land, or land previously irrigated, either willfully, carelessly, or on account of defective ditches, or who shall flood certain portions of the land to an unreasonable depth or amount ...will be refused the use of water until such conditions are remedied."

In 1933, after the drainage system was completed, the Board of Directors adopted a resolution that permitted the District to refuse water service to any water user who intentionally or carelessly permitted discharge of excess irrigation water into drains.

The 1930s and 1940s were extremely difficult times. The nationwide depression of the 1930s resulted in great financial stress to both Valley farmers and the District. Then, in 1934, a severe water shortage caused crop losses and additional hardships, and financial problems continued through the decade. In 1939, a hurricane swept through the Valley, dropping nearly 7 inches of rain almost continuously for a week. Great damage was done to the District's systems. In May 1940, the most severe earthquake of the century caused substantial damage to cities and towns. Several lives were lost. Again, extensive damage to District facilities took place, mainly to the Solfatara Canal in Mexico. The newly completed All-American Canal sustained a horizontal shift of over 14 feet in its right bank not far from Calexico. Substantial time and money were expended to make repairs.

The District began to improve its system after the All-American Canal was completed in 1941. (This canal was the first to provide the Valley with a reduced-silt water supply.) Old timber structures were replaced with concrete. Corrugated metal pipes in culverts and flumes were replaced with concrete pipe. Imperial County improved its road system by constructing numerous bridges and cooperating with the District in replacing old siphons. As those roads were paved, the District's operations improved due to better access to checks and delivery structures.

D. OVERVIEW OF WATER CONSERVATION

During the past four decades, the District has initiated many water conservation programs and has participated in various programs in cooperation with government agencies. Various structural programs have been initiated and continued by the District in cooperation with private individuals and public entities. Operational and administrative programs designed to conserve water have been put into practice. In addition to taking part in cooperative ventures, the District has offered public education programs and has encouraged innovative on-farm irrigation practices. These programs are described within this chapter and form the foundation of future water conservation plans.

Water not consumed or lost in farm and District operations is:

1. Leach water is irrigation water that is in excess of consumptive-crop needs required to leach salts below the root zone. It percolates through the soil, enters the on-farm drainage systems, and is then discharged into the District drains.

2. Tailwater is irrigation water that runs off the lower end of the fields and is discharged into the open drains by gravity or pumping.

3. Operational spills result from an imbalance of canal flow and diversions to landowners.

4. Canal seepage results from unlined canals.

Items 1 and 2 are not directly controlled by the District, and farmers must be relied upon to use their water in a reasonable manner. However, the District historically has encouraged efficient on-farm water use by enforcing rules and regulations designed to limit overapplication of water at the on-farm level. Items 3 and 4 are the District's responsibility, and the District is continually taking steps to reduce them. Leaching is necessary for farm operations, and current testimony indicates that the actual leaching is about equal to theoretical requirements.

Canal seepage is being reduced through canal lining. Tailwater and canal spill are interrelated. Tailwater may be increased if farm headgate deliveries fluctuate, more water is ordered than needed, or more water is delivered than ordered (consumptive need may be miscalculated). A reduction in tailwater can be made if headgate deliveries are better controlled. Improved headgate control can be obtained by carrying extra water in the canal, hence some canal spill. One important method to reduce spill and tailwater is to provide better control to the farmers' headgates. Several structural and nonstructural elements contribute to water control; however, the effects are hard to measure.

The District's basic responsibility of delivering water when, where, and in the quantities needed has provided an efficient water delivery system compared to similar districts.

E. WATER MEASUREMENT PROGRAM

The District has developed a highly integrated water measurement program to accurately control flows for proper delivery of water to the farmers. Hydrographers make periodic current flow measurements as needed for control. Since its inception, the District has maintained an extensive measurement program not only of water quantities but also of water quality, District and farm facilities, crop patterns, and meteorological and hydrological conditions, including Salton Sea records. A water report is published annually that summarizes the measurements.

Water measurements are conducted in accordance with standards developed by the District, in compliance with accepted hydrologic criteria, and as required by cooperating agencies, including the USGS, National Oceanic and Atmospheric Administration, International Boundary and Water Commission, the USBR, University of California, and Resources Agency of California. During the last few years, there has been an increase in measurements into other areas. These include installation of continuous recording devices on a sample number of canal spills, canal laterals, farm deliveries and tailwater boxes.

F. STRUCTURAL PROGRAMS

Structural programs to conserve water include physical changes to the water conveyance and usage system that will bring about benefits independently of user practices. An example would be the lining of canals to reduce seepage losses.

1. Canal Lining

In 1954, the District began a program of concrete lining canals and laterals. The program provided that the landowner submit a request to the District to concrete line the reach of canal contiguous to his land, agree to pay a share varying from 25 to 30 percent of the lining cost, and furnish rights-of-way and earthfill as necessary for construction of the embankment. Under this program, 871 miles of canals and laterals (over one-half of the District's water conveyance system) have been concrete lined through 1984 (Table III.3). The cost-sharing program between the landowner and the District had two beneficial aspects regarding water conservation. First, where canal seepage was causing a problem, a landowner would request that a canal be lined; hence, some of the canals with high seepage rates were lined under the program. Second, by using a cost-sharing program, the net result was that more miles of canal were lined and there were greater savings in seepage losses. Cost savings to the District have not been determined because no values have been placed on farmer-supplied earthfill. Considering haul distances, this could be the most costly item.

In addition to concrete lining, about 9 miles of laterals have been replaced with concrete pipe, primarily through portions of the Cities of Brawley, El Centro and Holtville.

It is difficult to estimate the reduction of seepage resulting from canal lining. The seepage per mile of lateral derived from a USBR study on canal lining averages 135 AF per year (USBR, 1984). Using this number, the practice of lining canals is currently saving about 118,000 AF per year (871 miles x 135 AF), creating a total savings of 1.6 MAF from 1954 through 1983. This estimate is probably low because the canals that have been lined include some of the most permeable areas.

In addition to lining the District's lateral canals, about 80 percent of farm head ditches have been lined. The District uses private contractors to line its canals so that contractors are available in the Valley for farm ditch lining.

2. Regulatory Reservoirs

The District has four regulating reservoirs in operation providing a total storage capacity of 1,570 AF. One reservoir is located on each of the three main canals - East Highline, Central Main and Westside Main. The fourth and newest reservoir, the Herman "Red" Sperber Reservoir, began operating May 1, 1983, and stores water from the

Rositas Canal. A total of $3.3 million was spent for construction of the four reservoirs.

These reservoirs are all located near former spill locations (laterals discharging into drains or other laterals). Reservoirs reduce canal spill at other locations because they provide for better control. The only direct savings credited to reservoirs are the changes in annual amounts of spill at those locations. Table IV.1 lists the pertinent information on the four reservoirs.

TABLE IV.1
COMPARISON OF REGULATORY RESERVOIRS

Reservoir	Year Completed	Capacity (AF)	Direct Savings[a] (AF)	Cumulative Storage 1984 (AF)
Singh	1976	350	400	29,109
Sheldon	1977	500	1,300	24,221
Fudge	1982	320	2,400	24,937
Sperber	1983	400	2,100	24,518
Totals		1,570	6,200	102,785

[a]Estimated reduction in annual spill

3. Seepage Recovery Lines

The District has constructed 6 miles (twelve 0.5-mile sections) of seepage recovery lines parallel to the East Highline Canal to recover canal seepage losses. Water entering these lines is pumped back into the canal for delivery to farms. Through 1984, it is estimated that nearly 210,000 AF have been returned to the distribution system. Total expenditures for seepage recovery lines were $492,000. Approximately $50,000 per year is budgeted for operation, maintenance and power costs associated with the seepage recovery program. A summary of annual amounts of water conserved by these seepage recovery systems is shown in Table IV.2.

4. Farm Delivery and Outlet Structures

Since 1976, farm delivery structures have been installed or reconstructed using standard designs to provide for better water control and measurement of farm deliveries and to facilitate measurement of tailwater runoff. Farm drain outlet structures are owned and maintained by the landowners.

TABLE IV.2

WATER RECOVERY DRAINS PARALLEL TO EAST HIGHLINE CANAL

Year	DP-17 Plum to Pine Acre-Feet Recovered	DP-17 Cost	DP-18 Pear to EHL Lat. 10 Acre-Feet Recovered	DP-18 Cost	DP-19 EHL Lat. 10 to Lat. 11 Acre-Feet Recovered	DP-19 Cost	DP-20 Oat to Oasis Acre-Feet Recovered	DP-20 Cost	DP-21 Highway 80 to EHL Lat. 8 Acre-Feet Recovered	DP-21 Cost	DP-22 EHL Lat. 8 to Pear Acre-Feet Recovered	DP-22 Cost	DP-23 Oak to Moss Acre-Feet Recovered	DP-23 Cost
May to Dec. 1967	736	$ 287	-	$ -	-	$ -	-	$ -	-	$ -	$ -	-	-	$ -
1968	1,288	510	467	182	262	116	140	98	96	54	121	58	-	-
1969	1,449	516	1,508	580	723	353	697	323	1,120	455	713	355	-	-
1970	1,321	479	1,416	533	658	332	653	314	1,088	447	621	328	925	361
1971	1,349	487	1,455	544	570	304	640	309	1,053	436	593	317	1,351	533
1972	1,207	451	1,388	526	568	306	599	295	1,123	456	652	332	1,297	519
1973	1,130	432	1,410	531	511	284	589	287	936	431	658	334	1,272	513
1974	1,109	590	1,363	680	599	384	587	304	889	532	588	385	1,340	700
1975	1,072	790	1,220	889	512	448	301	263	932	606	499	437	1,190	927
1976	984	755	1,084	839	470	422	371	314	865	717	507	461	1,269	948
1977	1,060	928	663	643	397	428	397	384	885	878	347	371	1,347	1,119
1978	977	977	559	679	390	462	441	439	911	915	242	438	1,298	1,272
1979	1,113	1,252	693	841	260	406	515	528	921	1,104	243	524	1,298	1,510
1980	922	1,245	676	992	194	339	475	630	778	1,102	281	580	1,313	1,796
1981	948	1,335	788	1,195	390	367	309	780	866	1,350	643	822	1,334	1,774
1982	1,089	1,913	811	1,648	377	435	258	1,125	860	1,796	482	997	1,240	2,198
1983	1,154	2,221	938	2,157	355	598	206	1,204	860	2,066	494	1,351	1,150	2,482
1984	1,066	2,206	842	2,087	288	591	249	1,224	902	2,036	456	1,268	1,215	2,535

Year	DP-24 Ohmar to Oleander Acre-Feet Recovered	DP-24 Cost	DP-25 Orange to Ohmar Acre-Feet Recovered	DP-25 Cost	DP-26 Oxalis to Orange Acre-Feet Recovered	DP-26 Cost	DP-27 EHL Lat. 11 to Lat. 12 Acre-Feet Recovered	DP-27 Cost	DP-28 Oasis to Orient Acre-Feet Recovered	DP-28 Cost	Totals Acre-Feet Recovered	Totals Cost	Average Power Cost Per Acre-Foot
May to Dec. 1967	-	-	-	-	-	-	-	-	-	-	736	287	-
1968	-	-	-	-	-	-	-	-	-	-	2,374	1,018	$ 0.43
1969	-	-	-	-	-	-	-	-	-	-	6,210	2,582	0.42
1970	-	-	-	-	-	-	-	-	-	-	6,682	2,794	0.42
1971	406	143	-	-	-	-	-	-	-	-	7,417	3,073	0.41
1972	1,854	653	1,361	627	-	-	-	-	-	-	10,049	4,165	0.41
1973	1,795	636	1,489	648	3,309	1,120	2,731	1,012	-	-	15,830	6,228	0.39
1974	1,850	884	1,109	603	3,714	1,825	3,195	1,548	2,369	1,063	18,712	9,498	0.51
1975	1,460	1,124	1,300	995	3,368	2,362	3,046	2,097	3,094	1,822	17,994	12,760	0.71
1976	1,388	1,168	1,370	1,195	3,126	2,387	3,062	2,271	3,296	2,092	17,792	13,569	0.76
1977	1,760	1,388	1,210	1,388	3,047	2,665	2,947	2,566	3,244	2,412	17,304	15,170	0.88
1978	1,833	1,569	1,322	1,544	3,704	3,475	3,039	2,863	3,255	2,633	17,971	17,266	0.96
1979	1,639	1,827	1,146	1,780	3,332	3,777	3,014	2,469	3,449	3,383	17,623	20,401	1.16
1980	1,625	2,138	1,113	2,061	3,357	4,469	2,883	3,836	3,499	3,983	17,116	23,171	1.35
1981	1,456	1,915	1,249	2,139	3,235	4,339	3,021	4,040	3,321	3,923	17,560	23,979	1.37
1982	1,523	2,346	1,188	2,741	3,460	5,966	2,947	5,213	3,148	4,956	17,383	31,334	1.80
1983	1,478	2,666	1,287	3,137	3,373	6,788	2,794	5,691	3,052	5,928	17,142	36,289	2.12
1984	1,440	2,690	1,120	3,092	3,280	5,539	3,280	5,539	2,669	5,807	16,807	34,614	2.06

Mileage: .50 Mile - Total 6.00 Miles
Power costs calculated in Engineering Section

5. Automatic Controls

The Water Control Section and the Watermaster operate remote electronic monitoring and control devices at 22 locations, including the All-American Canal. The hydrographers and other field personnel can operate these facilities manually in case of power outages and emergencies. Automatic control and remote monitoring of operations will increase under the present District Plan as provisions for telemetry are built into every new or replacement structure.

6. Evaporation Ponds

Evaporation ponds have been constructed at 17 locations in the New and Alamo Rivers to reduce inflow to the Salton Sea. Through 1984, $1.5 million has been expended on this program.

G. OPERATIONAL PROGRAMS

Operational Programs refer to changes in operational procedures that have been initiated to promote water conservation.

1. Radio Equipment

All water-operation personnel have radio equipment for rapid exchange of information. The District also has installed radio equipment in all the division offices (where water orders are received and processed) as well as in the operating headquarters. Effective communication between operating personnel (zanjeros, water clerks, and their supervisors) and farmers improves the efficiency of daily operations. It also provides instant communication among personnel during emergencies. Better communication permits greater operational flexibility in switching water deliveries from one farmer to another, thereby reducing operational spills. The Water Department currently has 11 base stations and 147 mobile radios.

2. Personnel Training

As operational methods are changed and structures built or modernized, the District has established a training program for all Water Department employees. New employees tour the District facilities to gain an overall view of the operations. Specialized training in water measurement and management is given to new zanjeros and hydrographers. Each division has monthly meetings to discuss operations, conservation, safety, etc. Daily on-the-job training is an integral part of the training program. As conditions in the field change, supervisors inform their personnel of new procedures and methods.

H. ADMINISTRATIVE PROGRAMS

Administrative options are available to public distributors of water. An example is the establishment of incremental water rates to encourage water conservation.

1. 13-Point Program

In July 1976, the District supplemented its existing water conservation efforts with a stringent 13-Point Program (Table IV.3). The overall goal of the 13-Point Program was to improve water use efficiency within the District and reduce inflow to the Salton Sea.

The achievement of these goals has been completed. Three reservoirs (Sheldon, Fudge, and Sperber) have been constructed. An accelerated program to reconstruct farm outlet (tailwater) boxes has been instituted. More zanjeros and hydrographers are being used. A tailwater assessment program is in progress to monitor tailwater and assess penalties for excessive discharges. Evaporation ponds have been constructed at 17 locations along the New and Alamo Rivers. In cooperation with the USBR, a study is in progress to determine seepage along the East Highline Canal. Drainage water is available on request. Lateral prioritization for the concrete-lining program has been assumed by the District. To determine actual water deliveries versus water ordered and billed, the District's computerized billing system is being modified. Radio equipment has been installed in water operation personnel vehicles, and the District's water conservationist works directly with farmers on irrigation management programs. Water Control personnel make off-schedule water deliveries after determining that there is excess water, contacting field personnel, and locating a second party willing to receive the excess water.

TABLE IV.3
IMPERIAL IRRIGATION DISTRICT 13-POINT PROGRAM
FOR WATER CONSERVATION

Point	Description	Targeted Water Loss Reduction
1	Construct water regulating reservoir on Westside Main Canal	Operational spills
2	Reconstruct farm outlet boxes, as required	Tailwater runoff
3	Assign adequate water regulating personnel to provide more efficient deliveries	Tailwater runoff and operational spills
4	Conduct daily inventory of surface field discharge and charge users who waste water an assessment for that day equal to three times the scheduled water rate	Tailwater runoff
5	Develop surface water evaporation ponds	Inflow to Salton Sea
6	Conduct preliminary studies for a regulating reservoir on Central Main Canal	Operational spills
7	Conduct study of the water recovery lines paralleling the East Highline and Westside Main Canals to recover seepage that is now going into the drainage system and the Salton Sea	Canal Seepage
8	Provide free drainage water to persons willing to pump and use it	Inflow to Salton Sea
9	Continue the concrete-lining program	Canal Seepage
10	Initiate a record of accrued water use by computerized billing	Tailwater Runoff
11	Install radio equipment in all water conservation-related vehicles to provide immediate communication	Tailwater runoff and operational spills
12	Initiate irrigation management services program	Tailwater runoff
13	Deliver water off-schedule when possible	Tailwater runoff

2. Water Conservation Advisory Board

The District Board of Directors recognized the need to continue and expand water conservation efforts and in 1979 appointed a Water Conservation Advisory Board made up primarily of District farmers. The purpose of the Advisory Board is to make recommendations to the District Board regarding the implementation of additional water conservation measures. Meetings of the Advisory Board were held on a regular basis, and resolutions were adopted by the Board, setting forth suggested additional water conservation measures. The recommendations presented by the Advisory Board were reviewed by the District Board and, in 1980, the District Board adopted a 21-Point Program intended to supplement the original 13-Point Water Conservation Program adopted in 1976.

The Advisory Board has remained active since its formation and continues to work with the District Board in order to obtain more efficient water use within the District.

3. 21-Point Program

The 21-Point Water Conservation Program recommended by the Water Conservation Advisory Board and adopted by the District Board is set forth as follows:

(1) The District shall establish a penalty of $100.00 for the unauthorized adjusting of delivery gates, which results in a change in the amount of water being delivered. Furthermore, whenever a water order is in the process of being pumped through a sprinkler or gated pipe system and the operator-user experiences a mechanical failure of the subject equipment, said operator-user shall be permitted to discontinue his water delivery for a period of not more than 3 hours. The free time permitted under this schedule shall be considered as separate instances, but in no event shall the combined hours so considered exceed 3 hours before a triple charge is to be assessed.

(2) The concept of installing gate control devices of a standard design is recommended and supported, such devices to be installed on structures accommodating gates that are owned, operated and maintained, as well as regulated, under the jurisdiction of the District and its personnel.

(3) Application of the assessment charge shall apply on the same basis to all types of irrigation, with the following exceptions:

(a) The percentages of surface runoff allowed when water is being used to irrigate plowed or flat unseeded ground shall be 5 percent for the last day of said irrigation; no measurable waste shall be allowed for any previous days.

(b) When water is being run in furrows to germinate crop seeds and establish a stand, no assessment charge shall be made unless one of the two consecutive measurements showing 15 percent or more runoff is made between 12:00 noon and 6:00 p.m.

(4) In the event a water user is receiving more than his confirmed order, said surplus shall be subtracted from his surface runoff for the purpose of determining if his runoff is excessive.

(5) In no event shall any water user be assessed unless his runoff is 15% or more of his running order irrespective of the quantity of water the user is receiving.

(6) Any surface runoff measurement made within 4 hours after the District has reduced the quantity of water delivered shall apply to the order in effect before said change.

(7) The application of an assessment charge based on waste measured after the delivery gate is closed shall apply on the same basis as when water was actually running. Any assessment made after the gate is closed shall be based on the order last running.

(8) In no event shall the user pay more than triple the normal charge for water, except when he adjusts the delivery gate without permission.

(9) All net proceeds from surface runoff assessment charges shall go into a special fund for conservation purposes other than the concrete lining of ditches.

(10) All District personnel whose duties include checking of surface runoff will initial any waste assessment sheet issued.

(11) Changes can be made for the last day of a run by notifying the District not later than 3:00 p.m. of the preceding day.

(12) When a water user requests an adjustment in the quantity of water delivered not to exceed 2 ft^3/s, the District shall be obliged to honor the same if it is within the ability of the District's system to accommodate such a request and if the water user

notifies the zanjero in advance of beginning his daily run. The zanjero of said run shall obtain approval to make said change from his respective superior or section.

(13) A reduction in the water order shall be made to apply to the last 12 hours water is run, provided that the District is notified in advance but not later than 3:00 p.m. of the day preceding the time the order is changed. No penalty shall be charged for said reduction as long as the same does not exceed 50 percent or 5 feet of the order as confirmed, whichever is less. Water that is returned with notice after 3:00 p.m. or that exceeds the quantity that this rule authorizes shall be subject to an assessment equal to two times the regular water rate.

(14) By notifying the District before 3:00 p.m., orders can be adjusted for the last 12 hours of the run, up to 50 percent of the confirmed order or 5 ft^3/s, whichever is less.

(15) Finish heads can be ordered up to 3:00 p.m. of the day preceding the day of delivery.

(16) By notifying the District before 7:30 a.m. of the last day of a run, an order can be adjusted up to 50 percent, without penalty.

(17) One-day orders shall be checked by the appropriate District employees on the same basis as any other water order. For the application of the assessment charge, the first waste measurement shall not be made later than 18 hours after the beginning of the day's water delivery.

(18) The District shall secure whatever additional radio equipment is necessary to improve communications between the farmers and Water Department personnel.

(19) The Water Department of the District shall make 6 waste water recorders available to be installed at various locations within the service area boundaries as defined.

(20) The District shall prepare a monthly water information bulletin for distribution that shall include information submitted to the District by a committee to be appointed by the Water Conservation Advisory Board and from other sources as required to assist the water user in using all water beneficially.

(21) Routine canal cutouts shall be accomplished once every 8 weeks, except when special circumstances require more frequent cutouts.

The 21-Point Water Conservation Program (Supplement 1) defines the required policies adopted by the Board to administer and enforce the 13-Point Program.

I. TAILWATER REDUCTION PROGRAM

As stated earlier, District policy prohibits the wasting of water. After the 13-Point Program was accepted in 1976, the District began a system of assessments for tailwater quantities in excess of 15 percent of deliveries. The District also requires tailwater structures to be in adequate repair. This 13-point program represents a real and visible effort by the District to conserve water. The heads that are not checked are those through service pipes and deliveries of less than 1 ft^3/s. Thus, essentially 100 percent of normal irrigation running heads are checked daily.

J. EDUCATIONAL PROGRAMS

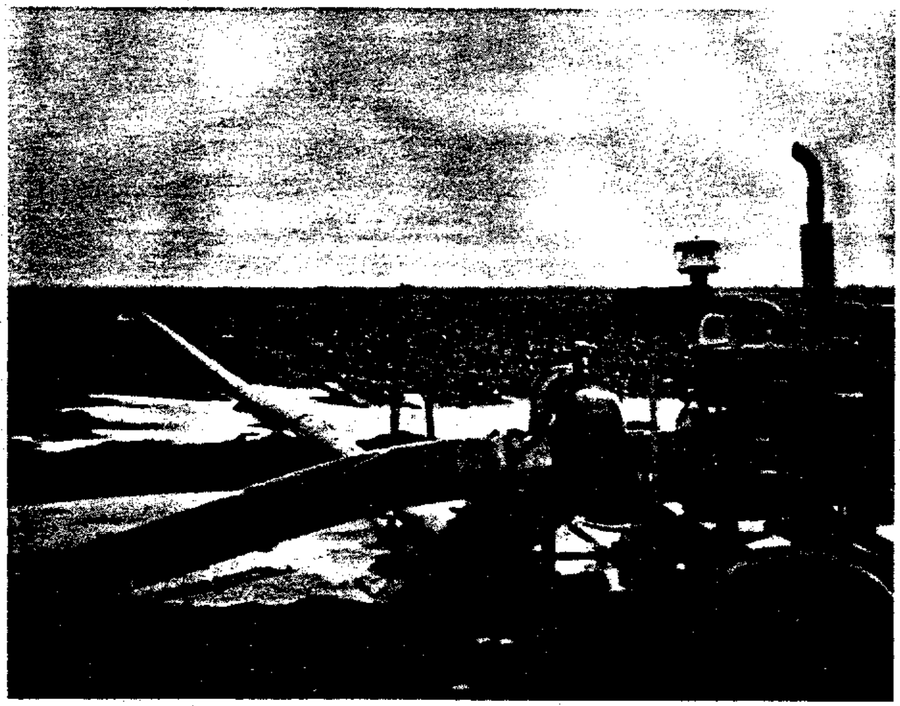
The District has implemented a series of educational programs to encourage water conservation within the Valley. These programs range in complexity from public meetings to full-scale demonstrations. A newsgram is inserted with monthly power bills, frequently containing brief articles on water conservation.

1. Demonstration Tailwater Recovery Systems

Tailwater runoff is usually necessary to properly refill the moisture removed from the root zone on the tail end of the field. Using a pond to collect tailwater and a pump to recycle it, subsequent runoff can be reduced. In 1983, the District conducted tailwater recovery demonstrations with a portable diesel pump and aluminum pipe (Exhibit IV.1). The demonstrations were successful, and tailwater was reduced to 15 percent.

2. Modified Demand Irrigation Trial

The District normally delivers water for a period of 24 hours and attempts to deliver within 10 percent of the farmer's order. The farmer can usually determine his field's moisture requirements within 10 percent. But, even if the District delivers the exact amount of water the farmer ordered, it may not be the quantity needed to irrigate the field. That is why many farmers have said, "I wish the District would deliver the amount of water the field needs, not what I order." With this thought in mind, the Modified Demand Irrigation Trial was conceived.



THE BENEFITS OF A TAILWATER RECOVERY SYSTEM BEING DEMONSTRATED BY THE DISTRICT.

EXHIBIT IV.1

This project was started on a single zanjero run which consists of five laterals off the East Highline Canal. Water orders on this run can be terminated up to 4 hours before or after the regular ending time. The analysis of the irrigation efficiency on the run has not yet been completed, but, if properly managed and implemented, tailwater should be reduced on this run. Since changes are being made at odd times, a substantial increase in District labor has been required to implement this program.

3. Public Meetings

During July through October of 1983, the District held several meetings with area farmers to discuss current water issues, including water conservation. Meetings were held on July 26 in El Centro, September 6 in Calexico, September 11 in Holtville, and October 8 in Calipatria. Each meeting was attended by Board members and staff. Attendance by area farmers varied from 15 to 30 persons at each meeting.

The format of each meeting varied slightly, but the presentations by the District were consistent: summary of Decision 1600 (Supplement 2) by the State Water Resources Control Board and the District's rights to Colorado River water; outline of the proposals regarding water conservation measures being considered by the District staff; and report on the status of discussions with the MWD regarding a water exchange agreement. The farmers at each meeting had many questions and some offered recommendations.

In addition to holding public meetings, the District mailed out a questionnaire to 478 agricultural water users to receive input from them on their present water conservation measures. Most of the 147 responses indicated that the District was delivering water efficiently (Exhibit IV.2).

An internal survey of District water delivery personnel was also conducted to obtain input (to be evaluated) on the District's Water Conservation Program.

4. Field Irrigation Demonstration and Training

Proper management and measurement of irrigation water in the District are necessary to achieve high irrigation efficiency. Field irrigation demonstrations in conjunction with the Irrigation Scheduling Program (discussed in the next section) have been conducted. The agenda usually consists of discussions on the following subjects:

Irrigation Scheduling with the Neutron Probe
How to Measure Water
Cutback Irrigation
Irrigation with Minimum Tailwater

A limited irrigation training program was implemented in 1983. Several farmers and irrigators were trained to observe and record the stream advance and tailwater in border strip irrigation. Adjustments were then made during the irrigation to reduce the amount of tailwater. Unit irrigation efficiencies of 90-95 percent were achieved during the training period.

Previously, unit irrigation efficiencies of 70-75 percent had been recorded. During 1984, these fields were monitored and unit efficiencies increased to 85-95 percent. When unit irrigation efficiencies approach these levels, case-by-case evaluations must be made to determine whether irrigation uniformity is being adversely affected to the extent that crop production problems or soil salinity problems will result. Although limited in size, this program was very successful (Exhibits IV.3 and IV.4).

5. Regulation No. 39 - Tailwater Structures

In 1984, the District revised Regulation No. 39 of its Rules and Regulations (Supplement 3) to provide for standard tailwater structures and to facilitate the reasonably accurate measurement of tailwater discharge from each farmed unit.

K. COOPERATIVE PROGRAMS

The District has been involved in various cooperative studies and programs, researching innovative water conservation methods. Different levels of involvement have been required of the District.

1. Irrigation Scheduling Program

a. History and Summary of Program

The District, in cooperation with the USBR, started a demonstration Irrigation Scheduling Program in September 1981. The purpose was to identify on-farm opportunities for conserving water and to determine the costs that farmers would incur. The program involves about 10,000 acres on which neutron probes (see Exhibit IV.5) were used to monitor soil moisture depletion, schedule irrigation dates, and determine the amount of water to be applied. Water level recorders were also used to measure delivery and

478 Questionnaires Mailed
147 Responses Received
Narrative Questions - Answers Are A Crossection Of Responses

Imperial Irrigation District
Water Conservation Questionnaire
August 1984

		Yes	No
1.	How many acres are you farming? *40 To 7000 Acs. 1129 Avg.*		
2.	Do you agree that we (District and Water users) need to have a water conservation program?	*131*	*5*
3.	Is the District doing enough in its Water Conservation Program?	*72*	*50*
	Should it do more, or less? *51 - More, 7 - Less*		
4.	Do you understand the way IID orders water from Imperial Dam and has to control it?	*117*	*19*
5.	Do you think the District's 13-point and 21-point conservation programs are adequate?	*87*	*26*
	If not, what changes would you make? *More Flexibility, Cut Tail Water, Meter Waste Water, Publicize Program*		
6.	Do you feel the District is doing a good job in delivering water?	*111*	*20*
7.	What are your recommendations for changes in the system of delivering water? *More Flexible In Changing Orders, 12-Hour Orders More Punctual With Deliveries*		
8.	How can we, District and water user, reduce our use of water? *Line Canals, Change To Sprinkle Or Drip Irrigation, Flatten Fields By Laser Better Management & More Care By Farmer When Ordering, Better Cooperation Between Farmer & I.I.D.*		
9.	Are your water orders delivered correctly as ordered?	*63*	*22*

100% of the time	*19*
95% of the time?	*37*
90% of the time?	*44*
Less than 90% of the time?	*24*

		Yes	No
10.	Do the zanjeros on your laterals cooperate to the best of their ability, within their IID assigned constraints, such as treating all farmers equally?	*113*	*17*

11. How do you determine how much water to order? Check all that apply:

Experience	*128*
Irrigator suggestion	*44*
Analysis of records, humidity, soil, neutron probe	*22*

Exhibit IV.2

		Yes	No
12.	Do you keep records of your previous orders on each particular field, so you can look back a year and see how much you ordered under similar conditions?	99	34
13.	Do you use multiple-day orders?	111	19

If not, why not? *Better Control From Alternate Days, Only Good For Small Acreage, Only When Germinating Seed, Cost Of Labor*

		Yes	No
14.	Do you think multiple-day orders would result in less water applied?	81	38

If not, why not? *Same Amount Goes On, Last Day You Get Stuck With Too Much, Land Requirement Doesn't Change, Wouldn't Cover Ground As Fast*

		Yes	No
15.	Would you be in favor of zanjeros starting their runs 2 hours later each day?	35	91

In this case zanjeros would spend the first 2 hours of their day moving water off-schedule.

For example: Zanjero starts work at 6:00 a.m., moves 3 or 4 heads off-schedule, then starts regular run at 8:00 a.m. The additional time would allow irrigators to "push out" their slower rows.

16. Since zanjeros often start at 6:00 a.m., a change at 7:25 a.m. can send him all the way back to readjust every gate. Do you believe we should:

		Yes	No
a.	Continue as we do?	81	
b.	Start deliveries two hours later?	29	
c.	Take no changes after 5:45 a.m.?	17	
d.	Other?		

17. What impact would a delay of two hours in starting delivery of water each day have on you? *Possible Labor Costs, Start Too Late, 13% No Impact, Harmful When Hot, Won't Work With Sprinklers & Row Crops*

		Yes	No
18.	Is the moving of water in canals for some farmers having an impact on you?	34	90
19.	Should farmers be allowed to order a large standing head and then ask zanjeros to move it around through the canals to other fields in different canals?	45	82
20.	If so, should they then be allowed to go ahead of other water users with orders placed for that day?	28	94
21.	Should farmers with large standing heads have their water moved ahead of water users who have been held over for one day?	27	101

	Yes	No

22. If it becomes necessary to move water to another field in another canal, what do you believe would be an appropriate charge for it?

$100	19
$ 50	33
$ 0	46

Other water districts charge $50 to $100.

	Yes	No
23. Should the maximum finish head be limited to a reasonable amount, say 5 feet instead of some of our present ones of as much as 20 feet which are usually followed by a request to move them as soon as the field is finished?	84	37
24. Should we establish a maximum head which the District would be expected to move?	69	48

25. What would it take for you to order water on a weekend in the same way you do during weekdays? Most Do Already – 32 % Possibly 58 %
Cheaper Rates, Irrigators To Work Weekends

26. What should be the limit of one-day orders for each field?

	Yes	No
Unlimited?	97	
10 per year?	9	
How many per year? ______		

	Yes	No
27. Would you like to have 12- and 18-hour orders in addition to the present 24-hour orders?	88	36
28. Is it possible for pumps to break down for 6 hours each day?	64	55

29. What do you believe would be an appropriate penalty for a farmer's irrigator moving gates without permission? Fine $25 To $500
& No Penalty To "Death"

	Yes	No
30. Do you feel there is excessive surface runoff (tailwater) from irrigation in the District?	56	74
31. From your land?	19	108
32. Should District continue current "triple-charge" assessment for tailwater in excess of 15%?	81	44
33. Should tailwater be limited to 10%?	34	
limited to 5%?	5	
34. Should District measure and charge for excess tailwater by total quantity?	54	62

		Yes	No
35.	Please list reasons you need to have some tailwater runoff. *Subbing Seed, Wash Off Salt, Wet Lower End Of Field, Can't Let Water Sit - Scalds, Row Crops Require It*		
36.	Should the District charge annual fee for each tailwater structure?	10	115
37.	Should each field have only one tailwater structure?	46	72
	If not, why not? *Some Fields Are Split Leveled, Too Costly*		
38.	Would you be willing to group fields so that all fields in one area contained the same crop (i.e., cotton) in order to make it easier to install a water saving system?	21	96
39.	Do you understand the advantages of using recorders?	92	35
40.	Can recorders indicate your irrigator's efficiency?	85	24
41.	Do you want District help/advice regarding on-farm water use?	64	62
42.	Are you participating in District's irrigation management service program (IMS or Doug Welch's program)?	20	108
43.	Do you think the water conservation service provided by Doug Welch to a few volunteer farmers should continue to be provided free to them?	59	48
44.	Do you believe it would be helpful to have a water conservation specialist in each division (with a background similar to Doug Welch)?	49	58
45.	Would you attend or send your irrigator to meetings that would explain water saving methods?	98	26
46.	Have you tried using the evaporation information printed in the Imperial Valley Press?	27	102
47.	Do you know how to use that information?	47	72
48.	Recognizing that fines are not tax-deductible, should we change any of our systems to install fines instead of service charges, or vice versa?	30	76
	Which ones? *3x Charge To Service Charge, All To Service Charge*		
49.	Where would you like to see a regulation pond or reservoir constructed? *End Of Westside Main & E.H.L., Z Drain, On Ash, North End Dam Area*		

		Yes	No
50.	Would you be willing to use the surface water that runs off another water user's field?	32	79
51.	If not, why not? Salt, Herbicides, Trash, Too Hot In Summer		
52.	Have you ever been to Imperial Dam and had a briefing on the All-American Canal system?	57	74
53.	Would you be willing to travel to Imperial Dam on an Imperial Irrigation District rented bus to learn more about the system?	107	16

Please sign (optional) this questionnaire and state which division(s) of Imperial Irrigation District provides your water. List any additional comments on separate sheets of paper and attach them.

If you have any questions, please call Mr. Welch at 339-9393.

Please return questionnaire within ten (10) days.

Many Responses Had A Variety Of Suggestions & Comments.

tailwater (see Exhibits IV.6 and IV.7). The growers in the program were contacted monthly to review their progress. Fifty-six growers have cooperated in the program to date.

b. District Staff and Dollar Contribution

	1982	1983	1984
Salaries	$ 22,794.00	$ 68,383.20	$ 75,947.83
Benefits and Overhead	7,750.29	23,250.29	26,581.74
Vehicles	5,964.22	17,893.98	21,755.22
Totals	$ 36,508.51	$109,527.47	$124,284.79

c. Acreage Served

	1982	1983	1984
Alfalfa	7,553	7,479	5,477
Sugar Beets	2,094	2,430	2,259
Wheat	2,583	2,018	3,013
Cotton	2,468	1,397	2,561
Melons	70	312	0
Asparagus	140	70	0
Onions	72	0	359
Tomatoes	142	0	140
Carrots	80	140	0
Barley	0	72	0
Bermuda	0	0	270
Total Acres	15,202	13,918	14,079
Total Sites	251	216	200

d. Scheduling

Two probe readers monitor the sites once or twice a week. The data is then plotted on Soil Moisture Charts. Irrigation dates and the amount of water to apply are predicted by the Water Conservation Specialist. The grower is notified of the recommendation by telephone and/or a postcard.

e. Summary of Data

	1982			1983			1984		
	Water "/Ac.	T.W. %	Unit Eff.	Water "/Ac.	T.W. %	Unit Eff.	Water "/Ac.	T.W. %	Unit Eff.
Alfalfa	77.0	12	88	67.6	12	88	65.6	13	87
Cotton	60.2	16	84	63.8	17	83	53.8	17	83
Wheat	*	11	89	24.9	12	88	34.1	13	87
Sugar Beets	*	24	76	49.9	22	78	55.6	24	76
Asparagus	*	23	77	*	23	77	--	--	--
Watermelons	*	26	74	*	26	84	--	--	--
Carrots	--	--	--	*	12	88	--	--	--
Tomatoes	--	--	--	--	--	--	*	30	70
Bermuda	--	--	--	--	--	--	*	10	90
Onions	--	--	--	--	--	--	53.0	22	78

*entire crop season not monitored

f. Impacts and Benefits

Yields have been about the same and irrigation efficiency has improved. The average unit irrigation efficiency for all of the fields monitored in the program is 86 percent.

2. Drain Water Reuse

The Drain Water Reuse Program initiated in 1976 permits farmers to utilize drainage water, free of charge, for irrigation or reclamation. The effect of this program is to reduce inflow to the Salton Sea and encourage more efficient water use. California Department of Fish and Game, in cooperation with the District, utilizes drain water to maintain approximately 1,400 acres of wildlife habitat adjacent to the Salton Sea. The District has also created a 100-acre wildlife habitat in the New River bottom using reclaimed water.

3. Imperial Valley USDA Irrigated Desert Research Station

The District has cooperated for many years with this important USDA facility in several ways.

a. Underground Soil Lab

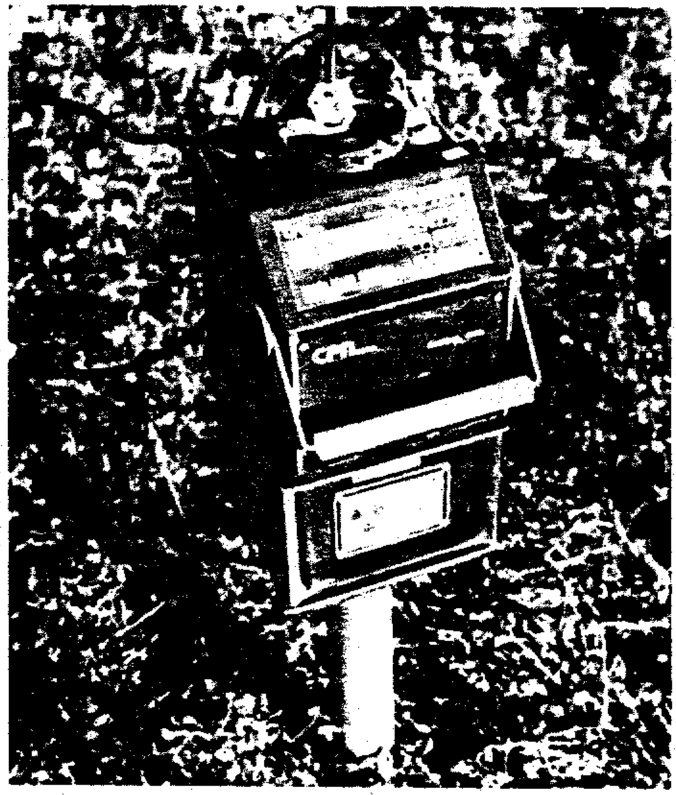
In 1969, the District helped the Research Center install an underground soil column laboratory.

THE SUPERVISOR OF WATER CONSERVATION EXPLAINING HOW TO IRRIGATE WITH MINIMUM TAILWATER.

EXHIBIT IV.3

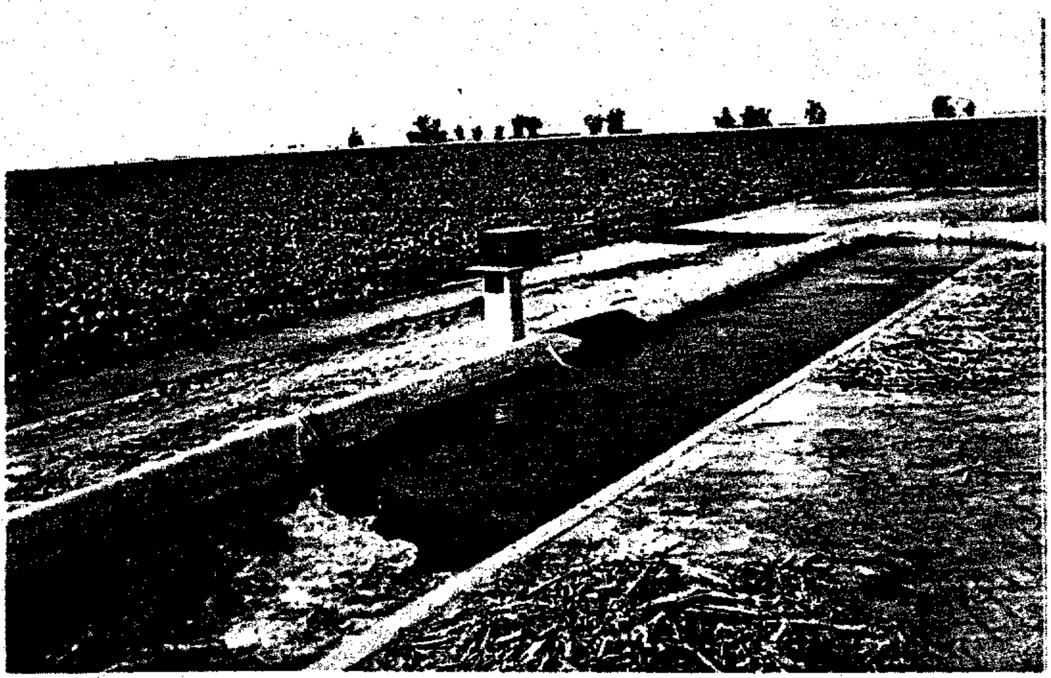
AN IID IRRIGATION TECHNICIAN TRAINING AN IRRIGATOR TO USE NEW IRRIGATION TECHNIQUES.

EXHIBIT IV.4



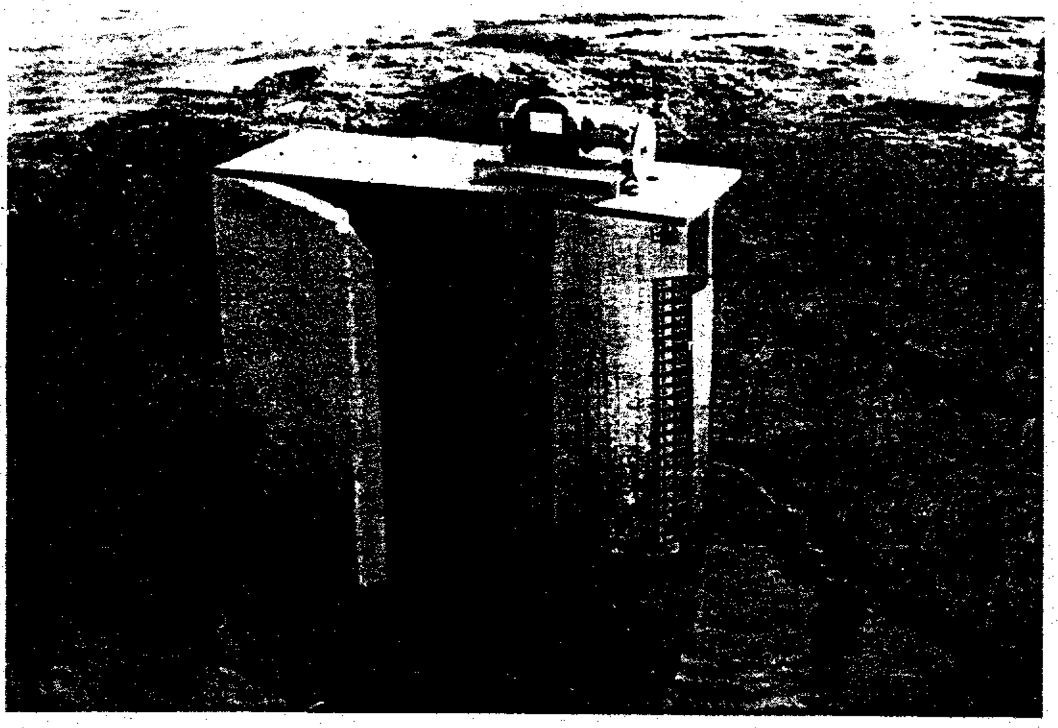
A NEUTRON PROBE IS BEING USED TO MEASURE THE MOISTURE IN THE SOIL.

EXHIBIT IV.5



A WATER-LEVEL RECORDER IS RECORDING THE DELIVERY OVER A BROAD-CRESTED WEIR.

EXHIBIT IV.6



A WATER-LEVEL RECORDER INSTALLED ON A STANDARD TAILWATER STRUCTURE.

b. Lysimeter

In 1970, the District constructed a 13-foot-wide by 21-foot-long by 5-foot-deep weighing lysimeter to determine water consumption by crops for use by the Research Center.

c. Reservoir

In 1971, the District helped construct a 2-AF reservoir and pumping station at the Research Center.

d. Evaporation Data

In 1974, the District installed evaporation pans and other weather instruments at four representative locations throughout the Valley, in cooperation with the USDA Research Center in Brawley. A weather station with pan had been in service since 1960 at the Brawley Research Center. Daily measurements from the 5 stations have been furnished to the local papers and published daily. Farmers can use this information to calculate the amount of water the crop has used.

The use of pan evaporation information for irrigation scheduling requires setting up a water budget, which includes maintaining records on the available water supply in the soil and balancing the soil water input (irrigation) with the crop water output (evapotranspiration).

Knowledge of the soil crop factors and the use of the daily reported pan evaporation enable the farmer to calculate how much of the input water has been used by the crop. A forecast of the irrigation requirements is based on the historical pan evaporation data. The predicted irrigation schedule can be adjusted to compensate for any variation in weather conditions that may be different from the historical average.

In balancing the irrigation input against the evapotranspiration output, a grower simply balances the soil water content by periodic irrigation at certain times to replace the quantity used by the crop. The steps to implement this method are:

(1) Determine the water-holding capacity of the soil.

(2) Determine the rooting depth of the crop.

(3) Steps 1 and 2 will result in the amount of water available to the crop when the soil is saturated.

(4) Measure irrigation water added to the crops's rooting depth in the soil.

(5) Conduct daily measurement of evaporation (Pan E) from a standard Class A Weather Bureau evaporation pan and convert to the appropriate crop evapotranspiration (Crop ET) using the monthly crop factor given in Table IV.3

(6) Subtract the amount of water lost by evapotranspiration as calculated in step 2 from the amount of water in the crop's rooting depth, step 3.

(7) When the water lost by evapotranspiration is equal to approximately one-half to two-thirds of the available water in the crop's rooting depth, replace it by irrigation.

An example of a procedure to use for this water budget method is shown in Table IV.4 for an irrigation interval during April for a sugar beet crop. In this example, at least 3.9 inches of irrigation water replaced in the rooting depth were needed on the 18th day to maintain the proper supply of water in the soil. With each irrigation input, the water budget is adjusted to start the water use cycle over again.

This method of scheduling irrigation by the use of pan evaporation data can be used on all crops for which crop factors are known. Research is continuing to obtain factors for more crops and to verify the accuracy of the ones currently being used. Use of the method will allow growers to maintain soil moisture for crops accurately and at levels that are optimum for maximum production. This method also gives growers a procedure for determining the exact time to irrigate and how much water to apply. With the information now available, even the next date of irrigation can be predicted.

e. Irrigation Efficiency

In 1977, the District began a 5-year Irrigation Efficiency Study, in cooperation with the USDA Research Center, by furnishing labor, material and equipment to measure on-farm inflow and outflow for about nine farms. The data collected were analyzed by USDA and U. C. Extension specialists; the results were published (ASCE, 1984) (Supplement 4).

TABLE IV.4
CROP FACTORS FOR CONVERSION OF PAN EVAPORATION TO CROP EVAPOTRANSPIRATION

Month	Wheat[a]	Barley[b]	Beets[c]	Cotton[d]	Alfalfa[e]
January	0.32	0.51	0.75	-	-
February	0.73	0.66	0.67	-	-
March	0.78	0.82	0.64	-	0.70
April	0.79	0.57	0.66	0.31	0.65
May	0.57	-	0.69	0.30	0.66
June	-	-	0.59	0.57	0.73
July	-	-	-	0.51	0.84
August	-	-	-	0.49	0.67
September	-	-	-	0.59	0.73
October	-	-	0.21	0.25	0.70
November	-	-	0.41	-	0.78
December	0.043	-	0.49	-	0.50

[a]Irrigated on December 20; Harvested on May 25.

[b]Irrigated on December 23; Harvested on May 14.

[c]Irrigated on October 1; Harvested on July 4.

[d]Irrigated on April 1; Harvested on November 25.

[e]Irrigated on previous fall.

Source: MacKenzie, 1976

TABLE IV.5
SAMPLE CALCULATIONS FOR IRRIGATION SCHEDULING
USING DAILY PAN EVAPORATION INFORMATION

Month of April	Input (In.) 1/ Irrigation	Output (In.) Pan E	Crop Factor	Crop ET	Soil Water Balance (In.) 2/ Carry-over	Remaining
2	4.2	0.29	0.7	0.20	1.80	5.80
3	0	0.20	0.7	0.14	5.80	5.66
4	0	0.30	0.7	0.21	5.66	5.45
5	0	0.43	0.7	0.30	5.45	5.15
6	0	0.42	0.7	0.29	5.15	4.86
7	0	0.32	0.7	0.22	4.86	4.64
8	0	0.34	0.7	0.24	4.64	4.53
9	0	0.16	0.7	0.11	4.53	4.24
10	0	0.41	0.7	0.29	4.24	4.10
11	0	0.20	0.7	0.14	4.10	3.96
12	0	0.20	0.7	0.14	3.96	3.69
13	0	0.38	0.7	0.27	3.69	3.46
14	0	0.33	0.7	0.23	3.46	3.23
15	0	0.39	0.7	0.27	3.23	2.96
16	0	0.39	0.7	0.27	2.96	2.69
17	0	0.52	0.7	0.36	2.69	2.33
18	0	0.34	0.7	0.24	2.33	2.09
19	0	0.27	0.7	0.19	2.09	1.90
20	4.0	0.19	0.7	0.13	1.90	5.77
21	0	0.36	0.7	0.25	5.77	5.52

1/ Net water actually added to the crop's root zone in the soil. Surface runoff and drainage waters not included.

2/ Sugar beet crop grown in a clay loam soil with a 3-foot rooting depth is calculated to hold 6.0 inches of available water. Irrigations scheduled when two-thirds of available water were used or when the soil water balance was depleted to 2.0 inches.

f. Drain Study

In 1980, the District installed a drain sump pump and power line to a plot on the Research Center in the New River bottom to study tile problems.

g. Use of Drain Water for Irrigation

In 1983, the District installed a sump pump, 0./25-mile pipeline, and electric power to a project sponsored jointly by USDA and DWR to study the feasibility of using drain water from the Alamo River, in rotation with canal water, to grow certain crops. This will be a 4-year study.

h. Advisory Committee

For many years, the District has participated by having a representative as a member of an Advisory Committee to the Research Center.

4. USDA Soil Conservation Service

The District showed its concern for soil and water conservation long ago when it entered into a Memorandum of Understanding with the USDA, Soil Conservation Service (SCS), on March 6, 1945. During this 40-year working relationship, there has been a substantial commitment in personnel and money by both agencies toward the conservation of Imperial Valley's soil and water resources. The District furnishes the SCS with a full-time secretary to assist with the conservation work load generated by this office. In addition, the District supplies office space and equipment to SCS at its El Centro Division office building at a substantially reduced rental rate. The cost to the District in its support of SCS soil and water conservation activities is about $39,000 per year.

To satisfy the conservation needs of the intensively farmed Imperial Valley, the SCS maintains a permanent staff of two conservationists and one technician. In 1982, in response to the District's need for an increased water conservation effort, the SCS designated the Imperial Valley as a "target area." This designation allowed the SCS to establish an Irrigation Water Management Team consisting of an engineer, a conservationist and a technician to carry out this program. Through a one-on-one grower contact, the Team performs detailed irrigation and salinity evaluations for land users and implements water conservation measures where applicable. Efforts have been successful largely because of SCS's history as a leading technical agency working directly with the growers in solving their conservation needs. The SCS contribution to the water conservation effort in Imperial Valley is about $167,000 per year in salaries and equipment.

5. University of California Extension Service (Farm Advisors)

The District has cooperated with the University of California Extension Service Farm Advisory staff for many years, mainly by furnishing water flow and water quality data. Most recently, the District participated in the California Irrigation Management Information System (CIMIS) and mobile laboratory programs sponsored by the University in conjunction with the DWR.

Discussions of water use and water requirements were held recently with University of California Extension Service personnel. Extension Service professionals in Davis, Riverside and Imperial Valley indicated their willingness to work with the District in developing and implementing a conservation plan, especially in working with water users. District staff acknowledge the necessity of interagency coordination and propose that a technical advisory group be formed.

L. ON-FARM WATER CONSERVATION PRACTICES

Imperial Valley farmers have been practicing conservation from the beginning of development in the Valley. The land must be properly tiled, graded, smoothed and otherwise prepared for the uniform application of water to the crop. Valley farmers have installed over 29,000 miles of underground tile, and 80 percent of farm head ditches have been concrete lined by individual landowners. Other management practices outlined earlier are practiced by Valley farmers. The District, through its Water Conservation Coordinator, encourages use of all of these available tools and practices.

The USDA, Agricultural Stabilization Conservation Service (ASCS), supplements the District's program by providing on-farm water conservation assistance to growers on request. Exhibit IV.8 outlines current programs available to Valley farmers from the ASCS.

1. Land Leveling

New ideas and techniques in land leveling to evenly distribute and conserve water have been used by many of the Valley's growers. Incentive programs such as cost sharing would increase utilization of these methods.

COUNTY COMMITTEE
EVELYN [illegible]-CHAIRPERSON
[illegible]-VICE CHAIRPERSON
[illegible]-REGULAR MEMBER

COUNTY EXECUTIVE DIRECTOR
MARILYN MCABEE

IMPERIAL COUNTY ASCS FARM LETTER

IMPERIAL COUNTY ASCS OFFICE
[illegible] NORTH [illegible] STREET, SUITE [illegible]
EL CENTRO, CALIFORNIA [illegible]
TELEPHONE (619) [illegible]
MONDAY - FRIDAY
8:00 A.M. - 4:30 P.M.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

Eligibility for participation in all programs administered by ASCS is established under law without regard to race, religion, sex or National Origin.

ANNOUNCEMENT

THERE ARE SEVERAL CHANGES IN THE 1985 PROGRAM. PLEASE READ CAREFULLY AND CALL THIS OFFICE WITH ANY QUESTIONS.

The 1985 ACP for Imperial County is aimed at solving the high priority conservation problems as identified by the County Committee. The County Committee would like to encourage you to consider whether you have any of these high priority problems which need solving to conserve our soil and water to reduce pollution.

THE SIGN-UP PERIOD WILL BE DECEMBER 3 - DECEMBER 21, 1984.

After the sign-up date has been closed selection procedures will be as follows:

1. The County Committee will select applications based on when the work is to be done, conservation priority and the funds available. It is not . first come first served.

2. After the selections, the applications are referred to Soil Conseravtion Service (SCS) for a needs and feasibility determination.

   WHEN YOU HAVE BEEN NOTIFIED THAT YOUR APPLICATION HAS BEEN SELECTED YOU MUST VISIT SCS AT 1285 BROADWAY, EL CENTRO WITHIN 30 DAYS, OR THE PRACTICE APPLICATION WILL BE CANCELLED.

3. If approval is given by SCS you will receive written notification from this office and you may then begin your practice.

   A PRACTICE WHICH HAS BEEN STARTED PRIOR TO APPROVAL BY THE COUNTY COMMITTEE AND SCS IS NOT ELIGIBLE FOR A COST-SHARE PAYMENT.

By law, cost-sharing is limited to agricultural producers. For program purposes, an agricultural producer is an ownwe, landlord or tenant of a farm used to produce commercially grown agricultural products, such as grain, row crops, trees, vines, livestock, etc.

THE MAXIMUM PAYMENT ANY ONE PERSON CAN RECEIVE CANNOT EXCEED $3500.00 PER FISCAL YEAR.

Exhibit IV.8

THE HIGH PRIORITY PRACTICES OFFERED FOR 1985 ARE:

Practice	Cost-Share
WC-4 Irrigation Water Conservation	50% of cost not to exceed $3500.00.
WC-4 Tailwater Recovery System	70% of cost not to exceed $3500.00.

SP-35 Water Management Systems for Pollution Control	50% of cost not to exceed $3500.00.

Soil Conservation Service is responsible for technical determinations. They will determine the proper depth and spacing needed to solve your conservation problems. Cost-Shares will not be approved if their recommendations are not met.

THE LOW PRIORITY PRACTICES OFFERED FOR 1985 ARE:

Practice	Cost-Share
SL-7 Windbreak Restoration or Establishment	50% of cost not to exceed $3500.00.
WC-1 Water Impoundment Reservoirs	50% of cost not to exceed $3500.00.
WL-2 Shallow Water Areas for Water Fowl.	50% of cost not to exceed $3500.00.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

Imperial County ASCS Office
390 North 6th Street, Suite 19
El Centro, California 92243

OFFICIAL BUSINESS
Penalty for Private Use, $300

BULK THIRD-CLASS MAIL
POSTAGE AND FEES PAID
USDA-ASCS
PERMIT No. 285

THIRD CLASS BULK RATE

2. Concrete-Lined Head Ditches

Valley farmers have concrete lined more than 2,400 miles (80%) of their head ditches. The concrete head ditch saves water in two ways: it reduces seepage in the ditch itself and it improves the ability to manage the water in the field.

3. Proper Use of Basic Tools

a. Shovel

In the hands of an experienced irrigator, a shovel is probably the most important water-saving tool. The shovel and the irrigator wielding it have more influence over the efficiency of an irrigation than anything else. The shovel is used to divert and direct the stream of water to the right place, at the right time, and for the appropriate length of time. It is used to rebuild broken berms and build small dikes to raise the height of the water in the furrow.

b. Tablitas

Tablitas are small wooden slats used to control the stream size entering a furrow through a pipe. As the water advances down the furrow, the tablita is used to maintain the even advance of the water. Once the water reaches the lower end of the field, it is cut back at the head to a lower flow. Usually, by the time this cutback is made, the infiltration rate in the upper end of the field has decreased and most of the water flows to the lower portion of the field. Water that does not enter the soil by the time it reaches the end of the furrow usually flows off the field as tailwater. By reducing the incoming stream size with the tablita, tailwater is reduced and water is conserved.

c. Recordkeeping

The maintenance of good records of irrigation dates, amounts applied, aplication rates, herbicide and fertilizer applications, cultural practices, etc., enables the farmer to plan and administer his farming operations more efficiently. Most farmers in the Valley have good recordkeeping practices.

4. Innovative Tools

a. "Fasets"

"Fasets" (variable size orifice caps, Exhibit IV.9) are also used to control the stream size entering a furrow. These caps were developed by a local grower. They allow the grower to select the stream size that best fits the size of the order, field length, slope, soil moisture and texture. They can also be used to reduce the stream size applied in the wheel row.

b. C-Taps

The more rapid infiltration can be achieved by the use of dikes in the furrow to raise the elevation of the water surface closer to the seed bed, slow the velocity, and increase the wetted surface. This practice is often accomplished locally by the use of plastic or metal taps (Exhibit IV.10). The plastic C-Tap was developed locally by a Valley grower to conserve water in his fields. They are now sold commercially in the Valley.

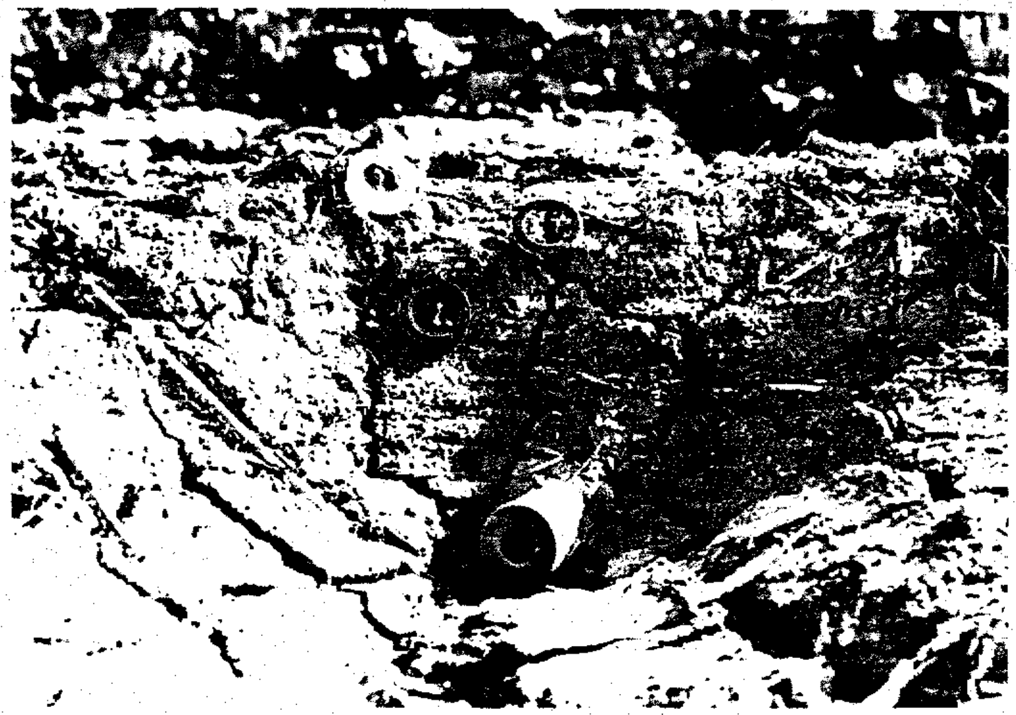
Some farmers use earth dikes protected by polyethylene sheeting or paper sacks. This practice is costly because of the extra labor needed to set the dikes and to remove them before cultivation. Another method used to accomplish this is construction of a V-ditch along the tail end of the furrows and installation of the outlets from the V-ditch high enough to back up the water for a distance. The outlets from the V-ditch are protected from erosion by plastic sheeting.

A farmer in Calipatria has developed a device to build earth dikes automatically in the irrigation furrow at any specified interval. The device is attached to a planter or a cultivator involving no extra labor. This device is just being marketed, and its use may be limited to locations where ground slopes are generally steeper than average.

c. Aquatic Vegetation

Growth of aquatic weeds in the canals is a continual maintenance problem. The canals must be dried up regularly to reduce the standing biomass. In addition, mechanical removal of the aquatics is often necessary. As the pieces of other aquatic plants float in the water, they can plug up checks, delivery gates, irrigation tubes and sprinkler pumps.

Again, local growers have met the challenge and have developed various methods to remove the debris from the water. Exhibit IV.11 shows the hydraulically driven aquatic plant remover. The flowing water drives the paddle wheel, which drives the revolving screen. At the top of the screen, bristles pull the moss from the screen, and the moss falls onto the platform. If the debris is



VARIABLE SIZE CAPS "FASETS" ARE USED TO CONTROL THE STREAM SIZE.

EXHIBIT IV.9

TAPS ARE USED TO ACHIEVE INFILTRATION AND REDUCE TAILWATER.

EXHIBIT IV.10

not removed from the irrigation water, the siphons or tubes used to distribute the water into the furrows will become plugged, and the advance of the water down the furrows will be very erratic. Excess tailwater can result. Therefore, to achieve high efficiencies, as much debris as possible must be removed from the water.

Hardware cloth, placed in front of each tube, is another method used by local growers to prevent clogging (Exhibit IV.12).

All of these methods are costly but necessary to improve water distribution and conservation.

M. PLANNING FOR WATER CONSERVATION

The District has cooperated with many agencies, including the USBR, to improve water management. The USBR annually reviews the operations of the District to evaluate compliance with water contracts. Since 1977, the USBR has been engaged in a study called "Water Conservation Opportunities, Imperial Irrigation District, California (USBR, 1984b)." Total expenditures for this study have been $988,000. The Bureau's current efforts are focused on an evaluation of the East Highline Canal with principal emphasis directed toward eventual concrete lining.

N. ACCOMPLISHMENTS OF WATER CONSERVATION PROGRAM

The estimated total capital expenditure by the District through 1984 for structural water conservation facilities is about $30 million. In 1984, more than $2 million was expended on structural features, and approximately $700,000 was included in the District budget for nonstructural measures. The accomplishments of specific water conservation programs follow:

1. Canal Lining

Since this measure was initiated in 1954, approximately 871 miles of distribution system canals have been lined with concrete. Landowners have contributed nearly $5 million, and the total District expenditure has been approximately $25 million.

2. Regulatory Reservoirs

The District has four regulating reservoirs in operation, providing a total storage of 1,570 AF. Sites have been selected for two additional reservoirs, which will have storage capacities of between 200 and 400 AF each. Approximately $3.3 million has been expended for construction of regulating reservoirs through 1984.

3. Seepage Recovery Lines

The District has constructed 6 miles (12 0.5-mile sections) of drainage lines parallel to the East Highline Canal to recover canal seepage losses. Total funds expended for seepage recovery lines have been $492,000, and approximately $50,000 per year is budgeted for operation, maintenance and power costs associated with the seepage recovery program.

4. Farm Delivery and Outlet Structures

Since 1976, farm delivery structures have been installed or reconstructed using standard designs to provide for more effective water control and measurement of farm deliveries. Farm outlet structures also have been installed or reconstructed to facilitate measurement of excessive tailwater runoff, which is the basis for assessments in addition to the normal water charge.

5. Automatic Controls

The District has installed remote electronic monitoring and control devices at 22 locations, including the All-American Canal and four regulating reservoirs. More than $1 million has been expended on these facilities.

6. Evaporation Ponds

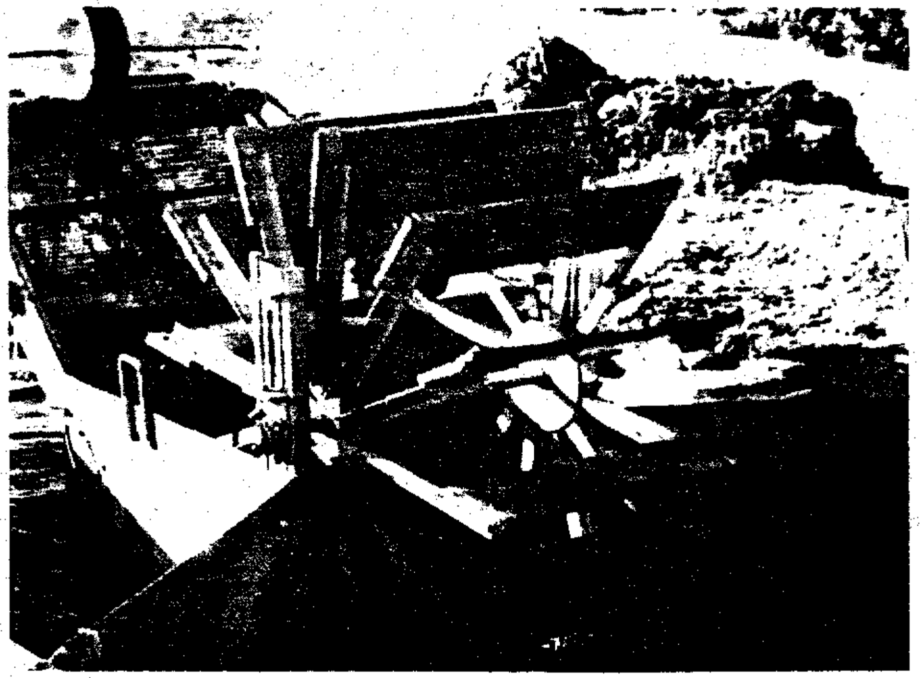
Evaporation ponds have been constructed at 17 locations in the New and Alamo Rivers to reduce inflow to the Salton Sea. Through 1984, $1.5 million has been expended on this program.

7. Irrigation Management Services Program

The Irrigation Management Services (IMS) Program was begun in 1981 as a 2-year program sponsored by the USBR to provide farmers with information on how to increase irrigation efficiency. The program is being continued through 1985 with an annual budget of approximately $170,000.

8. Improved Communications

All mobile equipment and vehicles assigned to operations have radio equipment for the immediate exchange of information with supervision and Water Control. The District also has installed radio equipment in all the division offices (where water orders are received and processed), as well as in the Operating Headquarters. Expenditures to improve communication capability in the District total over $100,000.



A HYDRAULIC MOSS REMOVER IN A FARM DITCH CONSERVES WATER BY REDUCING PLUGGING OF PIPES, WHICH IMPROVES DISTRIBUTION UNIFORMITY IN THE FIELD.

EXHIBIT IV.11

HARDWARE SCREEN BEING USED TO REMOVE MORE MOSS.

EXHIBIT IV.12

9. Educational Programs

Educational programs and training sessions for farmers and District personnel are imperative to the overall success of a water conservation program. The District, through the Water Conservation Supervisor, has implemented an educational program for farmers participating in the IMS program. Monthly newsgrams, often containing conservation information, are mailed out with water and power bills.

10. Administration

Specific accomplishments under this section are integrated with overall management of the District. These activities, such as water user penalties for tampering with gates or assessments for excessive tailwater runoff, are clearly associated with the Water Conservation Program. A review of personnel requirements and duties would be undertaken as a part of prudent District management.

A "Modified Demand Irrigation Trial" was implemented on one zanjero run in August 1983 and includes about 11,000 acres.

It is still too early to have any significant data on the results of this program in terms of any water savings or its possible effects on District operations.

11. Water Savings

The total impact of the Water Conservation Program, expressed either as total acre-feet per year or the accumulated water savings since 1976, has not been determined because of the time constraints. However, there appears to be a downward trend in inflow to the Salton Sea, as well as water deliveries at Drop No. 1 on the All-American Canal, since the 13-Point Program was implemented in the mid-1970s. This is illustrated in Exhibit IV.12 (B-E, 1983). Further evaluation is needed to estimate historic and projected future water savings from the existing Water Conservation Program. In broad terms, there is a trend of increasing diversion at Drop No. 1 and increasing inflow to Salton Sea for the 1965-1974 period but a definite decreasing trend from 1975 to 1982.

The District's past water conservation programs have reduced losses and agricultural drainage into the Salton Sea. This latter measurement is the prime indicator that shows the overall effectiveness of water conservation. Due to variations from year to year in cropping patterns, weather, economic conditions and other factors, it is necessary to compare Salton Sea inflow for a series of years to obtain a reasonable measure of reduced inflow.

An Analysis of the column headed "Imperial Irrigation District Inflow" for two 15-year periods shows the following:

Period	Average Yearly District Inflow
1951-1965	1,040,000 AF
1966-1982	951,000 AF
Reduction in Inflow	89,000 AF

This reduction is the direct result of the District's water conservation programs during the past 15 years.

The water deliveries to the District show a slight decline from a level of about 2,840,000 AF per year to less than 2,700,000 AF per year. Inflow to the Salton Sea increased in the mid-1970s, but amounts have declined to less than those of the early 1960s. These declines occurred while irrigated acreage increased about 6 percent since the 1960s. The amount of water received by the District has decreased from about 6.6 AF per irrigated acre to 5.8 AF per acre, or about 12 percent. The annual inflow per acre to the Salton Sea has also declined, representing a change from about 2.2 AF per acre to 1.9 AF per acre, a reduction of about 14 percent. It is noted that during the mid-1970s the annual per-acre inflow to the Salton Sea remained about the same. This indicates that the total increase in inflow to the Sea from the District during that period could have been due to the increase in irrigated areas.

12. Summary

The Imperial Irrigation District has demonstrated, through actions and policies of its Board of Directors, an awareness of the need for efficient water use within the District and the need to reduce inflow to the Salton Sea from the District. Water conservation measures, both structural and nonstructural, have been implemented and have been effective to varying degrees.

Additional water conservation measures have been suggested by the DWR (1983) and the USBR (1983). These measures are the subject of ongoing studies and, when completed, will provide a basis for expanding current water conservation practices. The Board will continue to ensure that available water supplies to the District will be used in a reasonable and beneficial manner.

DERIVATION OF COMPONENTS OF
INFLOW TO SALTON SEA

(Values in 1000 Ac.Ft.)

Year (1)	Imperial Valley Inflow: Measured and Estimated Inflow in New and Alamo River and Vicinity (2)	Less Inflow from Mexico (3)	Less Component from Coachella Canal (4)	Less Subsurface Inflow from West (5)	Imperial I.D. Inflow (6)	Coachella Inflow: Coachella Valley Inflow (7)	Plus Coachella Canal (8)	Total (9)
1950	1,143	38		29	1,076	65		65
51	1,206	37		29	1,140	108		108
52	1,298	37		29	1,232	86		86
53	1,378	32		29	1,317	63		63
54	1,304	31	0	29	1,244	72	0	72
1955	1,119	49	5	29	1,036	85	5	90
56	1,170	78	10	29	1,053	71	10	81
57	1,084	73	15	29	967	53	15	68
58	1,080	106	20	29	925	56	20	76
59	1,145	124	25	29	967	57	25	82
1960	1,183	123	29	29	1,002	70	29	99
61	1,168	117	34	29	988	84	34	118
62	1,223	134	39	29	1,021	113	39	152
63	1,295	141	44	29	1,081	133	44	177
64	1,011	106	49	29	827	121	49	170
1965	996	113	54	29	800	137	54	191
66	1,110	105	54	29	922	131	54	185
67	1,126	98	54	29	945	129	54	183
68	1,108	107	54	29	918	136	54	190
69	1,068	105	54	29	880	142	54	196
1970	1,122	101	54	29	938	130	54	184
71	1,202	109	54	29	1,010	138	54	192
72	1,177	113	54	29	981	148	54	202
73	1,184	119	54	29	982	149	54	203
74	1,236	113	54	29	1,040	143	54	197
1975	1,229	101	54	29	1,045	159	54	213
76	1,289	104	54	29	1,002	161	54	215
77	1,130	109	54	29	938	147	54	201
78	1,096	100	54	29	913	137	54	191
79	1,203	146	54	29	974	141	54	195
1980	1,201	158	54	29	960	134	54	188
1981	1,121	158	54	29	880	150	54	204
1982	1,048	159	54	29	806	145	54	199

(1) Calendar Year.
(2) Measured flow in New and Alamo Rivers at Salton Sea plus inflow from drains flowing directly into Sea.
(3) Measured surface flow of New and Alamo Rivers at International Boundary.
(4) Portion of seepage from Coachella Canal estimated to enter Salton Sea via Imperial Valley.
(5) Subsurface flow entering Imperial I.D. from west which is intercepted by drainage system.
(6) Column (2) less (3), (4) and (5).
(7) Coachella inflow as reported by USGS through 1972. From 1973 amount taken from Lowell Weeks' declaration of August 31, 1983 (Exhibit 11) and is "drainage water discharge from Coachella Valley."
(8) Same as Column (4).
(9) Sum of Columns (7) and (8).

CHAPTER V
OTHER PROGRAMS
FOR FUTURE CONSIDERATION

CHAPTER V

OTHER PROGRAMS FOR FUTURE CONSIDERATION

A. INTRODUCTION

Programs that may be considered in the future conservation plans are discussed within this chapter. Some of these are partially incorporated within existing conservation programs; others are included within the 1985 Plan presented in Chapter VI. The following programs will be reevaluated after more extensive monitoring and evaluation.

B. STRUCTURAL PROGRAMS

1. Improvement of Measurement Structures

Changes to the existing weir/orifice measuring structures to improve their accuracy should be investigated. Easily operated and accurate measuring devices must be found. It possible, the District should work with industry to develop equipment.

2. Pipelining

Conveyance of water in pipelines is an effective but costly method to eliminate seepage and evaporation, although some water would be lost through leakage at joints. Pipelining of laterals constructed through populated areas in and adjacent to cities should be considered if funds become available.

3. Desalinization

Desalinization of Colorado River water, or reduction of salts upstream of delivery to the District system, would eventually reduce the need for water to leach out the excessive salts. Reclaimed land would then be able to be irrigated with less water.

C. OPERATIONAL PROGRAMS

1. Standard Delivery Head Increments

Standardization of delivery head increments could allow "matching" of orders to reduce spills.

2. Sequential Water Deliveries

Sequential water deliveries sometimes may allow timely movement of water deliveries.

D. ADMINISTRATIVE

1. Water Allotment

The District has never had to allocate or limit water deliveries. In fact, within system capacities, the District attempts to deliver to each water user the amount of water ordered. However, water allocation is widely practiced in California and the irrigated West. This is frequently the case where project water supplements groundwater. It is also necessary where the project supply is barely adequate to meet crop consumptive requirements.

Water can be allocated in several ways, including:

a. Delivery allocation, e.g., 1 $ft^3/s/20$ acres, or other acreage amount.

b. Annual uniform limitation, e.g., 5 AF/Acre, perhaps allowing transfers between water users.

c. Crop allocation, e.g., consumptive use plus leaching requirement divided by 70-percent efficiency.

d. Allocation prorated on assessed land value.

2. Water Rates

The District's current water rate schedules are included in Supplement 1. It is frequently suggested that water rates be increased substantially to encourage conservation. However, others, including members of the Water Conservation Advisory Board, suggest that increased charges be applied only to those who have excessive tailwater runoff or use excessive amounts of water. These suggestions would lead to either tailwater charges, such as the current tailwater assessment, or escalation of water tolls, such as those in Water Rate Schedule No. 1A, or both.

The 13-Point Program provides a foundation to increase the rates for annual water use. Item 10 provides for "The initiation of record to reflect accrued water use per acre per parcel through computerized billing process for period July 1 to June 30 of each year." The District's water rates have been set and are revised periodically to provide the necessary funds to meet budgeted expenditures, primarily operation and maintenance of the water systems. However, in 1976 and thereafter, the rates have been increased to provide funds for the District's comprehensive water conservation programs. The current amount is $1.75/AF over the water delivery cost. It is expected that periodic consideration will be given to implement escalating rate structures to further encourage water conservation, especially if new programs are not effective.

3. Incentives

Proposals have been presented by local water users for the District to offer reduced rates as incentives to encourage such on-farm conservation measures as installation of tailwater recovery systems or reservoirs. Another suggestion has been to reduce rates to water users whose irrigation management practices do not permit excessive tailwater runoff. These proposals should be studied periodically and brought before the Board for consideration.

Several types of incentives could be established, based on volumetric measurements of tailwater.

a. Deferral of tailwater assessment.

b. Cash awards.

c. Credit on future water bills.

d. Recognition in the form of award dinners, Irrigator of the Year, publicity, etc.

4. Conservation Plan for Nonagricultural Use

The District should consider coordinating with local agencies and users to develop water conservation plans for municipal, industrial and recreational/wildlife uses.

E. ON-FARM

1. Crop Restrictions

A conservation tool often suggested is to reduce demand by growing crops having low water requirements. This should not be necessary in Imperial Valley in the foreseeable future and is not an acceptable measure for the District to consider at this time.

2. Restricting Tailwater Runoff

Many suggestions have been made to restrict the rate of tailwater runoff by physical means such as installing smaller pipes. The current maximum size of outlet pipe in tailwater structures or any inlet to District drains is 12 inches in diameter. Proposals that this size be restricted by inserting an 8-inch-diameter "choker" pipe, or similar devices, have been made. To date, these suggestions have not been implemented because such restrictions would cause trash to plug the pipe more readily. It seems more practical to reduce the quantity of tailwater by improved irrigation management or other alternatives such as tailwater recovery.

3. Reduce Excessive Leaching

Programs could be developed to control leaching on sandy soils.

F. PROGRAMS SUGGESTED BY OTHERS

1. USBR Proposals

According to the USBR study (1984b), "cost-effective water conservation opportunities are available to the District." Exhibit V.1 shows the features proposed for consideration. The USBR proposed "a natural progression for consideration of further detailed study leading to authorization and funding of the water conservation program implementation would concentrate initially on these features producing the most predictable results."

In October 1984, the USBR initiated an additional study, "Imperial Irrigation District Canal Lining and System Improvement" (CLSI) in which the District has agreed to participate. The first purpose of the CLSI investigation is "...to further study the application of water conservation measures...," and the initial effort will be to acquire additional water flow data.

Several administrative programs are suggested:

a. Distribution based on total demand (sequential irrigation).

b. Enhanced water accounting/automatic data processing.

c. Sliding water rates/incentive rebates.

Exhibit V.2 is the proposed implementation schedule (USBR, 1984b). This schedule indicates that construction would take place beginning in 1990, with the interim period dedicated to additional studies.

COMPARISON OF WATER CONSERVATION FEATURES
Water Conservation Opportunities
Imperial Irrigation District, California

Feature	Potential Water Conservation (acre-feet)	Capital Cost ($ Million)	Annual Cost ($/acre-foot) 1/ Ammortization Period (20 Yrs)	(40 Yrs)	Further Study Period (Years)	Potential Implementation Period (Years)	Responsible Agency 2/	Relative Degree of Certainty of Results
1. Structural features unaffected by operational changes:								
Canal Lining (340 mi.)	104,000	74	73	60	2-5	5-10	Fed/Partner	High
System Automation-East Highline Canal Only	25,000	8.5	35	29	3-5	5-10	Fed/Partner	High
Onfarm Water Measuring Devices	-------	4.5	--	--	1-5	5-10	Fed/Partner	Unknown 3/
Sub total	129,000	87.0	69	57				
2. Structural features possibly affected by operational changes:								
Large Regulating Reservoir	20,000	24.4	125	104	4-5	5-15	Fed/Partner	High (Initial) Moderate (Long Term)
Spill Interceptor System (no right-of-way cost incl.)	70,000	13	19	16	4-5	5-15	Fed/Partner	High (Initial) Low (Long Term) 5/
Sub total	90,000	37.4	43	35				
3. Distribution system management programs:								
Computerized Delivery System Scheduling	------	.3	--	--	2-5	5-20	District/Fed	Unknown 6/
Administrative Programs	------	----	--	--	5	5-20	District/Irrigator	Unknown 7/
Sub total		.3						
4. Onfarm management programs:								
Field Scheduling	135,000	.5	19 8/	19 8/	5+	20+	Irrigators/District	Low 9/
Administrative Information and Incentive Programs	-------	-----	--	--	5+	20+	District/Irrigators	Unknown 10/
Sub total	135,000	.5	19	19				
Total	354,000	124.9 11/	43 8/	37 8/				

1/ Capital costs are amortized at 8.125 percent and include interest during construction for equal annual expenditures.

2/ District and other beneficiaries of conserved water willing to finance cost of conservation measures.

3/ More precise measurement of farm deliveries is essential to improved conservation, but actual savings would be difficult to assess.

4/ Potential source of water conserved could be reduced through the implementation of system scheduling and more precise water ordering. However, improved operational flexibility provided by the reservoir may compensate by reducing operational spills elsewhere in the system.

5/ Features such as system automation, regulating reservoirs, and system scheduling could significantly reduce the spills that would be collected by the spill interceptor system.

6/ Computerized delivery system scheduling can improve operating efficiency, but the impacts of a computerized delivery system scheduling program are difficult to assess without a 2- to 3-year demonstration program.

7/ Would include a modified demand operation, information programs, and changes in policy. However, the effectiveness of these administrative programs could not be assessed without a multi-year demonstration program.

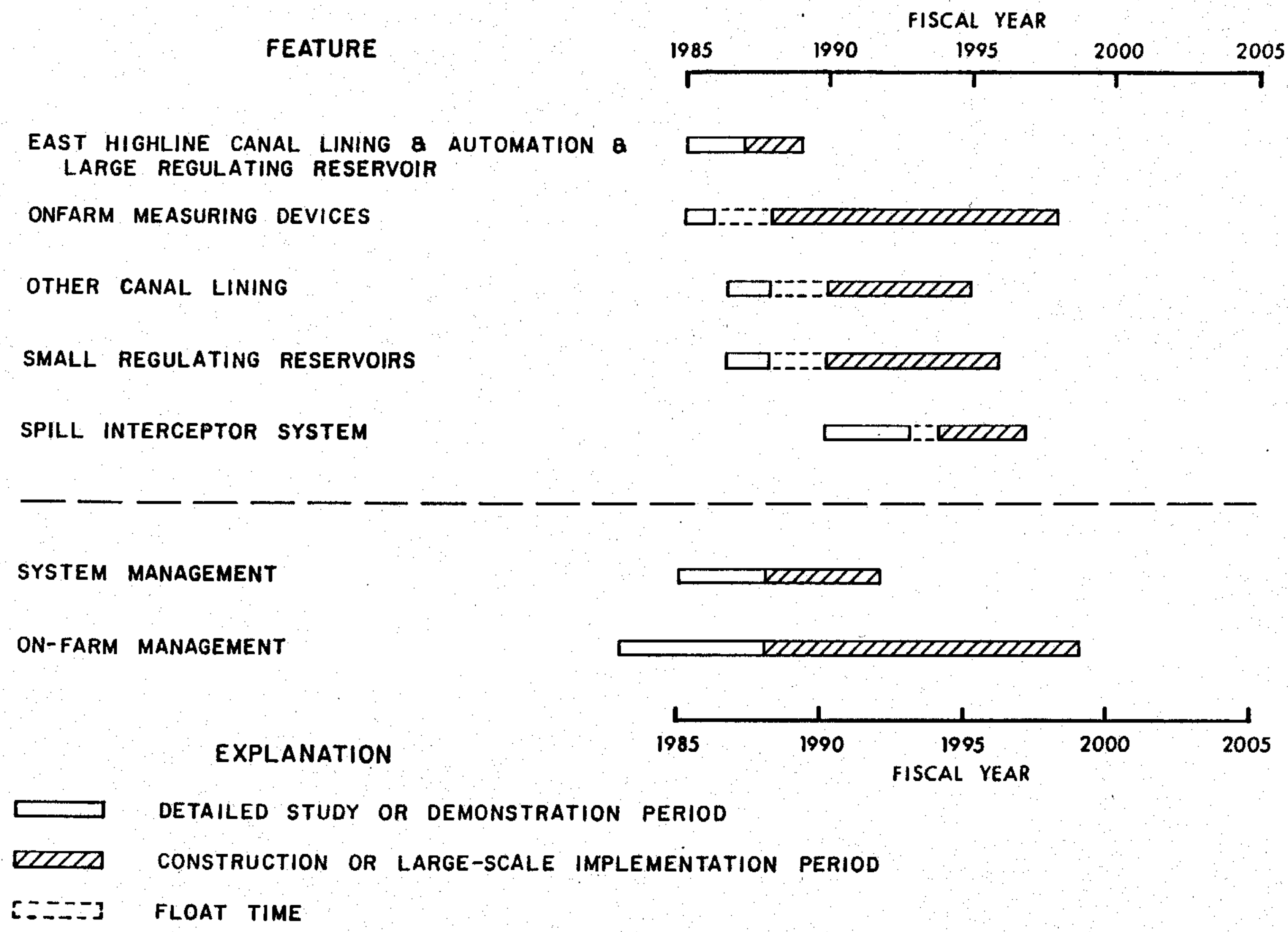
8/ Would include annual operating costs of $2.5 million for providing field irrigation scheduling.

9/ The ultimate impacts are unknown because success requires full implementation and use by water users. Full implementation may not be possible and maximum implementation may require up to 20 years. The ultimate level of implementation will depend on the effectivene of the ongoing WMC demonstration program.

10/ These programs would require a multi-year demonstration period in order to assess their impacts on conservation.

11/ Excludes capital costs for Feature 3. Computerized delivery system scheduling operational costs would total an additional $500,000 annually for 450,000 acres served.

Exhibit V.1



WATER CONSERVATION IMPLEMENTATION SCHEDULE

Exhibit V.2

2. Department of Water Resources

The DWR suggested three major areas of water distribution improvement (DWR, 1981):

a. Nonstructural

(1) Provide more flexible deliveries.

(2) Improve on-farm irrigation techniques.

(3) Expand use of irrigation management scheduling.

b. Structural

(1) Line canals/laterals.

(2) Expand seepage recovery system.

(3) Construct more regulating reservoirs.

(4) Expand electronic monitoring controls.

(5) Expand use of tailwater recovery systems.

c. Line All-American Canal

The DWR made an attempt to estimate the annual amount of water that some of these improvements would save. These estimates were based on District records and not on any extensive field investigation. The DWR estimates water savings from lining the All-American Canal, lining District canals and laterals, and expanding the seepage recovery program (DWR, 1981). For all the remaining improvements identified, DWR estimates that "A combination of these programs... could save 228,000 AF, including 178,000 AF of leaching water and tailwater and 50,000 AF of canal spills." The DWR also suggests in the same table that "...an operations plan is required to determine the most effective and economical level of development for each program [to] complement the others, not duplicate."

3. Citizens' Salton Sea Committee: June 1, 1976

Early in 1976, the Citizens' Salton Sea Committee asked the District Board for its cooperation in finding solutions to the rising elevation of the Salton Sea. District directors and staff met with this group several times, mainly to provide data. On June 1, 1976, a subcommittee of this group presented written recommendations to the Board (Supplement 5). The following points highlight some of the major recommendations from this subcommittee:

a. Initiate an immediate program of water use and control the flow of drainage to the Sea.

   (1) Begin spreading water on District lands, U.S. Fish and Wildlife lands, and volunteer private lands using drainage water at no charge.

   (2) Reduce delivery (to District) at Drop No. 1 by 5 percent below 1975 usage.

   (3) Study intercept or lateral to be placed along east side of Alamo River; pond and reuse in Vail system.

   (4) Initiate a program to educate water users; increase efforts to patrol wastewater offenders.

   (5) Accelerate current program of management ponds.

b. Establish an incentive conservation water-use program.

   (1) Increase water rate for 5 AF/Acre per year or less by $0.50 to $1.00 for lands using drainage pipes larger than 8 inches in diameter or outflow greater than 1.2 ft^3/s with a 6-inch head. Apply sliding scales beyond 5 ft^3/s AF/acre; add $1/AF for each step (5-8, 8-12, 12-16, 16-20, 20-24 AF/acre).

   (2) All funds collected more than $3.50/AF should be set aside for system improvements to reduce waste and improve delivery techniques.

c. Allow any water user to apply in order to improve outlet.

   (1) Install standard and certified structure with an 8-inch-diameter drain pipe 6 inches below field grade at landowner's expense.

d. Long-Range Recommendations.

   (1) Contact State of California Water Resources Control Board and Border States Commission seeking assistance in planning and implementation of conservation plan.

(2) Establish long-range planning board, including representatives of political subdivisions (including Mexico) to coordinate all planning regarding Salton Sea and Colorado River delta.

(3) Engage a technical investigator.

4. Individuals

In 1974, Ralph Gilbert, a Valley farmer, submitted recommendations for consideration by District Water Department staff relating to water conservation, primarily tailwater runoff (Supplement 3.) Some of these ideas were incorporated into the District's 13-Point Program in 1976. These suggestions are summarized below:

a. Surface runoff charges: When tailwater exceeds 10 percent of delivery, triple charge should be applied for amounts over 10 percent.

   Exception 1: Limit to 5 percent for no crop.

   Exception 2: For runs longer than 1 day, charge for excess only for the day water is wasted.

b. Measurements: Three measurements, 7 hours or more apart, used to determine amount of runoff; measurement permitted after delivery stopped.

c. Notices: Immediate notice to water user upon determination of excessive runoff.

d. Adjusting Deliveries: If requested to do so, the District should make reasonable effort to adjust delivery.

e. Reducing or Withholding Orders: the District should reduce orders only where very high percentage of delivery can be prevented from going into Salton Sea.

   Notify water user and irrigator immediately.

f. Explain foregoing program to all water users; try the program for 6 months, including information on runoff measurements.

CHAPTER VI
WATER CONSERVATION PLAN

CHAPTER VI

WATER CONSERVATION PLAN

A. INTRODUCTION

This chapter discusses the ongoing water conservation programs and identifies the additional efforts that will further enhance the District's and its water users' effective use of Imperial Valley's valuable water supply. In conjunction with the Water Conservation Plan (Plan), a comprehensive water management plan to guide future water supply, distribution, use and disposal will be necessary to ensure adequate water supplies and effective use. Such a plan is required to focus on water management activities, establish priorities, and allocate monetary and water resources available to the District.

The Water Conservation Plan consists of:

1. Procedures to measure and analyze water supply, distribution, use, and disposal to define current quantities; the resulting data will serve as a basis for defining priority actions.

2. Potential programs that may be useful for effective water management.

3. Evaluation and pilot programs to assess the effectiveness of potential actions.

4. Placing major emphasis on cooperation, coordination, and education.

5. Evaluation of accomplishments and effectiveness of measures taken.

The District's water operations staff is composed of technicians, professionals and managers experienced in operating and maintaining the District's irrigation and drainage system. Its major responsibility is to deliver water to users in the amount ordered, at the time required, and at the lowest possible cost.

The water users are experienced in applying water to crops, in the proper quantity, at the right time, and uniformly so that the crops that are produced will yield the maximum profit. There is strong need for integration and understanding of District's and water users' operational capabilities, limitations, and needed adjustments to further maximize water delivery and use effectiveness.

The short-term program is as follows:

1. Develop criteria needed for a water measurement program to assess deliveries, spill, tailwater, consumptive use and leaching quantities.

2 Establish a planning function to develop policies and long-range plans.

3. Define the current water conservation program, including costs.

Before long-term programs can be implemented, detailed analyses of data gathered during the short term will be required. However, several long-term goals that can be identified are: concrete line laterals and most main canals, install remotely operated water control structures, and computerize water control system including monitoring, controlling, and recordkeeping functions of District water operations. The District will continue to coordinate and cooperate with water users to achieve higher practicable overall efficiency in water use in the Imperial Valley.

The Plan must be capable of changes as conditions mandate. It should serve as a flexible framework in which to guide and coordinate activities. As a general plan, it will need to be reviewed annually to analyze its effectiveness. During these reviews, the proposals offered by various individuals and groups, described in Chapter V, will be reexamined and considered for possible implementation. This will apply especially to such proposals as water charges or incentives, which should be considered if other programs are not as effective as anticipated.

B. NEED FOR ACCURATE MEASUREMENTS

Clearly, accurate recordkeeping of water received by the District and its distribution, delivery, use and disposal is basic to the operation of the District. The accuracies of present waterflow measurements, while acceptable for overall distribution of water and billing purposes, are not necessarily sufficient to determine specific types of losses. Seepage losses, although apparently significant in annual quantities, based on District records, are not a large percentage of the total water inflow. Losses are known to vary with location and time. If flow measurements are accurate only within 10 percent and percentage seepage losses are less, such losses cannot be determined with reliability.

The purpose of the water measurement program is to:

1. Document clearly how water is used and disposed of within the District.

2. Provide information to establish water use and conservation criteria.

3. Measure conservation accomplishments.

For each element of the internal District water balance, there are wide-ranging differences in measurement requirements, including precision and accuracy, reliability, manpower needs, processing techniques and costs. Because of the large amount of water delivered, the number of farms, miles of canals, and complexity of the distribution and drainage system, any method or procedure to measure, compile, process, evaluate and report necessarily involves a significant expenditure of management effort, funds and manpower. The compilation of data required could range from minor expansion of the present program, through some additional measurement and estimation and some reevaluation of these data, to detailed measurements of all or nearly all of the water quantities involved.

The USBR/IID cooperative study during the next 2 or 3 years will emphasize the accurate measurement of water flows, which will require the installation of additional measuring devices and recorders.

C. WATER MEASUREMENT AND ACCOUNTING PROGRAM

The water measurement and accounting program has two principal objectives at this time. The first and foremost objective is to make measurements necessary for the delivery of water. These are termed "operational measurements." The secondary objective is to obtain those measurements helpful and necessary in determining the disposition of water within the District. Over the years, the measurements required for operational purposes have been taken, recorded and published in an annual report.

Measurements made by the District include:

1. All-American Canal flows.
2. Deliveries from All-American Canal to Main Canals.
3. Lateral Canal Headings.
4. Farm deliveries.
5. Spills (sample).
6. New and Alamo River flows at Mexico and at discharge to Salton Sea.
7. Drainage ditches discharging into Salton Sea.
8. Drainage sump discharge.
9. Crop acreage.
10. Weather data including rainfall, wind and evaporation.
11. Seepage recovery data.
12. Salinity.
13. Other measurements, as required.

The supplemental measurements necessary for preparing a water balance have not been made in any significant number until recently. The principal objective of the District is to deliver water for farm use, which it does effectively. Information for water balance, however, requires additional measurements, including a more accurate assessment of tailwater runoff, canal spills, and generally those processes that involve the disposal of water.

Historically, the District has made numerous measurements of flows required for operational purposes. Within the last several years, this policy has changed and measurements are currently beinq made of canal spills, lateral headings, field deliveries and tailwater structures, as well as tile drainage quantities and qualities. Measurements have also been made of the amount of water which is flowing into the Salton Sea from the District. This flow includes tailwater runoff, leaching water, canal spills, rainfall, subsurface inflow and surface inflow from outside the District (sewage, etc.). The problem in preparing a water balance is that there is difficulty in separating the total inflow to the Sea into all of its various components (e.g., groundwater and natural runoff).

The District has a goal of using water effectively and efficiently. To reach this goal, an accurate accounting of water will be necessary. With this information, it will be possible to define and evaluate means of conserving water. Accurate measurements will allow for continuing efforts by the District to effectively manage the distribution of water.

Any water accounting procedure must be reasonable, practical and cost effective. The programs are being funded by the District and its farmers, and the resources are limited. It must be recognized that recording devices in the gravity flow system will be exposed to weather, vegetation, vandalism, etc. In considering the water accounting program, the extremely large number of facilities must be considered, as previously described in Chapter III.

There are about 1,800 service pipes within the District. These service pipes provide water for domestic uses, stock watering, small irrigations and other miscellaneous uses. They range in diameter from 2 to 6 inches. The pipes provide a very small percentage of water, and metering every pipe would not be practical. Therefore, water delivered through the service pipes will continue to be estimated. A more accurate estimate of the quantity can be made, using random samplings and the existing service pipe inventory.

Many of the facilities noted above are measured directly, and some are equipped with recorder chart equipment. Most of the measuring devices are located where flow is relatively constant over a 24-hour period. Flow volume is determined based on the assumption that flow is uniform.

The entire distribution system is extremely complex, and there are a number of variables. As an example, not all lateral canals have spills to drains. Some of the lateral spills flow into adjacent canals, and the water becomes available for reuse.

The system is open channel without a significant amount of storage, but water must be ordered and scheduled before it is delivered. Changing weather (e.g., high winds and rainstorms) can affect the water requirement pattern.

The District has an obligation to provide water to farmers and others as required. Although the demands on the system are not under the control of the District, it must ensure a sufficient water supply to meet the needs. This water must be delivered when and where it is needed.

Metering and measuring in a gravity system are considerably more complex than in a pressure system. Propeller-type meters are not installed on a permanent basis because of algae and debris in the water. The District is evaluating recently developed electronic equipment which uses computer technology to totalize flow data.

1. Measurement and Accounting Principles

In developing a water accounting program, the significance of the quantities must be carefully considered. As an example, the USGS rates a gauging station with an accuracy of 95 percent as an excellent record (USGS, 1982). Assuming the gauging station at AAC Drop No. 1 is measured with an accuracy of 95 percent, there could be a deviation of plus or minus 125,000 AF annually. This is a very large quantity of water, and any measuring program must consider the accuracy obtainable under reasonable means. The variations tend to balance, but the magnitude of the problem is noted. It also must be noted that more detailed measurement of major quantities of water does not result, in itself, in water conservation.

Data processing is a major step in the accounting procedure. Data must be obtained, summarized and analyzed. Reduction of graphical data from stream-flow recorders requires a significant amount of time. The District is currently utilizing computers to aid in data reduction and compilation. It is also investigating the use of computers to obtain stream-flow measurements directly. The responsibility for data processing rests with those who are knowledgeable about the needs and purposes for which the data will be used. Any water accounting program requires an evaluation of the data and appropriate summaries to evaluate the overall program. It is necessary that those involved in data collection be in direct contact with those using the data to prevent the collection of unnecessary and useless data.

2. Data Reporting

A significant amount of the data collected by the District is summarized and reported in an annual water report. This 130-page document reports the data for the current year and also summarizes historical data to permit rapid comparisons with prior years. The firm of Bookman-Edmonston Engineering, Inc. (B-E), a consultant to the District, expressed its opinion that this water report contains the most extensive reporting system they are aware of for any irrigation district.

D. FUTURE WATER REQUIREMENTS

Past and current water requirements for Imperial Valley have been met by diversions from the Colorado River. Before Hoover Dam was built, diversions were sometimes limited to the available supply in the River near Yuma, Arizona. Since completion of Hoover Dam, the District has seldom been limited in diversions, and the quantity diverted was considered to be equal to the water requirement of the Valley, including operational losses within the conveyance and agricultural systems. Conservation measures should reduce these losses, thereby resulting in lower water diversions.

However, it is important to consider whether the District has reached a peak in water use. The actual amount of water used by crops within the District varies widely by month and year because of the variations in temperature, wind, humidity and other factors affecting evapotranspiration (ET). Furthermore, cropping patterns change rapidly because of market conditions or other factors. These factors are not subject to advance determination. Thus, wide and unpredictable variations in future water use are probable, and this affects estimates of water losses as well as estimates of water needs. During the 10-year period from 1974 through 1983, the annual inflow at Drop No. 1 varied from 3,072,000 AF in 1974 to 2,417,000 AF in 1983, a range of 655,000 AF, or 27 percent of the lower flow.

In the future, increased double cropping and transplanting may increase total water requirements. Another consideration is that increased water costs in other areas of the southwest may result in acreage increases of certain crops in Imperial Valley. This shift on water requirements must be considered.

The need for water to cool geothermal power plants being constructed in the Valley has been described in Chapter III. Developers of these plants have expressed the desire to acquire water allocations of conserved water through contributory funding of conservation projects.

A study should be initiated, perhaps by a cooperative agreement with the University of California, to forecast future water requirements for Imperial Valley.

E. POTENTIAL SAVINGS BY WATER CONSERVATION PROGRAMS

The USBR and DWR have made estimates of the total annual amount of water which might be saved by water conservation projects (USBR, 1984b; DWR, 1981). These estimates are not supported by detailed technical analyses, but are based on a review of existing records furnished by the District. Furthermore, estimation of the breakdown of losses required these investigators to make numerous assumptions such as percentage of a particular loss which might be salvaged by water conservation programs or projects.

The USBR identified the total annual amount of 350,000 AF if all water conservation opportunities were implemented (USBR, 1984b). Lining of the All-American Canal was excluded.

The DWR (1981) estimated that 438,000 AF/year "could be saved" from the quantities of "water being lost," including lining of the All-American Canal.

B-E has prepared analyses of losses and potential water savings (B-E, 1983). Because of the time constraints imposed by the District and the complexity of the factual data and issues involved, B-E's reports are reconnaissance level in scope. The conclusions are considered sound but are subject to revision as more detailed information and more complete analyses become available. B-E did have an advantage over previous studies in preparing a water balance in that additional data, particularly on canal spills, were available. B-E concluded in its study that, based on a water balance for the years 1977-1980, the following quantities of water from the system are lost each year:

Conveyance Losses	Loss (1,000 AF)
Net Canal Seepage and Evaporation	263
Operational Spills	136
Tailwater	327
Leaching	236
Total	962

Conveyance losses in the All-American Canal are not included. Some of the losses would not be recoverable such as:

1. Losses from evaporation.

2. Leaching water required to maintain suitable conditions for growing crops.

3. Some tailwater.

4. Losses which under any conservation system would still occur, such as canal seepage and operational carriage water.

The unique conditions within the District which control irrigation (including climate, distribution, irrigation and drainage systems, water quality and soils) dictate that some water could not be recovered or conserved. Potential conservation estimates are shown in the following tabulation (B-E, 1983):

Conveyance Losses	Potential Conservation (1,000 AF)
Canal Seepage (District canals and laterals)	100
Operational Spills	100
Tailwater	125
Deep Percolation	0
Total	325

F. FINANCING WATER CONSERVATION

Past funding of projects relating to water conservation has been accomplished using a portion of the revenues from water sales (Chapter IV). It is anticipated that some future water conservation projects and programs will be funded in the same manner. Many conservation projects are more costly than can be justified by the District. However, during recent months, proposals have been made that water conservation projects be paid for by interests outside the Imperial Valley. This concept is discussed in the USBR study (1984) in which estimates are made of water losses that could be salvaged within the District. Furthermore, assuming that the District now delivers the full agricultural water requirement to farmers, it appears that such conserved water could be available for use by other California entities willing to finance conservation projects in exchange for the contractual right to purchase the salvaged water.

By Resolution No. 8-84, adopted January 24, 1984 (Exhibit VI.1), the District invited "...other members of the Seven Party Agreement, the Bureau of Reclamation and beneficial users, including geothermal industry, within the District...to discuss water conservation ... including the cost and method of payment for such conservation, and the potential use by the District and other members of the Seven Party Agreement of the water thus conserved." Ongoing discussions with interested parties are being held to evaluate the feasibility of providing outside financing for conservation projects. Agreements appear possible. Three main components of any agreement must determine: water quantities to be salvaged, cost of specific water conservation works to salvage the water, and terms of reimbursement to the District through sales of conserved water. Studies to delineate these components will be necessary.

USBR's 1984 draft study plan of the District's Canal Lining and System Improvement (CLSI) (USBR, 1984) proposed to "...further study the application of water conservation measures to existing Imperial Irrigation District irrigation facilities, operations, and practices in promoting more efficient use of water, and to develop an additional water supply for future needs in the District and in Southern California." Other means of financing, such as loans or bond sales, may be considered at some future time, as will increased rates or assessments if deemed necessary.

This USBR report also contained an estimate that the capital cost of "cost effective" programs would be $124.9 million. The District has not evaluated this estimate but is now participating with the USBR in the new study on an equal cost-sharing basis. It is anticipated that estimates of costs and quantities of water savings will be refined in the final draft of this USBR study. District staff will continue independent studies and may recommend retaining consultants for this purpose.

Expenditures on water conservation projects and programs, structural improvements, and management programs will be made at the maximum level commensurate with funding capabilities, including revenues derived from sales of water.

G. 1985 AND SHORT-TERM CONSERVATION PLAN

1. Introduction

Short-term plans are those which will be implemented from 1985 to 1989. During this period, the emphasis will be on data collection and analysis to formulate long-term plans. The structural programs identified in the short-term plan are those which have proven to be beneficial. A summary of the 1985 plan elements and the associated cost are presented in Table VI.1.

2. Water-Balance Accounting

a. Delivery Accounting Program

The District's present water billing policy is to charge for water ordered, which may differ from water delivered. For billing purposes, a flow of 1 ft^3/s for 24 hours is considered to be 2 AF. Unless the zanjero must deliver a different flow rate due to physical limitations, the user is billed for the amount ordered. Users are billed for increases in water orders but, in accordance with the 21-Point Program, are not given credit for decreases. When a user has his delivery changed from one headgate to another on the same canal, the charge is prorated between the two accounts, based on time of run for each headgate. If a user is allowed an additional few hours to finish an irrigation, the billing is prorated.

It is obvious that present billing records cannot be used to account for the actual quantity of water delivered to users. In 1985, an accounting procedure was adopted to provide for the separate accounting of water delivered versus water ordered and billed. An estimate of water delivery through about 1,800 service pipes will be prepared based on an inventory of randomly sampled measurements.

b. Tailwater Monitoring Program

The current program of monitoring tailwater runoff and applying assessments for excessive runoff is described in Chapter IV. It has been in operation since 1976. This program has been restricted in its effectiveness because:

RESOLUTION NO. 8-84

WHEREAS, the Imperial Irrigation District is responsible for delivering Colorado River water to certain lands within Imperial County for agricultural, domestic and industrial uses; and

WHEREAS, the District has rights to certain portions of the waters of the Colorado River, such rights having been perfected at the beginning of this Century and having been recognized by Congress, the Supreme Courts of the United States and the State of California, and other individuals and entities; and

WHEREAS, the District, formed under the laws of the State of California, operates and maintains a vast system of water control, conveyance and distribution facilities, and an extensive drainage network; and

WHEREAS, it is the policy of the United States and the State of California that the general welfare requires that water resources be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented; and

WHEREAS, it is also the policy of the United States and the State of California that full utilization of water resources requires that a maximum effort must be directed toward maintaining the highest possible water quality; and

WHEREAS, the District believes that the members of the Seven Party Agreement should use their best efforts to see that all Colorado River water to which they are entitled be put to beneficial use to the fullest extent possible and that all appropriate measures are implemented to maintain salinity concentration at or below levels presently found in the lower Colorado River; and

WHEREAS, the Board of Directors of the District, in recognition of federal and state policy of water conservation,

has previously adopted structural and non-structural water conservation programs; and

WHEREAS, the District recognizes that additional conservation measures might make more water available for beneficial use within the District or be available to lower priority users according to the Supreme Court ruling in Arizona v. California and the provisions of the Seven Party Agreement.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

1. The Imperial Irrigation District shall expand its water conservation programs including, but not limited to, increased water conservation educational programs for valley farmers, increased emphasis on canal lining, water regulation reservoirs, and other structural improvements with the goal of reducing inflow to the Salton Sea 100,000 acre feet by July 1, 1985.

2. That the Bureau of Reclamation continue with its evaluation of water conservation opportunities in the District in order to determine the amount of water which could be salvaged and the cost-benefit of the conservation methods recommended.

3. The District is willing, and invites the other members of the Seven Party Agreement, the Bureau of Reclamation and beneficial users, including geothermal industry, within the District, to meet with officials of the Imperial Irrigation District to discuss water conservation opportunities in Imperial Valley, including the cost and method of payment for such conservation, and the potential use by the District and other members of the Seven Party Agreement of the water thus conserved.

PASSED AND ADOPTED this 24th day of January, 1984.

IMPERIAL IRRIGATION DISTRICT ORGANIZED JULY 25, 1911 EL CENTRO, CALIFORNIA

IMPERIAL IRRIGATION DISTRICT

By ____________________
President

By Larry E. Bick
Secretary

TABLE VI.1
1985 PLAN SUMMARY

PROGRAM	COST THOUSAND $
WATER BALANCE ACCOUNTING	
Delivery Accounting	5*
Tailwater Monitoring	280
Spill Monitoring	10*
Canal Seepage Study	5*
Leaching Requirement	57.5
Structural Programs	
Canal Lining	2,250
Regulatory Reservoir	1,200
Non-Leak Gates	10*
Remote Control Equipment	180
OPERATIONAL PROGRAMS	
Remote Control Study	60
Personnel Training	2*
ADMINISTRATIVE Programs	
Additonal Personnel	200
Tailwater Assessment	325
EDUCATIONAL PROGRAMS	
Pilot Tailwater Recovery Systems	300
Conservation Education	2.5
Field Irrigation Demonstration	2.5
Irrigation Training	7.5
COOPERATIVE PROGRAMS	
USBR Cooperative Study	162
USDA Lateral Fluctuation	250
DWR/USDA Drain Water Reuse	2
Fish & Game Drain Water Reuse	100
USBR Irrigation Scheduling	200
SCS Water Conservation	39
RESEARCH PROGRAMS	
Spill Interceptor Study	50
Modified Demand Irrigation	3
Computerized Water Management Study	7.5
OVERHEAD CHARGES	710.8
Subtotal	6,346.3
*Items are included in the Operation and Maintenance Budget	95
Total	6,441.3

(1) The period of time between tailwater checks has been extended.

(2) Water users are now permitted to move their own water to another field.

The purpose of the program has been to encourage water users to reduce tailwater by ordering less water, cutting back the flow or changing their gate settings at the proper time. The Water Conservation Advisory Board has been discussing this program with the intent of proposing revisions. The Advisory Board has supported the District's program and feels that efforts must continue to monitor tailwater and apply assessments to reduce excessive tailwater.

At the public hearing held on September 20, 1984, those water users who testified seemed to oppose the use of recorders on all tailwater structures. However, no constructive suggestions have been presented to modify the current program.

The District Board authorized several changes in the tailwater monitoring program at its November 6, 1984, regular meeting. The first was the adoption of a resolution revising Regulation No. 39, providing for standard tailwater structures. A copy of the new regulation is contained in the Supplement.

In 1985, working with the Advisory Board, District staff will recommend a revised tailwater monitoring program to replace and supersede the 13- and 21-Point Programs.

The District Board has also authorized a tailwater monitoring study program to aid in revising the existing assessment program. This study program will include the following elements:

(1) Lease/purchase several recorders from different companies to determine the best type of recorders to purchase for the rest of the study.

(2) Begin to install recorders on up to 15 percent of the fields to monitor delivery and tailwater.

(3) Determine what is "reasonable" tailwater.

(4) Identify high tailwater farms.

(5) Evaluate the effectiveness of the current assessment program.

To evaluate the effectiveness of the current assessment program, a reporting procedure was put into effect in September 1984 (Exhibit VI.2). The purpose of this procedure is to verify the checks made on every tailwater structure.

As can be seen in the tailwater monitoring summary reports, not all running heads (water deliveries) are being checked; however, in a few cases, more running heads appear to be checked than are being run. This occurs for many reasons. In some instances, the heads running include deliveries to nonagricultural customers; the percentage of heads checked to heads running would be less than 100 percent, even though all tailwater structures were checked. In other cases, the report shows checks on more than 100 percent of running heads. This inconsistency occurs when a running head is split into two deliveries and both are checked, but only one is recorded as a running head. During 1985, in conjunction with the delivery accounting program, both of these discrepancies in the accounting procedure will be resolved. An effort is being made to check all running heads for tailwater to provide accurate water accounting.

c. Spill Monitoring Program

There are 241 locations where water can be spilled from District canals. These spill amounts are generally small and represent the mismatch between water released to a lateral canal, seepage, actual deliveries to farmers and operational requirements. Most canals spill into the drainage system, and the water discharges into the Salton Sea. At some of these spill locations, reservoirs have recently been installed.

A complete listing of the spill locations is included in the Supplement, which also includes a complete listing of both main and lateral canals within the District, within divisions, and lists the lengths of both earth-lined and concrete-lined reaches for each canal. Canals without spill structures are listed as having "no spill." Canals with spill structures have the location of spill deposition listed.

Spill monitoring data for the years 1972-1983 are available for the main canals. From 1975 to 1979, seven or fewer laterals were added to the spill monitoring program each year. By 1980, there were 15 monitoring sites, while in 1984 there were 31 sites. Spill records for each site consist of daily records of the flow rate, measured in cubic feet per second, at the head and tail ends of each canal.

A statistical study of the existing spill data was performed to estimate the total amount of spill occurring in the District. It was found that the sampling was not adequate for the purpose of extrapolating with confidence, although a formidable number of spill measurements were taken. Representative locations were not sampled, skewing the data. A statistical sampling plan to measure spills has been formulated and will be implemented within the year.

An annual memorandum report will be prepared on the monitoring program. This report would include, as a minimum:

(1) Inventory of spill locations.

(2) Map of spill locations.

(3) Record of spill amounts.

(4) Estimate of total annual spill.

(5) Estimate of total annual spill for maintenance purposes.

(6) Recommended changes in program.

(7) Recommendations regarding any specific spill location. Analysis of various operating records and discussion with District superintendents to determine if recorders should be installed on any other specific spill locations.

d. Canal Seepage Study

It is difficult to monitor and determine the amount of canal seepage for all canals. Canal seepage will decline over the years. There are approximately 578 miles of unlined laterals. Until recently, the priorities for lining laterals were based on cooperative agreements between the District and the landowner. Under these agreements, the landowner paid for a portion of the cost of the lining. This was a beneficial program because those landowners who were interested in participating financially were those who farmed areas where seepage presented a problem. In addition, by financially sharing the burden, the District was able to line a greater distance of laterals. This joint cooperation and participation program has declined markedly in the last few

TAILWATER MONITORING SUMMARY

MONTH: October, 1984

Date	HEADS RUNNING			HEADS SPILLING OVER 15% First Check		Assessed	
	Total	Checked	%	Heads	%	Heads	%
1	514	458	89.1	14	2.7	3	0.6
2	546	496	90.8	20	3.7	11	2.0
3	583	508	87.1	31	5.3	10	1.7
4	550	491	89.3	25	4.5	5	0.9
5	568	485	85.4	23	4.0	8	1.4
6	541	446	82.4	22	4.1	7	1.3
7	455	386	84.8	16	3.5	5	1.1
8	486	414	85.2	26	5.3	10	2.1
9	538	470	87.4	27	5.0	10	1.9
10	523	442	84.5	21	4.0	10	1.9
11	503	430	85.5	20	4.0	12	2.4
12	506	427	84.4	22	4.3	6	1.2
13	479	427	89.1	21	4.4	7	1.5
14	403	342	84.9	12	3.0	4	1.0
15	452	390	86.3	17	3.8	5	1.1
16	500	407	81.4	19	3.8	5	1.0
17	498	440	88.4	18	3.6	9	1.8
18	533	470	88.2	36	6.8	14	2.6
19	531	448	84.4	29	5.5	10	1.9
20	477	421	88.3	12	2.5	7	1.5
21	397	334	84.1	10	2.5	5	1.3
22	442	368	83.3	11	2.5	2	0.5
23	450	392	87.1	16	3.6	5	1.1
24	464	405	87.3	23	5.0	9	1.9
25	480	423	88.1	25	5.2	3	0.6
26	468	403	86.1	22	4.7	6	1.3
27	444	386	86.9	21	4.7	7	1.6
28	372	310	83.3	14	3.8	3	0.8
29	441	383	86.8	11	2.5	3	0.7
30	462	391	84.6	22	4.8	5	1.1
31	433	380	87.8	12	2.8	4	0.9
Total	15 039	12 973	86.3	618	4.1	210	1.4
Avg.	485	418		20		7	

Exhibit VI.2

TAILWATER MONITORING SUMMARY

MONTH: November, 1984

Date	HEADS RUNNING			HEADS SPILLING OVER 15%			
				First Check		Assessed	
	Total	Checked	%	Heads	%	Heads	%
1	458	381	83.2	20	4.4	5	1.1
2	442	375	84.8	16	3.6	4	0.9
3	417	361	86.6	5	1.2	2	0.5
4	350	292	83.4	5	1.4	1	0.3
5	411	343	83.5	8	1.9	1	0.2
6	413	347	84.0	15	3.6	1	0.2
7	396	338	85.4	21	5.3	6	1.5
8	437	386	88.3	14	3.2	4	0.9
9	433	346	79.9	14	3.2	5	1.2
10	366	301	82.2	10	2.7	1	0.3
11	283	238	84.1	7	2.5	3	1.1
12	383	327	85.4	10	2.6	3	0.8
13	371	313	84.4	15	4.0	3	0.8
14	393	329	83.7	14	3.6	5	1.3
15	401	346	86.3	19	4.7	6	1.5
16	395	328	83.0	21	5.3	4	1.0
17	345	296	85.8	9	2.6	1	0.3
18	237	194	81.9	7	3.0	1	0.4
19	318	271	85.2	6	1.9	2	0.6
20	352	289	82.1	13	3.7	3	0.9
21	350	309	88.3	9	2.6	3	0.9
22	205	153	74.6	5	2.4	3	1.5
23	267	212	79.4	5	1.9	4	1.5
24	184	138	75.0	3	1.6	1	0.5
25	142	97	68.3	3	2.1	1	0.7
26	173	142	82.1	4	2.3	2	1.2
27	216	173	80.1	11	5.1	1	0.5
28	231	181	78.4	9	3.9	1	0.4
29	307	251	81.8	5	1.6	2	0.7
30	305	268	87.9	12	3.9	5	1.6
31							
Total	9981	8325	83.4	315	3.2	84	0.8
Avg.	332.7	277.5		10.5		2.8	

TAILWATER MONITORING SUMMARY

MONTH: December, 1984

	HEADS RUNNING			HEADS SPILLING OVER 15%			
				FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	%	HEADS	%	HEADS	%
1	346	242	69.9	5	1.4	0	0.0
2	248	158	63.7	2	0.8	1	0.4
3	299	203	67.9	4	1.3	0	0.0
4	259	176	68.0	11	4.2	2	0.8
5	267	192	71.9	9	3.4	5	1.9
6	257	177	68.9	18	7.0	4	1.6
7	252	165	65.5	12	4.8	1	0.4
8	262	139	53.1	0	0.0	0	0.0
9	171	77	45.0	2	1.2	0	0.0
10	207	104	50.2	1	0.5	0	0.0
11	143	56	39.2	2	1.4	0	0.0
12	125	45	36.0	3	2.4	0	0.0
13	151	66	43.7	3	2.0	0	0.0
14	184	95	51.6	0	0.0	0	0.0
15	211	115	54.5	6	2.8	0	0.0
16	167	91	54.5	7	4.2	0	0.0
17	226	139	61.5	7	3.1	0	0.0
18	281	187	66.5	7	2.5	2	0.7
19	239	150	62.8	7	2.9	0	0.0
20	257	168	65.4	8	3.1	5	1.9
21	362	248	68.5	6	1.7	1	0.3
22	317	229	72.2	11	3.5	5	1.6
23	264	170	64.4	7	2.7	2	0.8
24	176	86	48.9	8	4.5	3	1.7
25	105	21	20.0	1	1.0	0	0.0
26	228	116	50.9	6	2.6	0	0.0
27	173	23	13.3	0	0.0	0	0.0
28	101	12	11.9	0	0.0	0	0.0
29	78	7	9.0	0	0.0	0	0.0
30	74	8	10.8	0	0.0	0	0.0
31	79	10	12.7	0	0.0	0	0.0
TOTAL	6509	3675	56.5	153	2.4	31	0.5

years primarily because the remaining unlined laterals are not causing serious seepage problems to the adjoining landowners. Therefore, the District assumed full responsibility for prioritizing canal lining (see Supplement 1, Resolution No. 9-84). Joint participation with the adjoining landowners has been discontinued as of January 24, 1984.

The District has prioritized the lining of laterals based on:

(1) USBR Study List (USBR, 1984b).

(2) Connecting lined portions.

(3) Canal reaches reported by Division Superintendents as having high seepage.

(4) Maintenance problems (hydrilla is a principal problem).

The current priority list of canals to be lined within each division is given in Supplement 13.

To quantify the amount of lateral canal seepage, the following program will be implemented in 1985: A map showing all unlined sections of laterals will be prepared, and an inventory will be given. These laterals will be rated by the expected seepage characteristics in general terms of highest, high, low and lowest. Superimposed on the map will be a soils map to aid in determining seepage rates. Several seepage measurements will be made each year using ponding studies. Using the map and the results of the ponding tests, an annual estimate will be prepared of the total seepage in unlined laterals. An annual memorandum report will be prepared on the relevant data, test results and an annual estimate of seepage.

With respect to seepage and the unlined lateral inventory, it must be noted that there are several miles of laterals that may never be lined. These laterals include those infrequently used, those that lie in very tight soil, and areas where it can be demonstrated that water is gained. It is estimated that the laterals that fall into this classification represent approximately 157 miles. This leaves the following classification of unlined laterals within the District:

Priority	Mileage
Highest	157
High	129
Low	135
Lowest	157
Total Miles	578

In addition, revised cost estimates are needed to define the cost of canal lining more accurately. In many cases, it is necessary to import up to 1,000 cubic yards of dirt per mile of canal to be lined. This dirt was previously provided by the landowner, usually during land leveling operations. If it becomes necessary for the District to import these quantities of dirt, there will be considerable change in the cost of canal lining. These factors should be taken into consideration and the information evaluated when developing a priority list. A policy will be developed to line canals when adjacent landowners might be land leveling and have dirt available, resulting in substantial savings.

In cooperation with the District, the USBR is conducting a study to determine seepage in the main canal system (USBR, 1985). This study is to be conducted by USBR in cooperation with the District and is designed to quantify seepage in the East Highline Canal by measuring the inflow and outflow in each reach of the canal. Similar studies may be conducted on the other main canals if the USBR study proves effective.

e. Leaching Requirements

The leaching requirement is the amount of water required to dissolve and transport enough salts through the soil profile to maintain a salt balance favorable to economic plant growth. The leaching requirement depends on crop tolerance and water quality. In Chapter III-C, Section 1, the leaching requirement for crops within the District was discussed. Table III.12 presented the average leaching requirement for the major Imperial Valley crops. The overall average was shown to be 0.6 AF/acre.

The District's major concerns on leaching requirements are that the water applied for leaching be essential and that it be applied efficiently. To address these concerns, it is necessary to perform on-farm water balance computations that quantify the amount of water utilized for leaching. Leaching water either percolates deep into the soil (deep percolation) and cannot be measured directly, or it is conveyed through the tile drainage system.

Chapter III discussed the District's drainage system, which is designed to accept discharge from farm tile drain outlets. Normally, one outlet is provided for each 160-acre plot. In locations where a drain cannot be maintained at sufficient depth, the District installs and maintains a sump pump. At present, there are 485 drainage sumps within the District.

Acreage with tile drainage that is pumped from sumps represents one-fifth of the total acreage within the Valley. The remainder of the tile outlets discharges directly into drains, and these flows are not easily monitored. Presently, the District computes water volume pumped in 235 of its sumps from power usage (kilowatt-hour) data for each pump. Calibrations to determine the volume pumped are performed on a quarterly basis. Annual tile discharge is then estimated by extrapolation using both the acreage served by tile drains and the miles of tile lines installed as proration factors. (See Exhibit VI.3 for a typical tile drain discharge report.)

The sampling area represented by the tile sump measurement program is shown in Exhibit VI.4. It can be seen that a large area in the eastern portion of the District does not have sumps and hence is not included within the current tile discharge study. The intent of the Tile Flow Monitoring Study (Chapter IV) will be to augment the District's current sump program by installing recorders on 10 tile outlets in the areas of the District not covered by sumps. This data will be used to estimate flows from tile for the whole District as part of the total water budget.

To complete the water budget, however, it will be necessary to quantify deep percolation water. Based on methods outlined by Lonkerd, Ehlig, and Donovan (Lonkerd et al, 1979), it should be possible to determine actual leaching water quantities. In this method, representative soil cores are taken, and the parameters are measured to determine the in-place leaching fraction, soil saturation percent, electrical conductivity, and chloride ion concentration of the saturation extract. This test will be performed on 20 fields to correlate the leaching fraction with soil type, crop tile flow, salinity, and other relevant parameters.

3. Structural Programs

a. Canal Lining

As in the past, canal lining will continue to be an integral part of the Water Conservation Program. The benefits derived from reducing seepage include reduction in maintenance, increased conveyance efficiency, reduced right-of-way land requirement, etc. Lining is a good practice for upgrading the overall system.

Concrete has been found by the District to be the most cost-effective material for lining, because of its structural properties and ease of maintenance. The flatter side slopes required in order to use plastic-membrane liners would increase the cross-sectional area and right-of-way requirements and would be more susceptible to damage from maintenance activities.

The District has budgeted $2.25 million for canal lining during 1985. Areas found to have high seepage rates have been identified and are listed by Division in the Supplement. Several factors other than seepage rate are considered when formulating the canal-lining schedule. Canals with aquatic weed infestations (in particular, hydrilla) are given high priority. Other canals with high priority include those laterals which are partly lined and require only minor amounts of lining to be completed.

A preliminary canal-lining schedule for 1985 is shown in Table VI.2. Preliminary USBR studies (USBR, 1984b) indicated that a total of 1,912 AF of seepage water can be conserved per year as a result of this lining. Two or three other canal sections will be added to the schedule to expend the budgeted allocation and to achieve expected savings of 2,200 AF/year.

The short-term plans: The District would continue with a $2-3 million annual budget, which would finance the lining over a 5-year period of more than 100 miles of lateral canals and possibly the partial lining of a main canal. With additional funding, $10 million could be spent on canal lining each year, limited by canal cutout scheduling.

b. Regulatory Reservoirs

Construction of a $1.3 million regulatory reservoir has been scheduled for 1985 to be located on the Westside Main Canal at

IMPERIAL IRRIGATION DISTRICT

TILE DRAIN DISCHARGE
Progress Report
Based on Measured Discharge from Sumps
March 1983 to November 1983

Sumps in Program	235
Sumps with valid measurements	227
Miles tiled (227 sumps)	3,074
Acreage tiled (227 sumps)	42,789
Calculated discharge, g.p.m. (227 sumps)	14,657
Calculated discharge, g.p.m. each sump	65
Calculated discharge in A.F. per year (227 sumps)	23,642 A.F.

Acre-Feet per year, per sump:	
23,642 A.F. / 227	104.15 A.F.
Assume 534 sumps operating:	
Total discharge for year	55,616 A.F.

Estimated total tile effluent for 1983, based on 227 sump tests made during the period March 1983 to November 1983:

Based on mileage:	
Cumulative miles of tile as of December 1983	28,972
Discharge for 3,074 miles of tile	23,642 A.F.
Discharge per mile of tile	7.69 A.F.
Total discharge (28,972 x 7.69)	222,822 A.F.
Based on acreage:	
Cumulative acres tiled as of December 1983	431,224
Discharge for 42,789 acres	23,642 A.F.
Discharge per acre tiled	0.55 A.F.
Total discharge (431,224 x 0.55)	238,262 A.F.

Note: Sump discharge determined by calculating KWH per acre-foot of water pumped from field tests. Annual discharge then computed from total KWH taken from power bills for the period March 1983 November 1983.

Exhibit VI.3

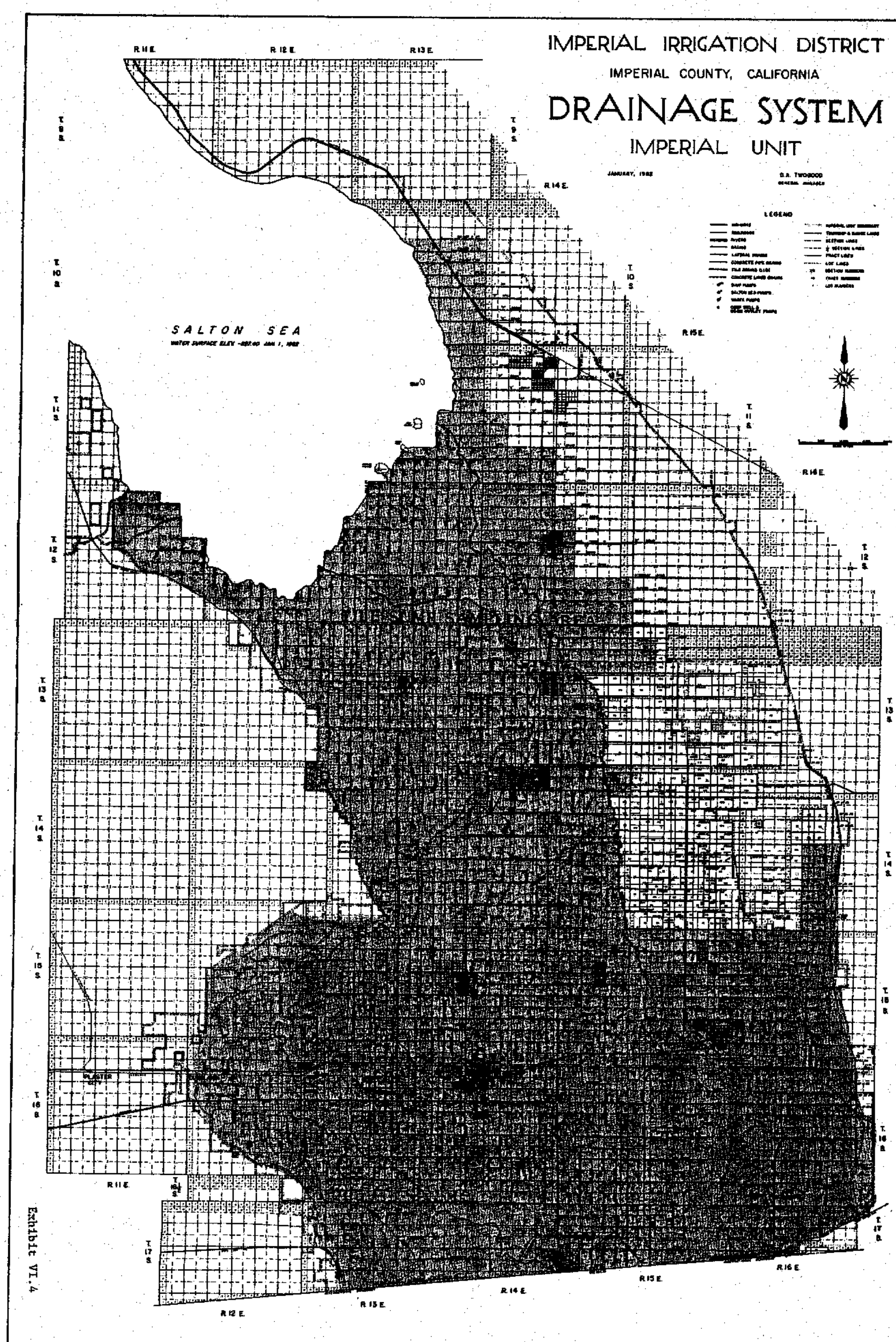

IMPERIAL IRRIGATION DISTRICT
IMPERIAL COUNTY, CALIFORNIA
DRAINAGE SYSTEM
IMPERIAL UNIT
LEGEND
SALTON SEA
R 11 E.
R 12 E.
R 13 E.
R 14 E.
R 15 E.
R 16 E.

Exhibit VI.4

the Trifolium Extension heading. Design parameters will include automatic inlet and remote-controlled pump outlet. Total capacity will be approximately 300 AF and will be contained in an area of 30 acres. The embankments will be concrete lined and the bottom will be clay lined.

Placement of a regulating reservoir in this area is important because of its location adjacent to the Trifolium Extension spill structure. The Trifolium Extension is in the extreme northwest corner of the irrigation system and requires water to travel approximately 60 miles in the Westside Main Canal after diversion from the All-American Canal. It is estimated that the strategic placement of a regulatory reservoir in this location would conserve at least 4,100 AF/year in operational spill.

Reservoir construction can result in water savings in three ways:

(1) Conserve canal spill that historically occurred at the new reservoir location.

(2) Conserve canal spill in the affected service area of the new reservoir.

(3) Reduce tailwater from farms in the affected service area resulting from a more uniform headgate delivery.

Item 1 is easy to quantify, and it is the only amount that has been directly measured. Item 2 has not been quantified because all spills in an affected area have not been measured. The affected service area is not a precise location but includes that area near a reservoir. From experience, one can assume that the affected area would be that served within 5 miles upstream and downstream from each reservoir. An estimate of loss under Item 2 is one-half of the unregulated average District canal spill per acre. Item 3 is the most important. It is known that more uniform farm headgate deliveries with additional on/off flexibility can reduce tailwater. A reservoir can help produce steadier headgate deliveries. It is roughly estimated by District personnel that there may be a 20-percent reduction of tailwater in the affected service area of a reservoir.

The short-term plans of the District are that by 1990 at least two reservoirs are planned for construction at main canal spill locations for studies to document the effects of other conservation efforts on storage reservoirs. With additional

TABLE VI.2
CANAL LINING SCHEDULE FOR 1985 BUDGET[1/]

Scheduled Construction Date	Canal	Length[2/] Miles	Estimated Cost, $	Estimated[3/] Salvage AF/Year
January 21-25	Mulberry	1.5	85,800	117
February 4-8	Wormwood	1.25	154,500	9
February 11-15	Eucalyptus	1.0	150,200	200
February 28-March 1	Palm	1.0	90,300	23
March 4-8	Wormwood	1.0	144,800	7
March 11-15	Eucalyptus	1.0	133,700	200
March 18-22	Ash Lateral	1.75	209,000	44
April 1-5	"E" Lateral	1.5	110,900	162
April 15-19	Elder	2.0	310,300	400
April 29-May 3	Pear	0.75	72,000	150
May 6-10	Pampas	0.60	49,500	85
May 13-17	Oxalis	1.65	131,300	233
May 20-24	Mesquite	1.0	72,100	78
Unknown	Sumac/Sumac Lateral 1	1.1	135,000	87
Unknown	Mulberry	1.5	120,000	117
Totals		18.6	1,969,400	1,912

1/ Preliminary, subject to weather, canal outages, etc.

2/ Lengths are approximate

3/ Based on figures from USBR study, "Water Conservation Opportunities" funding, the District could build two reservoirs each year over the next 2 to 3 years.

Potential sites for reservoirs are shown in Exhibit VI.5. These sites are adjacent to main canal spill locations, except for the site at the No. 11 Check on the East Highline Canal.

c. Non-Leak Gates

The District is replacing standard timber slide gates on spill structures with aluminum gates. This gate replacement program will become part of the District's normal maintenance program to eliminate leakage from spill structures.

d. Remote-Control Equipment

Equipment necessary for the remote-controlled operation of the Central Main Check on the All-American Canal will be purchased, and installation will commence in 1985. Equipment will be compatible with the new instrumentation planned for the Water Control Section. This station will not be fully operational until the computer control equipment at the central office is on line.

4. Operational Programs

a. Computer-Enhanced Remote Control System

A study will be made to determine the type and functions of a computerized System Control and Data Acquisition (SCADA) system and any changes necessary to the communication network. Specifications will be prepared for procurement of equipment in 1986.

Presently, the District controls lateral headgates at 22 sites by remote control from its operating headquarters using an analog electrical signal transmitted across pole lines. For the short term, the District plans to convert the current remote-control to the more accurate and trouble-free digital system and to use a computer for data reduction and analysis.

b. District Personnel Training

The zanjero training program will continue in 1985 with formal training scheduled for six new zanjeros and refresher classes scheduled for current personnel. This program will continue as part of the normal ongoing training.

The District is using recently acquired personal computers to train operating personnel in current technology for computation and recordkeeping of flow and delivery data. Furthermore, available electronic devices for recording water levels and flows are being tested, and personnel are trained in their use in coordination with the USDA Water Conservation Laboratory.

5. Administrative Programs

a. Additional Personnel

Six additional zanjeros will be employed in 1985, one for each division. This will provide more flexibility to make off-schedule changes in the delivery system and to monitor tailwater. Up to four additional positions will be filled for water conservation.

b. Tailwater Assessment Program

This program, begun in 1976 with the 13-Point Program, will be continued through its ninth year during 1985. Under current procedures, all significant running heads are scheduled to be checked daily. Those heads never checked are: service pipes, heads less than 1 ft^3/s, and instances where a zanjero has operating problems and cannot leave the head ditches. This program reduces tailwater because it is easily monitored and assessments on excess tailwater cost more money to farmers.

The Water Conservation Advisory Board has periodically recommended revisions to this program. High priority will be given by the Advisory Board, working with District staff and management, to thoroughly evaluate and consider recommending changes in this program to the District Board in 1985.

The three general categories to be addressed are (1) tailwater monitoring and assessments, (2) changing water orders, and (3) moving water to another gate. It is proposed that a new program be developed to replace and supersede the 13- and 21-Point Programs and be incorporated into the operating Rules and Regulations.

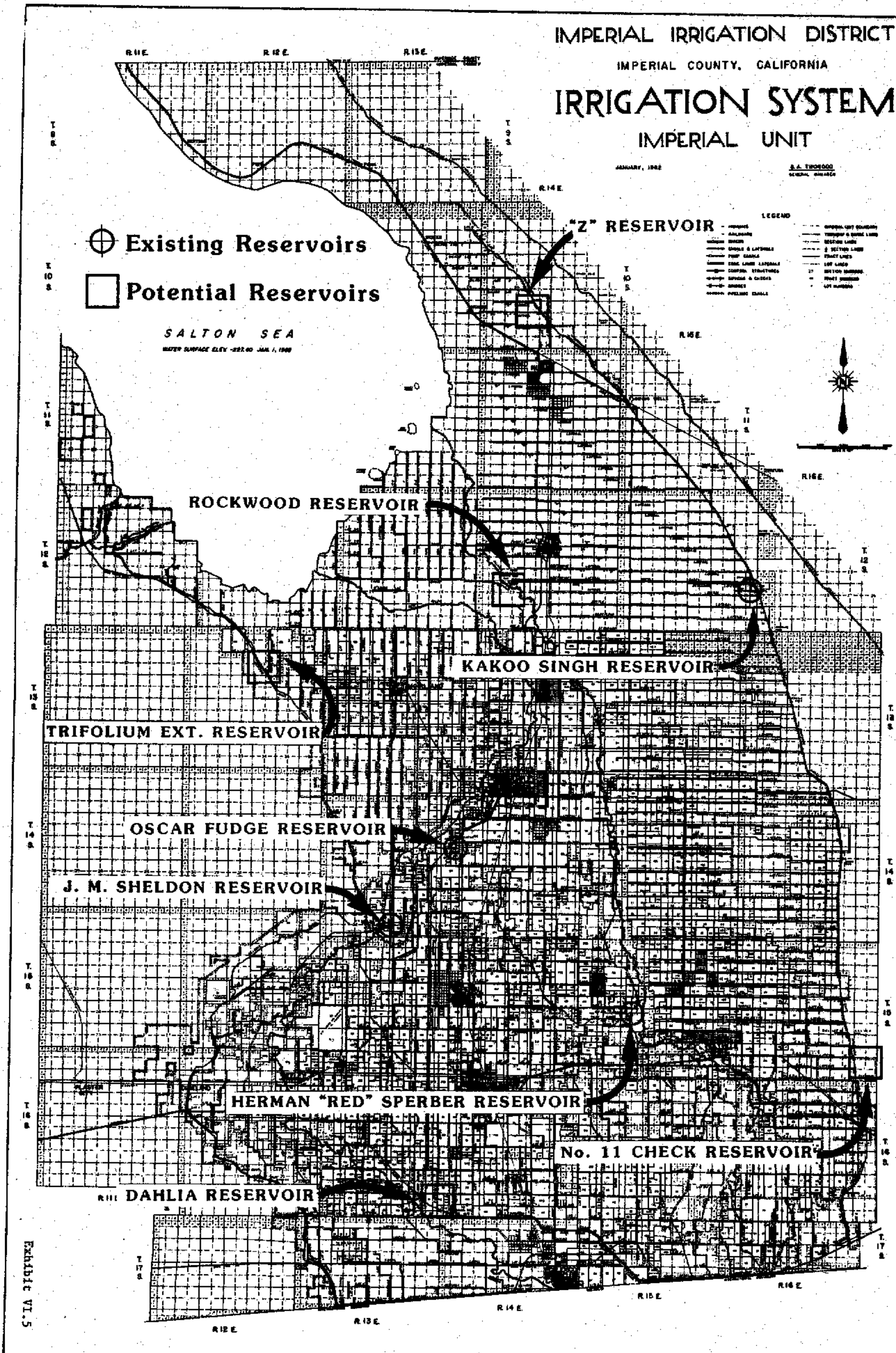

IMPERIAL IRRIGATION DISTRICT
IMPERIAL COUNTY, CALIFORNIA
IRRIGATION SYSTEM
IMPERIAL UNIT
Existing Reservoirs
Potential Reservoirs
SALTON SEA
"Z" RESERVOIR
ROCKWOOD RESERVOIR
KAKOO SINGH RESERVOIR
TRIFOLIUM EXT. RESERVOIR
OSCAR FUDGE RESERVOIR
J. M. SHELDON RESERVOIR
HERMAN "RED" SPERBER RESERVOIR
No. 11 CHECK RESERVOIR
DAHLIA RESERVOIR

Exhibit VI.5

6. Educational Programs

a. Demonstration Tailwater Recovery

This program has been developed to the effectiveness, potential problems and associated costs of tailwater recovery systems on different soils, slopes, crops, etc. Two to five tailwater recovery systems will be constructed. As a minimum, delivery, tailwater, recycled tailwater, salinity, soil salinity, and temperature will be monitored. In November 1984, the District Board authorized its staff to proceed with planning and implementation of a pilot tailwater recovery program for sites meeting the following criteria:

(1) Farmed unit, 70 acres or more.
(2) Location adjacent to well-traveled road for high visibility.
(3) Electric power readily available.
(4) Continuous cropping.
(5) Full cooperation of water user.

Potential savings are difficult to estimate, although measured savings are a major goal for the initial program. Assuming that 400 acres are served by the initial pump-back installations and that 1 AF/acre can be recovered, approximately 400 AF/year can be conserved. The potential savings becomes significant if pump-back systems can be installed on several acres, and this short-term objective will require a high degree of cooperation from the water users.

b. Conservation Education

Newspaper articles, brochures and instruction booklets relating to water conservation will be released through the Public Information and Community Services Section of the District. Examples of recent newsgrams mailed to consumers are contained in the Supplement.

c. Field Irrigation Demonstration

Four field irrigation demonstrations will be conducted in the areas of:

(1) Irrigation scheduling with the neutron probe.
(2) Water measurement.
(3) Cutback irrigation for reduction of water use.
(4) Irrigation with minimum tailwater discharge.

d. Irrigation Training Program

A series of video-recorded irrigation training programs will be developed for 10 growers and their irrigators to demonstrate the techniques of irrigating crops with minimum tailwater discharged.

e. California Irrigation Management Information System (CIMIS)

The District intends to work with DWR to disseminate to District water users the ET data from three automatic CIMIS stations located in the Valley.

7. Cooperative Programs

The District participates with governmental agencies in several study programs relating to the conveyance and usage of water within the Valley.

a. USBR/IID Cooperative Study

The District has pledged to cooperate in the USBR's current study a continuation of its earlier studies that "...identified a number of structural and nonstructural conservation measures warranting further study," according to the USBR's Plan of Study (USBR, 1984a). Based on 50-percent cost sharing, the District has budgeted $162,000 to be expended primarily on installation of measuring devices and the collection of records necessary to determine current losses and future quantities of water saved by conservation facilities and programs.

As proposed by the USBR (1985), this program will extend over a 3-year period, although the USBR has agreed to give priority to study seepage losses in the East Highline Canal and the development of an 8,000-AF-capacity reservoir on the All-American Canal. Construction of the reservoir, lining, or other structural changes on the East Highline Canal will depend on the results of the USBR's Plan of Study and funding availability.

b. USDA/IID Lateral Fluctuation

Lateral water surface fluctuations and the subsequent variability of water deliveries adversely affect irrigation efficiency. To maintain high irrigation efficiencies consistently, predictable nonfluctuating deliveries are required.

Transient flow characteristics in the Myrtle and Munyon Laterals will be monitored. The heading of the Myrtle Lateral is located immediately upstream of a check where water levels are stable. The water level fluctuations in the Munyon Lateral are expected to be much greater than in the Myrtle Lateral. A broad-crested weir will be installed downstream from each check to monitor flows. Water-level recorders and transducers will be installed to monitor water levels upstream and downstream from all checks and at the head of each delivery ditch. After 3 to 6 months, structural modifications (concrete lining, automated structures, mid-lateral reservoir, etc.) will be made, and changes in the transient flow characteristics will be monitored.

c. USDA/IID Drain Water Reuse Study

The District has signed an agreement (Supplement 9) with the DWR and the USDA to cooperate in a special study of using water from drains for irrigation. Continuation of this program requires an allocation of $2,000/year for electrical pumping energy.

d. Drain Water Reuse

A pond will be constructed at the outlet of Elder 14 Drain into New River. Approximately 825 AF of drainage water will be diverted each year to the waterfowl habitat area. The location of this facility is shown on Exhibit VI.6.

The District has installed structures in drains to divert water into adjacent lands of the State Department of Fish and Game to provide wildlife habitat. Additional sites where drain water can be diverted will be identified and structures installed as necessary. This program will reduce the amount of fresh water used for wildlife habitat.

e. Irrigation Scheduling with Neutron Probe

The Irrigation Scheduling Program conducted in cooperation with the USBR for the past 4 years (Chapter IV) will be continued through 1985 and will include data collection, analysis, and reporting. The 1985 program will also focus on involving water users who have not participated previously. Efforts will be made to include water users who have been identified as frequently having high tailwater runoff. The main goal of this program is to schedule water more accurately and thus reduce the quantity of tailwater.

It is expected that between 12,000 and 15,000 acres will become involved in the 1986 program.

f. Soil Conservation Service On-Farm Program

The District has submitted a proposal to the U. S. Soil Conservation Service to seek funding for extensive water conservation measures. Included are the concrete lining of head ditches on canals and the implementation of extensive on-farm irrigation strategies.

It is expected that the SCS can provide more extensive on-farm assistance than the District alone can provide.

8. Research Programs

a. Spill Interceptor Pilot Program

The District plans to study, design, and construct a pilot spill interceptor system. After construction, evaluation will be made and, if warranted, design of a full-scale system will be initiated.

This pilot program will evaluate the effects that a spill interceptor system will have on lateral spill, operational flexibility and tailwater discharge. Five laterals have been identified as the study area (Exhibit VI.7), located in the East Highline Canal system. Spill currently flows into the Alamo River. Both spills and drains in the study area will be measured to obtain baseline data for comparison with data gathered after construction of the interceptor system. Final design of the facilities and construction will begin in 1986.

b. Modified Demand Irrigation Trial

This program allows irrigation to be terminated up to 4 hours before or after the regular ending time. An analysis of the data gathered in this trial will be completed and recommendations for changes in the program will be made.

c. Computerized Water Management Study

The USBR has developed a program to assist irrigation districts that operate or are served by its projects and facilities. The program uses a modular system of 11 individual computer programs to assist the District and farmers in water management. This program will be initially tested on one or two zanjero runs.

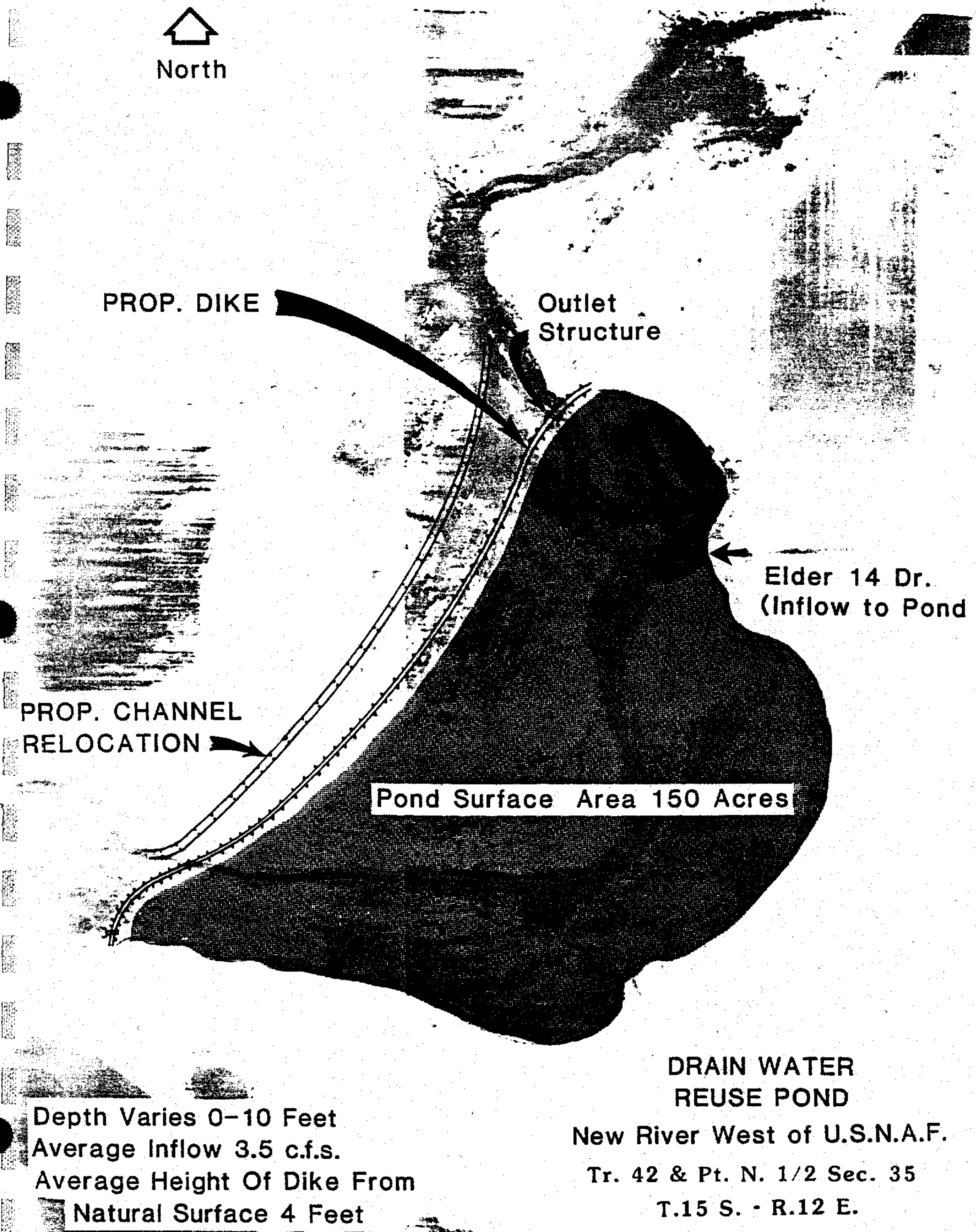
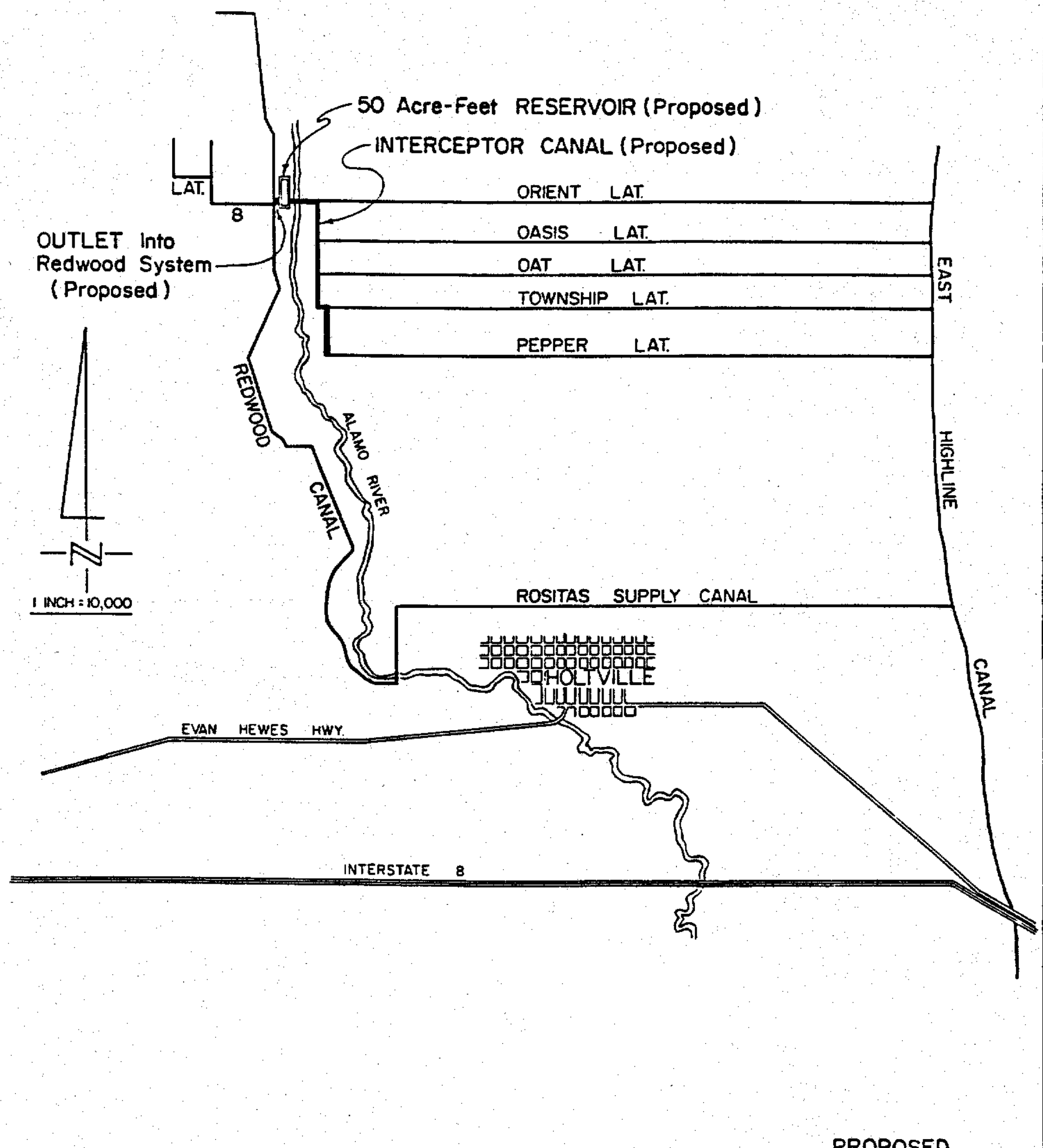

North
PROP. DIKE
Outlet
Structure
Elder 14 Dr.
(Inflow to Pond
PROP. CHANNEL
RELOCATION
Pond Surface Area 150 Acres
DRAIN WATER
REUSE POND
New River West of U.S.N.A.F.
Tr. 42 & Pt. N. 1/2 Sec. 35
T.15 S. - R.12 E.
Depth Varies 0-10 Feet
Average Inflow 3.5 c.f.s.
Average Height Of Dike From
Natural Surface 4 Feet

Exhibit VI.6



PROPOSED
SPILL INTERCEPTOR
SYSTEM

Exhibit VI.7

Dwg. No. L-2834

12-19-84 SIC

d. Delayed Start

Presently, most irrigations start between 6:00 a.m. and 11:00 a.m. If the farmer realizes that he is going to finish the irrigation early, District personnel are frequently not available before 6:00 a.m. to make any changes. If the official start time of the zanjero's run was delayed 2 hours, he would be available to make off-schedule changes during his first 2 hours of the day. A delayed start trial may be implemented to determine its potential for water conservation.

H. LONG-TERM GOALS

It is the District's goal to improve its water conveyance and distribution system to the fullest extent possible and to accomplish these improvements within a reasonable time. Increased efficiencies and water savings will result from these improvements. Specific improvements to achieve this optimum goal are shown in Table VI.3.

Conservation benefits that would accrue from the various programs may overlap each other. Thus, as some programs are implemented, other programs may appear less attractive. For example, seepage recovery systems and concrete lining both conserve seepage water, but would not be installed in the same reach of the canal.

The economics of all potential measures will have to be considered. Many of the programs that have been discussed are very costly and can only be implemented if funds are available from outside sources. Through the implementation of the short-term programs listed in Section G of this chapter, it should be possible to initiate the long-term planning process.

In the development of this Plan, no effort was made by District staff to estimate the potential water savings or the cost of new facilities or programs. B-E prepared estimates of water savings (given in Section E). A detailed evaluation of water savings and costs requires extensive investigation to determine losses accurately, as well as expanded measuring programs. Estimates of potential water savings and costs of facilities and programs have been made by other agencies, based on available operational records.

In Chapter V, estimates of water savings made by the USBR and DWR are described. Furthermore, the USBR prepared an estimate of capital costs for certain recommended features as shown in Exhibit V.1. The USBR list of features includes only a few of the specific improvements listed in Table VI.4.

TABLE VI.3
LONG-TERM DISTRICT GOALS

Goal	Description
1.	Concrete-line between 500 and 600 additional miles of District canals and laterals so that over 80 percent will be concrete lined.
2.	Cooperate with the USBR in lining All-American Canal from Pilot Knob to terminus.
3.	Pipeline all laterals and open drains through cities and towns in an aggregate length of 40 to 50 miles.
4.	Construct a large (8,000± AF) reservoir at or near East Highline Canal heading.
5.	Construct up to 10 regulating reservoirs, each with a capacity of 200 to 500 AF.
6.	Install remote control (SCADA) on all major structures such as main canal checks (59), all lateral headings (493), and all regulating reservoirs.
7.	Construct spill collector systems, where feasible.
8.	Install recovery systems in lieu of lining, where feasible.
9.	Install computerized scheduling system.
10.	Collect and distribute weather, soil, and other data for use by water users in scheduling water orders.
11.	Cooperate with farmers and farm advisors in providing irrigation information and training data on tailwater recovery systems, irrigation scheduling, etc.
12.	Continue to have the farmers make on-farm improvements, implement irrigation management programs, and install tailwater recovery systems in order to reduce tailwater runoff.

In 1983, the USBR initiated a study to determine the feasibility of lining portions of the All-American Canal (AAC) (USBR, 1983). Authorization of the study was based on preliminary estimates that seepage losses of 70,000 AF/year could be salvaged by reconstructing and/or lining the AAC from Pilot Knob to Drop No. 4. A Planning Report/Draft Environmental Statement is scheduled for completion in October 1985.

According to District records (annual water reports), total annual losses from the AAC between Pilot Knob (PK) and the East Highline (EHL) heading, together with total losses from EHL to the Westside Main Heading (WSM), during each of the past three years are shown below:

Calendar Year	Acre-Feet PK-EHL	EHL-WSM	Totals
1982	78,918	17,458	96,376
1983	134,011	28,469	162,480
1984	78,032	28,758	106,790

The District intends to cooperate with the USBR to consider lining portions of the All-American Canal, dependent upon the results of current studies.

In 1985, several engineering firms submitted proposals, at the District's invitation, offering to perform planning, design, supervision of construction, and/or professional services with the District to implement elements of this Plan.

The firm of Parsons Water Resources, Inc., a subsidiary of the Parsons Corporation in Pasadena, California, submitted a proposal that included a preliminary schedule to implement various features of the District's Plan, estimates of water conservation, and preliminary cost estimates. Parsons conducted an on-site review of the District's system and operations, interviewed operating personnel, and reviewed pertinent documents, including the USBR and DWR reports. District reports and records were also studied to document existing conditions.

The estimated costs of implementing various elements of the Plan, as proposed by Parsons, were approximately $450 million as shown in Table VI.4. Parsons' tentative planning and implementation schedule extends over a 13-year period. The cumulative estimated water yield would be approximately 550,000 AF/year, if all elements were implemented.

In May 1985, Parsons was authorized to proceed with initial studies and analyses in order to quantify the District's present and future water needs and determine the conserved water that might be available for use by others and the potential transferees for that water. These studies will be completed in the fall of 1985. It is also intended that Parsons will continue to assist the District to develop and implement various water conservation projects and measures included in this Plan, as further refined during the implementation planning phase. As directed by the District, Parsons will also provide technical, legal, and financial experts and consultants as may be necessary or useful to enable the water conservation program to proceed efficiently and expeditiously.

TABLE VI.5
ESTIMATED COST SUMMARY[1/]

Item	Cost ($ Millions)
Develop Plan and Marketing	$ 2.0
System Automation	23.0
Lateral Lining	79.0
On-farm Effort[2/]	14.0 (14.0 to 90.0)
Reservoirs	50.0
New Lined Canals	151.0
New Canal Structures	21.0
New Headgates	4.0
Connections to Laterals	12.0
Roadways, Bridges	15.0
Power Plants	40.0
Spill Interceptors	26.0
Wells	13.0
Total Estimated Cost	$450.0

[1/] Estimate is based on first-quarter 1985 dollars.

[2/] Cost estimates depend on the number of acres using tailwater recovery systems and on the type of system. An exact cost benefit analysis will have to be performed for each farm to determine the practicality of using a tailwater system.

Source: "Proposal for Cooperative Development of Water Conservation Plan, Imperial Irrigation District," The Ralph M. Parsons Company, 1985 (used by permission).

I. MISCELLANEOUS PROGRAMS TO REDUCE SALTON SEA INFLOW

The Water Conservation Plan is designed to reduce water losses, most of which contribute inflow to the Salton Sea. Accordingly, other elements of inflow remaining unchanged, the level of the Sea is expected to decline. However, recognizing that conservation programs take time to implement, other programs need to be considered that can be applied in a shorter time. Some of the possible alternatives that will be studied in 1985 include:

1. Spreading drain water on available idle land by ponding, flooding or sprinkling.

2. Constructing storm detention basins on the East and West Mesas.

3. Irrigating with free drain water through the cooperation of landowners and alternating with canal water.

4. Pumping water from the Salton Sea to shallow ponds adjacent to the Sea.

5. Pumping water from drains to shallow ponds on the East and West Mesas, (or other available lands) for wildlife ponds/marshes or other uses.

6. Supporting the continued investigation of diverting the New River at or south of the Mexican border to Laguna Salada in Mexico.

7. Separating tile drain flows from tailwater to reduce surface runoff.

J. ENVIRONMENTAL ISSUES

In accordance with the California Environmental Quality Act, the District has adopted the State CEQA Guidelines for application to the District.

These guidelines provide that certain programs are exempted from preparation of environmental assessments (17 Cal. Adm. Code §15268 and §15300). Programs in this category include concrete lining existing District canals, pipelining portions of laterals and drains, installing road crossings, and replacing existing structures.

The District has prepared a declaration of negative impact for each of its regulating reservoirs, and will continue to file this type of environmental review for similar projects.

As major projects in the Water Conservation Plan are prepared for implementation, an environmental assessment, as required by CEQA, will be prepared. The major environmental issues expected to be of concern are:

1. Reduction of flows in drains.

2. Reduction of inflow to Salton Sea.

3. Increase in salinity of drain water.

4. The impact of these three factors (above) on fish and wildlife, recreation, and aesthetic values.

K. CONCLUSIONS

This Plan delineates specific projects and programs that have been proven to save water or that have a high degree of potential for conservation by increasing efficiencies of the District's systems and farmers' irrigation operations. As stated in the introduction, this is a general plan to improve both the structural and nonstructural conveyance, storage, and irrigation facilities in Imperial Valley. Conservation of water will result from the actions described in the Plan.

This Plan should be reviewed annually by the Board of Directors and modified as conditions change. The time schedules and estimated expenditures are obviously subject to review. If funds become available from outside sources, the schedules will be tightened and expenditures accelerated to accomplish the earliest construction of structural works. At this point, and presumably throughout the period of implementation, the Plan is voluntary on the part of District water users. There will have to be a continued monitoring of tailwater. There may also be assessments and penalties but, by coordinated efforts, landowners and water users will continue to improve their use of water to ensure that it is used wisely.

APPENDIXES

APPENDIX A

GLOSSARY

Acre-Foot: A measure of the volume (such as irrigation water) that would cover 1 acre to a depth of 1 foot.

Applied Water: Water delivered to a user. Also called delivered water. Applied water may be used for either inside uses or outside watering. It does not include precipitation or distribution losses. It may apply to metered or unmetered deliveries.

Alluvial: Deposits derived from stream flow.

Biomass Production: Cultivation of plants for their heat value.

Canal Cutout: The act of blocking all flow to a canal or lateral.

Consumptive Use: Total amount of water used for evapotranspiration and building plant tissue.

Conveyance System Efficiency: The ratio of the volume of water delivered to users in proportion to the volume of water introduced into the conveyance system. The conveyance system for the District service area begins at Drop No. 1 on the All-American Canal.

Crop Coefficient: A coefficient that relates the evapotranspiration of a given crop at a specific time in its growth stage to a reference ET condition. This coefficient incorporates effects of crop growth state, crop density, and other cultural factors affecting ET.

Cropping Pattern: The acreage distribution of different crops in any one year in a given farm area such as a county, water agency, or farm. Thus, a change in a cropping pattern from one year to the next can occur by changing the relative acreage of existing crops, and/or by introducing new crops, and/or by cropping existing crops.

Crop Rotation: The practice of growing different crops in succession on the same land chiefly to preserve the productive capacity of the soil.

Crop Water Requirement: Crop consumptive use plus the water required to provide the leaching requirements.

Deep Percolation: The movement of water by gravity downward through the soil profile beyond the root zone; this water is not used by plants.

Demand Scheduling: Delivery of water to the user by a water agency whenever the user demands it, subject to agency regulations on prior notice of demand and quantity availability. Scheduling is flexible and more convenient to the user than the supplier.

District Irrigation Efficiency: The ratio of the volume of water delivered to users in proportion to the volume of water delivered to the irrigation district service area conveyance system at Drop No. 1.

Drop No. 1: The initial drop structure located on the All-American Canal, considered as the head of the District conveyance system.

Double Cropping: Growing two or more crops on the same field at different times of the year.

Evapotranspiration (ET): The quantity of water transpired by plants or evaporated from adjacent soil surfaces in a specific time period. Usually expressed in depth of water per unit area.

Farm Head Ditch: The principal water conveyance channel within a farmer's property.

Growing Season: The time period during which it is warm enough for plants to transpire and grow.

Hydrographer: The water tender on the District's main canals.

Infiltration Rate: The rate of percolation of water through the soil profile, typically expressed as inches of water per hour.

Irrecoverable Water: That portion of delivered water degraded physically or chemically to a level that makes it uneconomical to reclaim; water discharged directly to the ocean or other land or water body when the water is no longer recoverable.

Lacustrine Basin: An enclosed or partially enclosed area having originated as a lake bed and exposed when the water level is lowered or the elevation of the land is raised.

Lysimeter: A device such as a tank or large barrel containing a mass of soil, usually planted with vegetation, that is isolated hydrologically from its surroundings. The device is commonly used in research to determine the evapotranspiration rate of various crops in a controlled environment.

On-Farm Irrigation Efficiency: The ratio of the volume of water used for consumptive use and leaching requirements in cropped areas to the volume of water delivered to a farm (applied water).

On-Farm System: The method used to distribute and apply water to the fields. Included are gravity/surface systems and pressurized systems such as sprinklers, drip lines. Tailwater disposal or recovery systems are included.

Precipitation: The total measurable supply of water of all forms of falling moisture (including dew, rain, mist, snow, hail, and sleet) usually expressed as depth water on a horizontal surface on a daily, monthly, or yearly basis.

Pump-back System: A return flow system in which tailwater is pumped back to the head of an irrigation ditch for reuse.

Return Flow: That portion of the water diverted for irrigation that returns to groundwater or stream system for potential rediversion or instream uses.

Return-Flow System: A system that recycles runoff water either by pumping it back to the supply or by using it sequentially on a lower field. (Often a reservoir is required to enable flexible operation and to save labor.)

Reused Water: Water used beneficially more than once.

Rotation Scheduling: Delivery of water to the user by a water agency usually on the basis of fixed amounts of water at fixed intervals. Therefore, scheduling is somewhat rigid and more convenient to the supplier than the user.

Rundown Water: Water left in a lateral after all scheduled deliveries have been made.

Runoff: Water that leaves an area or field as surface flow.

Seepage: Downward or lateral movement of water through a pervious or semipervious bottom or wall of a container such as a pond or canal.

Tailwater: Agricultural runoff.

Time of Advance: The duration of time required for water to flow from the upper to the lower end of a field.

Time (Duration) of Irrigation: The duration of time that water should be sprinkled or trickled over the surface in order to replace the soil water deficit at a given point.

Transpiration: The essential water process by which water is evaporated from plant tissue and diffuses to the air.

Unaccountable Water: The difference between the quantity of water introduced into the system and the quantity delivered to the eventual consumer, usually expressed as a percentage of delivered water. Many local factors affect this percentage from system to system.

Unit Irrigation Efficiency: The ratio of the volume of water used for crop consumptive use and leaching requirement to the volume of water delivered for these purposes.

Unit Water Use: The average quantity of water used per person, acre, etc., over a specified period of time.

Water Conservation: Planned management to prevent or reduce loss or waste of water. Conservation should result in reduced water demand.

Watermaster: Supervisor of overall water distribution within the District's irrigation system and responsible for the operation of control structures in the main canals.

Wheel Row: A furrow that is tracked on by farm machinery.

Zanjero: The water tender (ditch rider) on the District's lateral system.

APPENDIX B

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APPENDIX C

ACRONYMS

AAC	All-American Canal
AF	acre-feet
ASCS	Agriculture Stabilization Conservation Service
B-E	Bookman-Edmonston Engineering, Inc.
DWR	California Department of Water Resources
CIMIS	California Irrigation Management Information System
CLSI	Canal Lining and System Improvement
CVP	Central Valley Project
EBMUD	East Bay Municipal Utility District
ET	Evapotranspiration
ft^3/s	cubic foot per second
IID	Imperial Irrigation District; District
IMS	Irrigation Management Services
KWH	kilowatt-hour
MAF	million acre-feet
MGD	million gallons per day
mg/L	Milligrams per liter
msl	mean sea level
MW	megawatt
MWD	Metropolitan Water District
Parsons	Parsons Water Resources, Inc.
PL	Public Law
SB	Senate Bill
SCADA	System Control and Data Acquisition
SCS	Soil Conservation Service of the U.S. Department of Agriculture

SWP	California State Water Project
t.a.f.	tons per acre-foot
TDS	total dissolved solids
USBR	United States Department of the Interior, Bureau of Reclamation
USDA	United States Department of Agriculture
USGS	United States Geological Survey

WATER CONSERVATION PLAN

JUNE 1986 UPDATE

IMPERIAL IRRIGATION DISTRICT

Water Conservation Plan

JUNE 1986 UPDATE

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EXECUTIVE SUMMARY

As proposed in the Imperial Irrigation District's (District) 1985 Water Conservation Plan, an update of water conservation activities has been prepared.

Brief summaries are given of the progress and status of the several conservation programs included in the 1985 and 1986 calendar year budgets; reports on activities relating to water conservation for the period January 1, 1985 through April 30, 1986, by the District Board of Directors, the Water Conservation Advisory Board, and the Water Conservation Task Group; descriptions of the negotiations between the District and the Metropolitan Water District of Southern California (MWD) of a proposed agreement to transfer water from IID to MWD in exchange for MWD funding water conservation measures such as those delineated in the Plan; and a record of the engineering work and other consulting services performed for the District by Parsons Water Resources, Inc. (Parsons).

Section 2 of this report updates records maintained by the District through 1985. These include:

(1) Maximum, Minimum and Mean Temperatures
(2) Record of Rainfall
(3) Historic Use of Colorado River Water by Four First-Three-Priority Agricultural Users
(4) Consumptive Use of Lower Colorado River Mainstream Water
(5) Flows Below Parker Dam and Below Yuma Main Spill
(6) Weighted Monthly Salinities at Selected Colorado River Stations
(7) All American Canal Distribution
(8) Imperial Irrigation District Water Delivered to Users
(9) Water Deliveries to Cities and Towns
(10) Annual Inventory of Areas Receiving Water, Years 1985, 1984, 1983
(11) Inflow to Salton Sea
(12) Salton Sea Evaporation
(13) Summary of Salt Balance

Flows from the Colorado River continued above average for the third consecutive year during 1985. Total flow in the Colorado River for calendar year

1985 was 17.0 maf, according to United States Geological Survey's Provisional Records.

Historic Colorado River Diversions were not presented in the 1985 Water Conservation Plan. In this update, use of Colorado River water by the first-three-priority agricultural users, including IID, for the 26-year period through 1985 are presented in Section 2. The last year that such use exceeded the "allowable" 3.85 maf was 1979, although 1981 was only slightly below. For the 26-year period, agricultural use exceeded 3.85 maf in 10 years. During the last four years, agricultural use has been the lowest for this 26-year period.

The Colorado River Board monthly reports include records of consumptive use of Lower Colorado River Mainstream Water, i.e., net diversions by all users in Nevada, Arizona and California. Annual Lower Colorado River Consumptive Use for the past four years, including total arrivals to Mexico, varied from 5.4 to 6.2 maf.

High flows have resulted in lower salinity in Colorado River water. Weighted monthly salinity during 1985 at Imperial Dam averaged 609 ppm compared to the 1974-1978 average of 844 ppm. District diversions at Imperial Dam into the All American Canal totalled 2,717,806 acre-feet (AF) for 1985. "Consumptive Use of Colorado River Mainstream Water" by the District, as prescribed in Arizona vs. California dated March 9, 1964, was 2,678,390 AF after return flow credits.

Deliveries to Users within the District for 1985 were 2,335,297 AF, compared to 2,386,328 AF in 1984. Municipalities received only 25,874 AF in 1985.

Total cropped acreage for 1985 was 509,881, including 56,779 multiple-cropped acres. Alfalfa continues dominate acreage with 41 percent of the total.

The elevation of the Salton Sea on December 30, 1985, was -226.85 feet. This is a drop in elevation of 0.15 feet from the same time one year earlier. Inflow to the Salton Sea from Imperial Valley was 65,541 AF less than in 1984.

For the 35th straight year a favorable salt balance has been achieved within Imperial Valley. Salt inflow from the Colorado River via the All American

Canal totalled about 2.47 million tons in 1985. District drains discharged 3.3 million tons of salt into the Salton Sea.

Total water revenues plus net interest income for 1985 totalled $24,301,994. Expenditures exceeded income by $552,669. Revenues deposited in the water conservation fund totalled $4,086,770.

The District Board of Directors has taken numerous actions related to water conservation planning and programs during 1985 and early 1986. The major actions following presentation to the Board of the draft 1985 Water Conservation Plan on January 22, 1985, included the following:

(1) Acceptance of the final 1985 Water Conservation Plan on August 13, 1985.
(2) The retention of Parsons Water Resources on April 16, 1985, to develop an implementation plan for programs described in the 1985 Water Conservation Plan.
(3) The acceptance of the reports by Parsons Water Resources entitled Water Requirements and Water Availability Study and Water Transfer Study.
(4) Adoption of the 1986 budget which included 6.5 million dollars for water conservation programs; and
(5) The authorization for Parsons Water Resources to proceed with the preparation of an Environmental Impact Report.

The Water Conservation Advisory Board met regularly from June 1985 through April 1986. This body is comprised of local water users. Major actions performed included:

(1) Presentation by Parsons of progress on the Water Requirement and Availability Study and the Water Transfer Study (June and September meetings).
(2) Review and discussion of MWD/IID water transfer negotiations, and review of draft Memorandum of Understanding (MOU).
(3) Review and discussion of completed Parsons reports (November meeting).
(4) Review and discussion of tailwater recovery program, including field tour at Veysey Ranch.

(5) Review of incentives for onfarm water conservation improvements and appointment of committee to develop and evaluate incentives.

The in-house Water Conservation Task Group, following preparation of the draft 1985 Water Conservation Plan, continued to review and respond to comments submitted by interested parties, and to edit and prepare the final plan. During the year the Task Group reviewed the progress on the 1985 programs. Exhibit 3-3, contains notes on meetings held from June 10, 1985 through April 21, 1986. Highlights of activities reported and discussed at these meetings are as follows:

(1) Implemented the Demonstration Tailwater Recovery Program. As of April 30, 1986, five tailwater recovery systems had been installed and were in operation. The sixth and last is scheduled for completion on or about July 1986.
(2) Measurements for various programs, including purchasing, testing, and installing electronic recorders.
(3) Grant and Loan applications.
(4) USBR/IID Cooperative Studies.
(5) Coordination with Parsons Water Resources.
(6) Special studies: Lateral Fluctuation, Modified Demand, Irrigation Scheduling, etc.).
(7) Preparation of 1986 budget.
(8) Review of progress on all water conservation programs, including concrete lining and tailwater monitoring.

To aid the District in the development and implementation of specific water conservation plans several engineering firms were invited to make presentations. The Ralph M. Parsons Company (Parsons) was selected from the six national firms responding.

A Letter of Intent was executed on April 19, 1985, which set forth the terms and conditions for a definitive water conservation planning and development agreement between the District and Parsons.

The intent of the letter was that the District and Parsons would cooperatively undertake a program that would (1) quantify the District's present and future water needs, (2) determine the additional water that might be available for use by others and identify the potential transferees thereof, and (3) provide for the planning, engineering, designing, financing, construction and implementation of the water conservation and transfer programs (collectively referred to as the "Program").

On May 17, 1985, the District Board of Directors authorized Parsons to proceed with initial studies. Seven major areas were to be studied and developed:

(1) Program Management, Control, and Administration.
(2) Program Procedures.
(3) Water Requirements and Availability Study.
(4) Water Transfer Study.
(5) Water Conservation Implementation Plan.
(6) Program Studies and Reports.
(7) Program Support Services (As required).

The "Water Requirements and Availability Study" was designed to quantify the District's present and future water needs. Additional water that could be made available to others was then to be determined.

The findings of the study are:

(1) The District's share of its allocated water as part of the Seven-Party Agreement will be available with greater than 99% certainty through the year 2010.
(2) Current baseline water demand within the District is 2,770,000 AF/year.
(3) With no conservation measures the baseline water demand will increase to 3 million AF/year by the year 2010.
(4) An estimated 138,000 AF/year of water has been conserved. New projects could conserve an additional 358,000 AF/year.
(5) There are 700,000 AF of groundwater available of which 300,000 AF/year can be retrieved at a cost of $32,000,000.
(6) The estimated capital cost for the post-1985 conservation program is $600,360,000, including $335,000,000 for a desalination plant.
(7) A potential 496,000 AF/year can be conserved.

The "Water Transfer Study" identifies potential water transfer candidates within the State of California.

Conclusions drawn were that:

(1) Water demand in Southern California will continue to increase.

(2) Diversion of Colorado River water to Central Arizona will impact Southern California.

(3) California laws support transfer of conserved water.

(4) Transfer of conserved water from the District is feasible.

(5) The coastal plain of Southern California incorporates the most appropriate transferees.

(6) The MWD, San Diego County Water Authority and Kern County are the most likely transferees.

(7) Conserved water from the District is the most attractive source because of location and cost.

The need arose to develop a Program Environmental Impact Report (EIR) for the implementation of water conservation projects designed to conserve up to 500,000 AF/year of water and the transfer of 250,000 AF/year of present District water allocations. A Focused EIR was also to be prepared for the potential transfer of 100,000 AF/year of water already conserved.

Seventeen consulting firms were invited to submit proposals for the two EIRs. On December 10, 1985, the Board of Directors selected Parsons Water Resources to prepare the Program and Focused EIRs. On April 15, 1986, the Draft EIR was presented to the Board. The major impacts from water conservation measures are as follows:

(1) The first 100,000 AF/year of water transferred would not have any significant environmental effect because this water has already been conserved and is not entering the IID's system.

(2) Water conservation will ensure that the IID's water availability is increased by conserving 500,000 AF/year and transferring only 250,000 AF/year.

(3) Reduction of the current level of the Salton Sea, by reducing losses and, therefore, inflow to the Sea will reduce penalty payments by the existing high sea level.

(4) Overall, there will be local and regional economic benefits from conservation expenditures, lower farm production costs and the inflow of money from outside sources for operation and maintenance

of the irrigation systems, and payment of costs for environmental mitigation measures.

Water conservation expenditures for 1985, as reported by the Finance and Accounting Operating Report dated 12/31/85 are tabulated below.

1985 Budget and Actual Expenditures
For Water Conservation

Work Order No.	Item	Expenditure	Budget
640.1 - 640.2	Reservoirs	23,876	$1,200.000
657.5000	Concrete Lining	$3 245,308	2 250,000
660.0 - 660.2	Tailwater Monitoring	483,968	444,000
660.3	Tile Recorders, Misc. Programs	53,361	194,400
660.4 - 670.2	Lateral Fluctuation	0	100,000
671.5	USBR Cooperative Studies	41,169	162,000
661.1 - 661.3	Irrigation Scheduling	215,018	188,600
671.6	Tailwater Recovery	632,757	300,000
671.7	Electronic Recorders	343,514	
671.2	Elder Evaporation Pond	913	102,300
680.0 - 681.0	Parsons' Studies	1,241 145	1,500,000
Total		$6,281,029	$6,441,300

The 1986 Budget submitted by the Water Conservation Task Group, prepared by program categories and adjusted to that approved by the Board of Directors, totals $7,928,000.

The 1986 budget assumed that loan funds in the amount of about $3 million will be available from the California Department of Water Resources by mid-year.

Actual expenditures for water conservation during the first four months of 1986, was about $1.8 million.

The District concrete lined 30.52 miles of laterals in 1985 and another 6.24 miles in 1986. A limit of $750,000 has been authorized by the General Manager for 1986 until sufficient funds become available to complete the budgeted program of $2.25 million. This will be accomplished through water sale accruals, loan funds, or other sources.

A methodology has been developed to determine water conserved by concrete lining. The following is a summary of the work done this year:

Canal	Length (Miles)	Water Conserved (AF/Year)
Wistaria Canal	1.43	221
Trifolium Extension	1.34	170
Dandelion	1.11	121
Rockwood Lateral 8	0.5	50
Rockwood	1.86	307

Cummulative annual water savings resulting from the concrete lining program through 1985 are estimated by the task group to be about 60,000 acre-feet per year.

Operation and maintenance of the seepage recovery system along the East Highline Canal allowed 14,721 AF of water to be conserved. A Parsons study estimated an annual recovery rate of 8,000 AF at the All American Canal between Drop 3 and Allison Check by seepage recovery pumps.

Operation of four regulating reservoirs resulted in the diversion of 110,301 AF during 1985. During the first four months of 1986, 37,000 AF of water were diverted for later use. It is estimated that 15,000 to 25,000 AF is conserved per year.

Two reservoirs are currently in the planning stages; Trifolium and Z Reservoirs.

The Trifolium Reservoir was one of the four projects for which a loan application was submitted to the Department of Water Resources (DWR). Funds are expected about August 1986, or later. Design work is complete, a Negative Declaration is being prepared, one parcel of land has been acquired, and a second parcel is in escrow. As a related project, a 1.34-mile section of the Trifolium Extension Canal was concrete lined earlier this year.

Under the Clean Water Bond Law of 1984, the District submitted an application for a loan to finance water conservation programs. The California Department of Water Resources (DWR), the bond coordinator, announced on May 7, 1986, that the District was one of seven applicants whose proposals would receive further review. Among the projects proposed by the District are:

Project	Amount Requested	B/C Ratio
Trifolium Reservoir	$1,600,000	3.80:1
Spill Interceptor	670,000	4.17:1
Concrete Lining South Alamo Canal	680,000	3.48:1
Concrete Lining Program	2,050,000	2.27:1

Also pending is a grant application submitted to the Soil Conservation Service (SCS), for federal assistance under Public Law 566. Specific programs included were:

(1) Determining optimum slope by soil type for land leveling.

(2) Concrete lining head ditches.

(3) Cutting length of run where feasible.

(4) Installation of tailwater recovery systems.

(5) Training for irrigation scheduling methods.

The development of a Water Balancing Accounting Program will provide a complete record of water delivered through each delivery gate.

Tailwater Monitoring continued under the same 13- and 21-Point Program rules previously in effect. A total of $249,443 was assessed in 1985, and $71,452 in the first three months of 1986. The number of heads checked has been in excess of 90 percent.

The USBR/IID Cooperative Study designated "Concrete Lining and System Improvement Study" has been conducted in accordance with the three-year agreement between the Bureau and the District. A memorandum of a staff-level meeting held between the Bureau and the District is included as Exhibit 5-4.

Extensive metering at measurement stations has been made and historical water-flow records have been entered into computer files for the East Highline Canal.

Electronic Recorders have been investigated to reduce the amount of labor required to monitor and report water flows. Ten companies demonstrated their products, three were selected for testing, and a unit utilizing a float and potentiometer was selected. This type of electronic recorder is being used on two District laterals as part of the lateral fluctuation study. The goal of the program is to identify structural problems and operational procedures which cause fluctuations in flow, resulting in variable deliveries to water users. This study will also be used to calibrate a system computer model being developed by Parsons.

Operational discharge is being determined under a random sampling program of the 241 spill locations; 30 are being sampled on a continuous basis. Yearly spill estimates will be determined and an operational discharge reduction plan prepared.

Annual reports to provide estimates of the total tile drain discharge have been prepared. This is a part of the leaching requirements study as well as contributing to an understanding of water balance within the District. The total tile discharge for the period August 1984 to May 1985, is estimated to be between 246,000 AF and 267,000 AF.

The District has completed four years of research on developing methods of controlling hydrilla in the waterway system. Research conducted in cooperation with Coachella Valley Water District has demonstrated the economical and effective use of triploid grass carp to consume aquatic vegetation. The District is currently using a variety of this fish called the "triploid" grass carp because it is assumed to be sterile, thereby reducing the concern of overpopulating District canals, thus having a negative impact on other resident fish, such as the largemouth bass, channel catfish, flathead catfish, and bluegill.

During the summer of 1985, 7,800 fish were placed in about 1.5 miles of the All-American Canal with very heavy hydrilla growth. The high stocking rate resulted in total removal of all hydrilla in about 8 weeks.

More recently, about 50,000 small (about 8 inches and 1/4 pound) triploid grass carp have been stocked into about 90 percent of the hydrilla-infested waters of the All-American Canal, Central Main Canal, Westside Main Canal system, and Sheldon and Fudge Reservoirs.

Demonstration Tailwater recovery systems - "pumpbacks" - were installed on five fields during 1985; a sixth system is to be installed in July, 1986.

The purpose of this program is to determine the effectiveness, potential problems and associated costs of tailwater recovery systems on different soils, slopes, crops, etc. Delivery, tailwater, recycled tailwater, water salinity, soil salinity, and temperature are being monitored.

Preliminary data shows that a substantial amount of tailwater can be conserved using these systems. Projections show that savings are in the range of 1 AF of water per cultivated acre.

The Irrigation Scheduling Program was increased to 15,000 acres in 1985, after termination of the three-year cooperative agreement with the U.S. Bureau of Reclamation (USBR).

Theoretically, irrigation scheduling could be the major, and possibly only onfarm program needed to conserve water. The program in its various forms, is intended to provide the farmer with data to show how much water to apply and when. With proper irrigation application techniques could concerve up to 100,000 acre-feet of water per year.

A broad-crested weir, developed by the Agricultural Research Service, has been used extensively in the District's Irrigation Scheduling Program to measure delivery. In conjunction with the weir, a water-level recorder has been used to record the totalized discharge. Although the broad-crested weir is an excellent tool for measuring delivery ($\pm$ 2 percent accuracy), it is not practical for use in measuring all deliveries in the District.

The District has received a grant of $25,000 per year for three years, from the DWR to develop an irrigation scheduling program using the California Irrigation Management Information Service (CIMIS) program. A practical computer program will be made available to all District water users. The CIMIS products will be regularly printed information and access to computer information via the telephone system.

As suggested by the Water Conservation Advisory Board a modified demand program was conducted during mid-1985. This program provides more flexibility to the water user. Further analysis will be made on the data obtained.

The Leaching Requirement Study has two elements; the first is to quantify total flow from tile lines, and the second element is to quantify deep percolation. During the summer of 1985, approximately 2,400 samples were collected from fields, primarily those involved in the pumpback project. These samples have been analyzed and the results of about 1,500 tests entered into a computer data base for later interpretation. This program is being coordinated with the several other ongoing studies.

In order to keep the general public informed on water conservation activities and to receive direct input, several public meetings were held during 1985 and early 1986. Six meetings were held at various locations to review the Draft Memorandum of Understanding (MOU) between the Metropolitan Water District (MWD) and the District. As a result of public input the Board has set aside the MOU and new negotiations have been held with MWD. Other meetings were held to receive input for the preparation of the EIR on the District's Water Conservation Plan and Transfer Program being developed by Parsons Water Resources. During several meetings it was suggested that the District should share the benefits of any outside funding obtained through the sale of conserved water. An Incentive Program is being developed by the Water Conservation Advisory Board,

This Update presents a listing and description of the several components of the District's continuing water conservation programs being undertaken in accordance with the 1985 Water Conservation Plan. Until outside funding is available, it is recommended that the current level of effort in water conservation continue with emphasis on expanding and improving the data base, planning, and construction of physical works such as concrete lining, as limited funds allow.

IMPERIAL IRRIGATION DISTRICT
WATER CONSERVATION PLAN
JUNE 1986 UPDATE

SECTION 1

Introduction

This report provides an update of water conservation activities and other matters relating to the District's 1985 Water Conservation Plan.

Brief summaries are given of the progress and status of the several conservation programs included in the 1985 and 1986 calendar year budgets; reports on activities relating to water conservation for the period January 1, 1985 through April 30, 1986, by the District Board of Directors, the Water Conservation Advisory Board, and the Water Conservation Task Group; descriptions of the negotiations between the District and the Metropolitan Water District of Southern California (MWD) of a proposed agreement to transfer water from IID to MWD in exchange for MWD funding water conservation measures such as those delineated in the Plan; and a record of the engineering work and other consulting services performed for the District by Parsons Water Resources, Inc. (Parsons).

The Board of Directors of Imperial Irrigation District adopted Resolution 19-85 on August 13, 1985 accepting the 1985 Water Conservation Plan (Plan) as the official plan of the District. The Plan was prepared by an in-house Water Conservation Task Group, with review by District staff and outside consultants.

A draft of the Plan was submitted to the Board of Directors on January 22, 1985 at which time the Board approved distribution of the draft to all interested parties for a sixty-day comment period. Distribution of the draft Plan was made to individuals and representatives of local, state and federal agencies, as shown in Exhibit 1-1

Comments were received from six individuals and representatives as noted in Exhibit 1-1, and incorporated into the final document, where appropriate. Over 80 copies of the final 1985 Plan were distributed as shown in Exhibit 1-2.

The conclusions of the 1985 Water Conservation Plan stated that it was a general plan to improve the structural facilities - conveyance, storage and irrigation (onfarm) - as well as nonstructural systems and procedures - administrative, operation, maintenance, ordering, scheduling, recordkeeping, etc. It was also recommended that the Plan should be reviewed annually by the Board of Directors and modified as conditions change.

Accordingly, the report herein prepared by the Water Conservation Task Group and designated Water Conservation Plan, June 1986 Update, is in compliance with the latter recommendation.

EXHIBIT 1-1
RECIPIENTS OF DRAFT WATER CONSERVATION PLAN
DATED JANUARY 31, 1985

Recipient	Written Comments Received
Bechtel Civil and Minerals, Inc.	*
Bookman-Edmonston Engineering, Inc.	1/29/85
California Department of Fish & Game	None
Carter, R. F.	None
Chevron Oil Company	None
CH^{2}M Hill, Inc.	*
Colorado River Board	3/21/85
Cooperative Extension Service, University of California, Attn: Robert M. Hagan	None
Department of Water Resources, Chief Southern District	None
Department of Water Resources, Attn: Suzanne Butterfield, Office of Water Conservation	None
Coachella Valley Water District	3/29/85
Gray, Carey, Ames & Frye	None
Harza Engineering Company	*
Heber Geothermal Company	None
Horton, Knox, Carter & Foote	None
Imperial, County of, Board of Supervisors	None
Imperial Valley Press	None
Jennings, Engstrand, Hendrikson	None
Kuhn, Fritz	None
Magma Power Company	None
Metropolitan Water District of Southern California	3/29/85
Morrison-Knudsen Engineers, Inc.	*
Palo Verde Irrigation District	4/18/85
The Ralph M. Parsons Company	*
Peace, Stephen, Assemblyman, 80th District	None
Republic Geothermal Company	None
San Diego County Water Authority	None
San Diego Gas & Electric Company	3/6/85
San Diego Union (Cheryl Clark)	None
State Water Resources Control Board, Attn: Raymond L. Walsh, Chief, Division of Water Rights	6/28/85
Sutherland & Gerber	None
U. S. Bureau of Reclamation, Regional Director, Boulder City, NV	4/9/85
U. S. Bureau of Reclamation, Yuma Projects Office	None
U. S. Department of Agriculture Agricultural Research Service, Irrigated Desert Research Station, Brawley, CA	None
U. S. Department of Agriculture, Soil Conservation Service, El Centro	3/25/85
Union Oil Company	None
University of California, Department of Land, Air and Water Resources	None
Water Conservation Advisory Board Members	None

*Submitted proposal for consulting work.

EXHIBIT 1-2
RECIPIENTS OF FINAL 1985 PLAN

Recipient	Number Received
Association of California Water Agencies	1
Bergeson, Marion	2
Bookman-Edmonston Engineering Company	1
Brawley, City of	1
Brawley Public Library	1
Calexico Public Library	1
California Municipal Utilities Assn.	1
California Regional Water Quality Control Board	1
California Department of Fish & Game (Regional Manager)	1
California Department of Fish & Game (Director)	1
California Department of Water Resources (California Water Commission)	2
California Department of Water Resources	1
California Water Resources Control Board	5
Chevron Oil Company	1
Coachella Valley Water District	1
Calipatria, City of	1
Colorado River Board	1
Cranston, Alan	1
Czajkowski, Mr. WLMJ	1
Dowd Public Library	1
El Centro, City of	1
El Centro Public Library	1
Ferguson Company	1
Heber Geothermal Company	1
Holtville, City of	1
Hunter, Duncan	1
Imperial, City of	1
Imperial, County of, Board of Supervisors	1
Imperial, County of, Director of Public Works	1
Imperial, County of, Planning Director	1
Imperial County Farm Bureau	1
Imperial Irrigation District (Directors)	5
Imperial Irrigation District (Staff)	12
Imperial Valley Press	1
Imperial Valley College	1
Jennings, Engstrand & Hendrikson	1
Kern County	1
Los Angeles Department of Water & Power	1
Magma Power Company	1
Metropolitan Water District	5
Palo Verde Irrigation District	1
Parsons Corporation	3
Peace, Stephen	1
Republic Geothermal Company	1
San Diego County Water Authority	3
San Diego Gas & Electric Company	1
San Diego State University (Imperial Valley Campus)	1
Southern California Edison Company	1

Strong, David (Cooperative Extension Service)	1
Union Oil Company	1
U.S. Bureau of Reclamation (Regional Director)	3
U.S. Bureau of Reclamation (Yuma Projects Office)	1
U.S. Department of Agriculture (Agricultural Research Service)	1
U.S. Department of Agriculture (Soil Conservation Service)	2
University of California	1
University of Southern California	1
Ventura County	1
Wilson, Pete	1
Western Water Education Foundation	1

SECTION 2

Updating the Records

Chapter II of the 1985 Water Conservation Plan presented historic records generally through calendar year 1984, with some records through 1983 only.

In this section, hydrologic, hydraulic, cropped acreage and other records are updated through 1985.

Weather Records

Table 2.1 presents temperature records for the District's weather station at Imperial (official) National Weather Service station, "Imperial, California"), for the period of record, 1914 through 1985. Table 2.2 shows rainfall for the same station and period. The maximum temperature in 1985 was 116°F on August 24, and the minimum was 28°F on February 1, 1985. Rainfall for the year was 3.74 inches compared to the 72-year average of 2.93 inches. Rainfall recorded for 21 days varied from a trace, to 1.02 inches on September 18, 1985.

Colorado River

Table II.3 in the 1985 Water Conservation Plan listed Annual Natural Flow of the Colorado River at Lee Ferry (Compact Point) for Water Years 1964 through 1983.

Runoff of the Colorado River continued above average for the third consecutive year during 1985. Colorado River Board (CRB) records show that runoff at Lee Ferry for calendar years 1984 and 1985 was 21.2 million acre-feet (maf) and 17.5 maf, respectively. The United States Geological Survey (USGS) provisional records 1/ for the same calendar years show 20.9 maf and 17.0 maf, respectively. It is interesting to note that the Metropolitan Water District (MWD) which reports flow data for their fiscal year (July - June), noted 2/ that the gaged flow at Lee Ferry for FY 1984 was 22.36 maf, only slightly below the record water-year runoff of 23.14 maf in 1982-83. The MWD also reports that releases from Lake Mead were 19.6 maf and 23.68 maf in FY 1984 and FY 1985, respectively.

1/ The sum of monthly provisional reports from the USGS, Lower Colorado River Diversions and Return Flows.

2/ The Metropolitan Water District of Southern California, Annual Reports for 1984 and 1985, Los Angeles, California.

Table 2.1

IMPERIAL IRRIGATION DISTRICT

MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1985, INCLUSIVE

	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE			JULY		
YEAR	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1914				No records for these months									100	51	75.4	112	58	84.4	110	70	89.8
1915	73	30	53.5	79	40	59.2	92	41	63.4	96	48	69.0	103	41	73.3	109	57	85.1	110	62	88.9
1916	75	25	52.3	88	29	61.8	100	42	67.8	100	44	71.8	105	50	75.9	116	55	85.4	111	62	89.9
1917	76	30	50.4	82	32	57.4	93	32	58.8	98	41	66.7	99	48	71.0	117	56	85.5	113	70	91.3
1918	85	26	53.7	88	28	57.1	95	40	64.7	96	44	69.5	98	50	73.0	113	59	88.7	110	59	89.6
1919	82	24	51.6	82	32	56.1	89	35	60.4	100	48	71.8	101	55	77.0	114	57	85.4	111	73	90.7
1920	81	33	55.6	82	41	60.5	85	38	61.1	96	44	68.0	106	41	76.2	108	58	82.8	115	63	91.3
1921	79	28	52.2	93	32	54.2	93	41	66.3	102	40	66.9	104	46	72.5	110	57	84.2	111	63	91.0
1922	75	23	49.5	90	28	55.7	89	32	58.8	96	40	65.1	106	46	77.1	114	62	86.5	111	69	90.3
1923	85	28	56.1	87	30	56.7	89	34	60.4	95	42	67.8	107	52	78.1	114	54	79.5	113	67	88.6
1924	81	27	53.6	91	37	64.2	92	38	66.0	95	39	70.4	107	53	79.8	113	60	88.9	111	65	89.8
1925	82	27	52.6	85	35	61.2	94	39	64.4	100	44	70.7	103	54	78.6	114	55	84.3	115	64	90.6
1926	85	29	53.9	88	33	61.5	91	42	66.9	105	50	73.0	104	55	78.6	113	62	86.9	112	62	90.3
1927	76	32	55.3	87	34	59.6	92	38	62.2	102	41	70.8	110	53	78.7	111	54	84.0	114	68	91.7
1928	86	29	56.2	84	33	57.6	91	42	66.0	96	39	69.6	105	53	77.9	112	57	85.2	114	62	90.3
1929	79	25	50.7	88	24	55.0	95	36	61.9	98	36	66.0	102	49	77.7	117	54	83.9	111	69	90.7
1930	77	28	52.7	89	34	61.0	92	34	62.4	99	45	71.9	104	43	71.7	112	57	83.4	112	68	90.2
1931	85	29	54.8	76	38	58.5	95	37	64.5	97	51	72.5	108	55	80.0	111	58	84.7	116	75	95.2
1932	75	25	49.7	87	28	57.2	94	40	64.1	98	47	69.2	102	52	76.9	110	58	84.2	111	63	89.9
1933	76	29	50.2	78	23	51.1	87	39	63.4	96	45	66.2	106	44	73.4	111	57	84.0	117	65	92.9
1934	81	30	56.5	82	40	62.9	101	42	72.6	102	42	75.5	112	54	82.2	106	52	80.5	118	66	93.7
1935	84	29	55.4	84	36	60.1	89	36	60.1	95	43	69.7	102	51	75.0	113	58	88.6	113	61	90.2
1936	78	31	54.9	83	35	59.3	93	41	67.2	101	43	73.3	106	51	80.6	117	54	88.0	119	63	92.4
1937	68	16	43.8	82	31	55.7	88	41	61.2	98	46	69.0	108	53	77.2	110	58	84.7	117	72	94.6
1938	80	33	56.8	82	34	57.1	88	38	61.4	105	40	69.7	111	50	77.9	112	58	85.7	115	62	91.7
1939	78	35	53.6	81	32	42.3	95	32	63.4	102	48	73.2	108	55	79.2	114	59	85.1	118	66	92.2
1940	83	32	57.8	83	35	58.5	91	39	66.8	103	52	72.3	108	61	82.7	117	62	88.4	116	61	90.8
1941	74	38	56.5	78	44	61.0	87	43	63.8	95	45	67.3	105	48	79.6	108	58	83.4	114	66	91.6
1942	80	27	56.4	78	33	56.3	93	38	62.5	94	45	69.1	110	46	76.7	113	58	85.6	118	71	94.5
1943	85	25	55.6	85	32	60.5	95	44	67.0	100	45	72.1	106	55	79.0	110	53	81.5	119	62	89.9
1944	80	31	53.9	78	32	54.5	88	39	61.3	99	47	69.3	100	50	76.3	110	57	79.9	112	64	87.9
1945	81	33	55.9	82	36	58.5	88	37	60.3	100	35	68.5	100	54	76.1	114	58	83.5	113	72	91.9
1946	78	31	54.9	86	31	56.3	87	40	62.3	101	44	73.1	103	56	77.0	111	60	87.6	111	67	91.5
1947	83	28	52.9	85	39	61.7	88	42	64.8	104	45	72.9	116	52	79.7	110	61	84.7	113	67	92.3
1948	84	25	54.8	85	26	56.9	85	35	59.0	100	41	70.5	104	50	77.3	114	54	83.7	113	65	89.8
1949	71	21	45.3	82	28	53.8	85	41	61.6	102	45	73.3	106	53	77.0	110	57	86.1	115	66	90.7
1950	82	21	51.7	85	34	61.0	95	36	64.9	101	45	73.6	103	49	75.5	118	57	83.6	117	65	89.8
1951	84	32	54.4	88	31	57.5	88	33	62.4	98	46	69.7	111	47	77.4	110	56	83.2	113	63	91.4
1952	75	26	51.4	81	35	58.0	87	37	59.4	95	50	69.5	105	56	81.6	110	55	82.7	111	67	90.5
1953	86	34	59.9	85	30	58.3	91	35	63.5	97	44	68.4	99	49	72.4	113	53	83.6	114	72	93.6
1954	84	31	56.0	92	41	64.4	90	37	61.9	103	45	74.5	102	50	78.0	112	53	83.5	116	71	92.9
1955	77	35	51.9	83	29	55.2	92	35	63.6	88	50	69.0	103	48	74.9	113	55	84.1	113	64	88.7
1956	80	35	58.1	80	29	54.3	93	33	64.9	98	41	68.9	104	52	76.8	113	59	87.1	110	64	90.2
1957	74	30	54.6	89	34	63.7	91	40	64.9	94	45	69.8	102	55	73.8	117	62	88.7	116	71	93.1
1958	80	35	57.5	81	40	61.6	80	38	60.7	102	42	70.4	109	54	82.6	112	61	86.1	117	67	91.2
1959	85	33	58.3	83	37	57.3	91	41	66.9	102	49	74.3	99	51	76.1	116	62	88.8	113	73	94.3
1960	79	27	52.1	81	31	56.9	92	43	67.8	97	47	73.1	109	52	77.8	113	65	89.6	115	69	93.1
1961	83	34	58.0	82	38	60.9	89	43	64.3	103	50	72.3	102	50	76.0	116	56	88.1	114	64	91.2

IMPERIAL IRRIGATION DISTRICT

MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1985, INCLUSIVE

YEAR	JANUARY Max.	JANUARY Min.	JANUARY Mean	FEBRUARY Max.	FEBRUARY Min.	FEBRUARY Mean	MARCH Max.	MARCH Min.	MARCH Mean	APRIL Max.	APRIL Min.	APRIL Mean	MAY Max.	MAY Min.	MAY Mean	JUNE Max.	JUNE Min.	JUNE Mean	JULY Max.	JULY Min.	JULY Mean
1962	87	25	55.4	81	28	59.1	89	32	59.7	101	50	74.5	101	48	73.5	111	57	84.4	110	68	90.4
1963	73	24	52.0	90	42	65.3	88	39	62.6	95	43	67.5	104	52	79.2	110	51	82.0	114	69	91.1
1964	77	30	52.0	80	32	56.2	91	36	61.5	99	47	68.4	102	45	76.2	112	60	84.0	116	72	92.1
1965	82	33	57.2	88	31	59.5	84	36	62.1	101	44	70.1	105	52	76.9	105	57	80.6	113	69	90.6
1966	77	30	52.8	77	32	55.9	97	34	65.7	98	49	73.6	103	58	80.4	110	62	86.3	115	71	92.3
1967	81	30	55.4	85	38	60.3	91	42	66.0	88	45	63.3	107	48	76.5	111	57	82.7	113	75	93.3
1968	79	33	55.7	90	44	65.4	92	44	66.0	98	46	69.5	108	55	78.7	115	60	86.6	114	68	91.4
1969	82	33	59.5	76	36	57.5	96	38	63.3	95	49	71.1	107	54	80.1	109	62	82.9	115	67	92.8
1970	79	29	55.3	83	39	61.6	90	43	63.9	94	43	66.9	109	53	78.8	119	58	86.8	113	71	93.1
1971	90	23	55.3	89	31	59.2	98	32	64.8	94	44	68.5	99	54	73.8	112	54	84.2	113	67	92.3
1972	75	24	52.9	86	30	61.8	94	46	70.8	96	42	71.7	102	54	78.3	114	66	86.0	116	73	94.0
1973	77	30	53.3	77	40	59.5	80	43	60.7	97	46	68.5	107	54	80.1	117	57	87.9	115	70	91.2
1974	81	28	56.0	81	38	58.3	90	40	65.6	96	47	70.5	111	51	78.7	116	59	89.4	112	69	91.2
1975	83	31	55.1	83	34	57.6	86	40	61.5	88	42	63.7	105	50	75.8	110	59	85.1	115	71	91.7
1976	86	29	57.2	84	40	60.9	89	42	63.0	99	45	67.7	106	55	79.3	115	50	86.8	115	66	90.6
1977	80	33	56.7	91	39	63.3	87	39	60.8	98	43	72.2	105	53	72.6	115	66	88.3	113	72	93.0
1978	76	37	57.4	82	39	60.6	95	47	67.6	93	48	69.3	107	54	78.7	115	62	90.9	116	68	93.6
1979	74	31	52.6	79	35	58.9	89	42	64.1	97	46	71.9	102	52	77.2	115	61	87.6	115	68	91.9
1980	77	38	60.1	85	39	63.2	86	46	63.3	101	46	70.7	101	52	73.9	114	59	87.4	116	73	94.9
1981	83	42	60.9	90	39	61.8	91	44	64.4	97	47	72.9	103	56	78.4	114	65	90.5	112	73	93.2
1982	76	33	55.8	86	37	61.7	83	41	63.5	94	44	76.7	101	52	70.9	108	59	82.8	113	61	90.5
1983	82	35	59.0	85	42	60.5	90	46	65.2	90	45	66.7	114	52	78.9	108	57	84.3	114	67	92.0
1984	82	35	58.7	83	38	60.3	95	40	66.7	101	48	70.2	111	58	83.0	111	61	85.7	112	75	91.9
1985	73	36	54.8	85	28	57.6	86	39	63.8	101	54	74.3	101	57	79.2	114	61	88.6	116	72	93.3
Average	79.7	29.8	54.6	84.0	34.3	58.8	90.5	39.0	63.7	98.0	44.9	70.2	104.9	51.6	77.3	112.5	58.0	85.3	113.8	67.4	91.5

IMPERIAL IRRIGATION DISTRICT

MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1985, INCLUSIVE

YEAR	AUGUST Max.	AUGUST Min.	AUGUST Mean	SEPTEMBER Max.	SEPTEMBER Min.	SEPTEMBER Mean	OCTOBER Max.	OCTOBER Min.	OCTOBER Mean	NOVEMBER Max.	NOVEMBER Min.	NOVEMBER Mean	DECEMBER Max.	DECEMBER Min.	DECEMBER Mean	FOR YEAR Max.	FOR YEAR Date	FOR YEAR Min.	FOR YEAR Date	MEAN FOR YEAR
1914	113	64	88 7	108	60	84 1	100	52	73 4	91	41	65 6	No Record			113	8- 3	Incomplete		
1915	117	64	90 6	109	52	81 2	104	50	75 5	91	30	60 8	82	28	54 1	117	8-10	28	12-17	71 2
1916	111	56	87 7	110	57	83 1	95	43	68 2	90	30	58 5	79	25	51 2	116	6-15	25	1-12	71 1
1917	109	62	88 9	108	53	85 3	106	44	76 2	90	38	63 7	89	31	58 3	117	6-16	30	1- 5	71 0
1918	114	55	86 7	105	56	83 1	110	44	74 7	86	32	59 4	82	28	50 5	114	8- 2	26	1-11	70 9
1919	113	67	90 3	107	60	83 7	94	36	68 3	88	31	59 7	82	31	55 6	114	6-26	24	1- 1	70 9
1920	111	58	87 8	108	53	81 8	102	41	65 7	86	34	58 2	78	29	52 9	115	7- 8	29	12-14	70 1
1921	110	68	88 5	107	57	82 6	103	43	75 1	93	32	62 2	81	33	53 4	111	7-22	28	1-12	70 8
1922	110	67	88 8	113	59	87 2	100	42	73 3	85	34	58 2	79	34	56 6	114	6-29	23	1-23	70 6
1923	107	67	87 6	109	51	80 7	97	44	69 7	83	35	62 1	78	32	52 8	114	6-29	28	1- 3	70 2
1924	113	61	89 0	108	48	84 2	100	44	69 4	93	34	61 6	83	23	53 1	113	6-28	23	12-26	72 5
1925	109	67	88 0	104	52	80 7	101	46	70 4	90	33	60 4	80	31	56 0	115	7-16	27	1-11	71 1
1926	110	63	89 4	106	53	82 6	100	44	73 1	92	39	63 4	78	27	52 1	113	6-26	27	12-27	72 6
1927	115	72	90 9	106	56	82 8	101	43	73 8	98	37	63 9	85	31	53 4	115	8-10	31	12- 8	72 3
1928	113	60	88 5	113	54	85 5	102	45	72 2	88	31	61 2	79	29	53 0	114	7-24	29	1-18 & 12-17/21	71 9
1929	111	73	90 5	112	54	80 8	104	40	73 8	88	30	59 2	84	31	58 0	117	6-24	24	2-8/9	70 8
1930	110	63	87 6	110	51	79 7	100	46	70 2	92	31	61 0	77	26	51 5	112	6- 7 & 7- 2,11,15	26	12-22	70 3
1931	112	70	89 9	111	58	83 0	98	51	73 1	93	27	58 0	75	28	51 1	116	7- 2	27	11-23/25	72 2
1932	114	62	89 9	112	60	85 6	102	45	71 8	87	40	63 2	80	30	50 8	114	8- 5	25	1-27	71 0
1933	118	67	91 5	109	59	84 9	105	50	77 9	91	37	63 5	82	29	55 8	118	8-11	23	2- 8	71 2
1934	117	71	94 0	114	53	86 5	109	49	77 5	94	38	65 6	81	31	57 2	118	7-26/27, 7-30/31	30	1- 9	75 5
1935	115	70	90 6	109	63	87 4	99	42	72 9	81	36	59 5	78	33	56 1	115	8-11	29	1-22	72 2
1936	112	67	91 8	108	52	83 7	103	47	74 2	90	36	62 3	76	32	54 8	119	7-14/16	31	1-19	73 6
1937	115	65	93 6	112	61	88 3	99	54	75 9	91	40	64 3	82	33	58 7	117	7- 2	16	1-22	72 4
1938	114	65	90 7	108	64	87 2	101	46	72 5	84	29	57 2	88	35	57 3	115	7-19	29	11-25/28	72 2
1939	111	75	92 7	112	58	82 1	95	44	72 4	91	44	64 7	85	32	59 7	118	7-13	32	2- 3/10 3-1;12-28	72 7
1940	117	66	92 3	110	62	84 3	101	48	75 1	86	38	61 1	85	30	58 6	117	6-13	30	12-15	74 1
1941	109	65	87 2	104	53	79 1	100	47	69 5	91	30	64 2	82	37	56 6	114	7-10/20	30	11-20	71 7
1942	113	62	91 8	109	60	84 1	101	45	73 9	88	36	63 3	81	32	57 1	118	7-24/25	27	1- 7	72 6
1943	110	67	88 9	113	64	87 7	105	45	74 8	86	36	62 3	74	35	54 7	119	7-25	25	1-19	73 0
1944	115	65	91 5	111	57	85 7	101	55	76 1	85	35	60 9	77	33	55 9	115	8-11	31	1- 9/10	71 2
1945	110	68	90 2	114	56	86 7	101	49	76 2	91	39	61 7	80	31	54 1	114	6-19 & 9-5	31	12-14/16	72 1
1946	113	68	92 0	111	63	86 6	96	46	70 1	81	38	59 0	82	35	57 3	113	8- 2	31	1-11/31; 2- 3	72 4
1947	113	60	89 2	113	64	87 5	105	49	74 5	89	30	57 9	74	28	51 6	116	5- 3	28	1- 4&12/14	72 4
1948	115	65	91 3	118	54	87 0	103	46	75 5	83	34	58 9	76	31	52 1	118	9- 3	25	1- 1	71 4
1949	114	61	89 8	112	64	89 7	102	41	71 5	93	43	67 8	87	26	52 8	115	7-14	21	1- 4	71 6
1950	116	66	90 5	118	58	82 8	106	54	78 7	98	34	67 2	84	35	60 6	118	6-30 & 9-1	21	1- 4	73 3
1951	111	66	89 6	109	62	86 8	105	50	75 6	85	38	60 7	78	30	54 6	113	7-31	30	12- 9	71 9
1952	112	72	92 2	112	51	87 6	108	57	81 6	88	34	58 9	84	32	55 1	112	8- 3&9-1/2	26	1- 4	72 4
1953	111	61	90 6	111	61	86 4	101	48	75 2	90	37	64 6	82	26	54 6	114	7- 2	25	12-25	72 7
1954	113	66	88 9	108	54	86 5	101	46	76 5	89	43	66 9	79	27	55 7	116	7-28	27	12-29	73 8
1955	110	72	90 9	113	60	86 5	104	52	77 7	89	40	63 4	84	37	57 8	113	6- 9/22, 7-15/9-6	29	2-20	72 0

IMPERIAL IRRIGATION DISTRICT

MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1985, INCLUSIVE

YEAR	AUGUST Max.	AUGUST Min	AUGUST Mean	SEPTEMBER Max.	SEPTEMBER Min.	SEPTEMBER Mean	OCTOBER Max.	OCTOBER Min.	OCTOBER Mean	NOVEMBER Max.	NOVEMBER Min.	NOVEMBER Mean
1956	111	60	88 3	113	64	90 5	100	44	73 5	92	33	62 0
1957	114	63	90 3	110	61	86 3	101	51	71 9	82	37	60 3
1958	111	77	92 9	109	60	87 7	103	50	78 3	90	32	63 3
1959	112	66	90 6	111	60	83 7	101	45	76 5	88	36	64 6
1960	115	69	91 5	111	64	88 5	103	50	75 2	90	39	62 7
1961	111	64	90 7	105	59	82 6	103	43	73 5	83	37	60 5
1962	113	69	93 6	110	61	87 1	102	55	76 0	93	42	66 3
1963	110	72	90 3	111	66	87 3	102	58	78 1	89	42	64 5
1964	111	68	90 5	107	61	83 7	105	55	79 3	86	33	60 7
1965	111	70	91 2	110	58	82 0	105	53	78 4	90	41	66 0
1966	111	70	92 6	109	62	86 1	95	49	74 6	94	43	65 1
1967	113	74	93 5	104	65	85 5	97	54	77 7	94	44	67 9
1968	108	65	88 6	113	58	85 5	98	53	76 0	88	42	65 9
1969	117	75	95 9	113	65	88 7	102	51	72 5	89	42	64 7
1970	114	72	93 5	111	57	84 5	98	42	72 9	87	43	63 8
1971	110	71	91 3	115	56	85 6	102	36	69 9	87	39	61 7
1972	116	68	89 5	107	61	84 2	104	52	72 0	84	41	60 5
1973	111	64	91 0	110	60	83 8	99	50	75 4	92	40	63 9
1974	112	68	90 7	110	67	88 6	102	49	75 8	88	40	64 2
1975	115	69	91.8	109	66	87 7	103	43	73 3	92	37	63 3
1976	111	64	89 1	105	66	82 6	98	47	75 0	92	33	65 9
1977	112	72	91 6	111	60	85 6	99	51	78 3	89	41	66 3
1978	111	65	91 6	107	60	84 7	105	57	79 9	89	42	63 0
1979	112	69	88 7	111	70	90 0	103	47	78 0	84	34	62 3
1980	113	65	91 1	110	63	86 6	110	48	76 6	94	38	64 9
1981	116	69	93 9	107	66	88 5	96	48	73 0	90	44	66 5
1982	113	73	92 4	116	56	84 5	95	50	73 8	84	43	61 9
1983	111	69	89 8	112	64	89 4	96	61	77 5	90	39	64 9
1984	116	76	91 8	112	67	89 9	102	49	72 8	89	38	63 3
1985	117	68	92 1	107	58	80 9	100	54	74 3	88	36	61 2
Average	112 6	66 8	90 6	110 0	59 1	85 2	101 4	47 9	74 4	89 0	36 9	62 6

YEAR	DECEMBER Max.	DECEMBER Min	DECEMBER Mean	FOR YEAR Max.	FOR YEAR Date	FOR YEAR Min.	FOR YEAR Date	MEAN FOR YEAR
1956	81	29	56 7	113	6-12, 9- 2	29	2- 3,12- 9	72 7
1957	82	36	57 9	117	6-24	30	1-27	73 0
1958	90	36	59 6	117	7- 9	32	11-17	74 4
1959	83	36	56 1	116	6-22	33	1- 5	73 9
1960	78	28	54 9	115	7-16 & 8-13	27	1- 3	73 6
1961	77	33	55 2	116	6-25	33	12-12	72 8
1962	83	34	58 0	113	8-25	25	1-12	73 2
1963	80	33	56 0	114	7-14	24	1-13,14	73 0
1964	85	32	56 8	116	7-12	30	1- 9,10	71 9
1965	80	36	55 2	113	7- 4	31	2-12	72 6
1966	82	32	57 4	115	7- 6	30	1- 4,22	73 7
1967	78	33	53 2	113	7- 1,2 & 8-29	30	1- 7	73 0
1968	75	27	52 4	115	6-22	27	12-22	73 5
1969	77	33	57 7	117	8- 4	33	1-30	74 0
1970	78	37	55 2	119	6-25	29	1- 3	73 1
1971	72	31	52 5	115	9-12	23	1- 5,7	71 7
1972	78	28	54 2	116	7-31 & 8- 1	24	1- 5	73 0
1973	80	37	57 5	117	6-27	30	1- 6,7	72 8
1974	79	30	53 7	116	6-27	28	1- 3	73 6
1975	85	32	57 2	115	7-11 & 8-4	31	1- 2,4	72 1
1976	79	33	56 5	115	6-27 & 7- 6,7	29	1- 1,2,3	72 9
1977	83	41	59 6	115	6-28 & 6-29	33	1-10	74 1
1978	75	29	53 0	116	7-19,20	29	12- 8,9	74 3
1979	85	37	59 0	115	6-13,27 & 7-10,24	31	1- 2	73 6
1980	85	40	61 4	116	7-27	38	1- 5 & 11-18	74 5
1981	81	36	59 8	116	8-27	36	12-23	75 3
1982	75	35	55 4	116	9- 2	33	1- 4	72 6
1983	76	36	58 8	114	7-12 & 13	35	1- 1,2&4	74 0
1984	71	34	54 6	116	8-30	34	12-15	74 1
1985	80	33	57 1	117	8-24	28	2-1	73 2
Average	79 2	31 4	54 8	115 3		28 4		72 5

Table 2.2

INPERIAL IRRIGATION DISTRICT
RECORD OF RAINFALL IN INCHES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1914	0.06	0.62	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.25	0.90	0.93	2.83
1915	2.30	0.02	0.10	0.28	0.00	0.00	0.00	0.60	0.02	0.00	0.00	0.00	3.32
1916	1.09	0.00	1.41	0.25	0.00	0.00	0.00	1.25	0.40	0.00	0.00	0.40	4.80
1917	1.32	0.00	0.00	0.10	0.00	0.00	0.20	0.00	0.02	Trace	0.00	0.00	1.64
1918	0.63	0.06	0.72	0.00	0.00	Trace	Trace	0.00	0.00	Trace	0.07	0.35	1.85
1919	0.08	0.40	0.26	0.00	0.02	0.00	0.08	0.00	0.89	0.28	0.84	Trace	2.85
1920	0.88	1.52	0.06	0.00	Trace	0.00	Trace	1.05	1.30	0.10	0.00	0.00	4.91
1921	0.47	0.00	0.03	0.00	0.12	0.00	0.06	2.84	0.85	0.00	0.00	1.66	6.03
1922	0.68	0.75	Trace	0.00	Trace	Trace	0.78	Trace	0.11	0.00	0.22	0.03	2.57
1923	0.09	0.10	0.40	0.20	0.00	0.00	0.02	0.02	0.59	0.02	1.29	0.78	3.51
1924	0.00	0.00	0.17	Trace	0.14	Trace	Trace	0.00	0.02	0.00	0.00	0.33	0.65
1925	Trace	0.03	0.24	0.09	0.00	0.00	Trace	0.16	Trace	1.62	0.30	0.50	2.94
1926	0.17	0.00	0.02	1.11	0.00	0.00	0.00	0.05	1.30	0.00	0.00	3.87	6.52
1927	0.12	0.64	0.11	0.02	0.00	0.00	Trace	Trace	0.00	0.89	0.00	2.92	4.70
1928	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	Trace	Trace	0.28
1929	0.15	Trace	0.00	Trace	Trace	Trace	Trace	0.26	1.23	0.00	Trace	Trace	1.64
1930	0.35	Trace	0.38	0.03	0.41	Trace	Trace	Trace	0.73	0.00	Trace	0.00	1.90
1931	0.06	1.90	0.00	0.93	0.00	0.00	0.05	0.51	0.57	0.10	0.33	0.30	4.75
1932	0.00	1.14	0.00	0.00	0.00	Trace	0.00	0.00	0.00	2.86	0.00	0.62	4.62
1933	0.47	Trace	0.00	0.79	0.02	0.00	0.10	0.63	0.01	0.30	0.06	Trace	2.38
1934	0.01	0.18	0.08	0.00	0.00	0.00	0.01	0.08	0.00	Trace	0.01	0.25	0.62
1935	0.62	2.12	0.12	Trace	Trace	0.00	0.12	1.14	0.50	0.00	Trace	0.70	5.32
1936	0.25	0.57	0.00	0.00	0.00	0.00	0.25	Trace	0.00	0.10	0.21	0.21	1.59
1937	0.19	0.10	0.61	0.00	Trace	0.00	0.35	0.00	0.15	0.00	0.00	0.09	1.49
1938	Trace	1.19	0.59	0.00	0.00	0.00	0.47	0.23	0.00	0.00	0.00	1.36	3.84
1939	0.73	0.45	Trace	0.00	0.00	0.00	0.00	0.00	7.06	Trace	0.28	Trace	8.52
1940	0.05	0.77	0.01	0.01	0.00	0.00	0.00	0.00	1.73	0.07	0.05	2.38	5.07
1941	0.85	0.30	1.10	0.46	0.01	0.00	0.06	1.08	0.28	1.04	0.10	1.34	6.62
1942	0.13	0.74	0.55	0.41	0.00	0.00	0.00	0.65	0.00	0.01	0.00	0.00	2.49
1943	0.44	0.04	0.24	Trace	0.00	0.00	0.00	0.90	0.38	0.00	0.00	2.46	4.46
1944	0.01	1.31	0.13	0.05	0.00	0.00	0.00	0.00	0.00	0.04	0.90	1.15	3.59
1945	0.57	0.07	0.03	0.03	0.00	0.00	Trace	1.44	Trace	Trace	0.00	0.67	2.81
1946	0.01	0.00	Trace	Trace	0.00	0.00	0.01	2.16	0.05	0.21	0.14	0.57	3.15
1947	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.06	0.08	0.03	0.10	0.14	0.49
1948	0.00	0.15	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.81	0.00	0.29	1.33
1949	1.77	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.04	0.20	0.03	0.19	2.29
1950	0.00	0.19	0.00	0.00	Trace	0.00	0.17	0.00	0.06	0.00	0.00	0.03	0.45
1951	0.38	0.01	0.01	0.13	0.00	0.00	0.18	1.79	0.00	Trace	0.26	0.36	3.12
1952	0.63	0.05	0.40	0.42	0.00	0.00	0.03	0.28	0.00	0.00	0.64	0.19	2.64
1953	0.00	0.02	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
1954	0.53	0.00	0.18	0.00	0.00	0.00	0.06	0.00	0.03	0.00	0.00	0.03	0.83
1955	1.60	0.00	0.06	0.00	0.00	0.00	0.29	0.53	0.00	0.00	0.00	0.05	2.53
1956	0.13	0.01	0.00	Trace	0.01	0.00	Trace	0.00	Trace	0.00	0.00	0.01	0.16
1957	0.63	0.04	0.07	0.03	0.00	0.00	0.00	0.45	0.00	2.04	0.02	0.07	3.35
1958	0.08	1.24	0.64	0.61	0.13	0.00	0.00	0.00	0.00	0.00	0.01	0.00	2.71
1959	0.15	0.23	Trace	Trace	0.00	0.00	0.02	0.02	0.11	0.40	0.01	1.03	1.97
1960	0.50	0.15	0.30	0.00	0.01	0.00	0.03	0.01	0.53	Trace	0.14	0.07	1.74
1961	0.20	0.00	0.00	0.00	0.00	0.00	0.04	0.75	0.00	0.00	0.05	0.83	1.87
1962	0.77	0.23	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.78	1.85

IMPERIAL IRRIGATION DISTRICT
RECORD OF RAINFALL IN INCHES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1963	0 06	0 14	0 18	0 00	0 00	0 00	0 00	0 30	1 06	0 23	0 45	0 00	2 42
1964	0 01	0 38	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 24	0 29	0 01	0 93
1965	0 04	0 22	0 10	0 72	0 00	0 00	Trace	0 00	0 00	0 00	0 24	1 89	3 21
1966	0 32	0 10	0 18	0 00	0 00	0 00	0 00	0 00	0 47	0 48	0 06	0 00	1 61
1967	0 34	0 00	0 12	Trace	0 00	0 00	0 00	0 21	1 31	0 00	1 50	0 77	4 25
1968	0 00	0 06	0 58	0 00	0 00	0 00	1 31	0 00	0 00	0 00	0 00	0 04	1 99
1969	0 92	0 08	0 02	0 00	0 00	0 00	0 00	0 01	0 82	0 02	1 51	0 12	3 50
1970	0 00	0 69	0 83	0 00	0 00	0 00	0 00	0 02	0 03	Trace	0 02	0 09	1 68
1971	0 10	0 01	0 00	0 13	0 00	0 00	0 00	0 32	0 44	0 18	0 00	0 11	1 29
1972	0 00	0 00	0 00	0 00	0 00	Trace	0 00	0 00	Trace	1 71	0 45	0 00	2 16
1973	0 03	0 58	0 31	0 00	0 00	0 00	0 00	0 27	0 00	0 00	0 09	0 00	1 28
1974	1 11	0 00	0 18	0 00	0 00	0 00	0 04	0 00	0 09	0 12	0 00	0 44	1 98
1975	0 07	0 00	0 16	0 47	0 00	0 00	0 20	0 00	0 17	0 00	0 00	0 12	1 19
1976	0 00	0 84	0 00	0 36	0 02	0 00	0 29	0 00	2 84	0 00	0 58	0 15	5 08
1977	0 05	0 02	0 04	0 00	0 00	0 00	0 01	3 87	0 00	0 29	0 00	0 93	5 21
1978	1 15	0 46	0 39	0 09	0 00	0 00	0 47	0 00	0 00	0 65	0 57	0 59	4 37
1979	1 09	0 09	0 60	0 00	0 09	0 00	0 07	0 40	0 01	0 00	0 00	0 00	2 35
1980	1 59	1 41	1 06	0 23	0 03	0 00	0 03	0 00	0 00	0 00	0 00	0 00	4 35
1981	0 88	0 36	0 60	0 00	0 05	0 00	0 00	0 36	Trace	0 00	0 27	0 00	2 52
1982	0 31	0 09	0 82	0 00	0 00	0 00	0 00	0 49	0 63	0 00	0 10	2 40	4 84
1983	0 23	1 25	1 64	Trace	0 00	0 00	0 00	1 21	0 79	0 00	0 00	0 60	5 72
1984	0 20	0 00	0 00	0 00	0 00	0 00	0 76	0 81	0 03	0 00	0 20	1 43	3 43
1985	0 03	0 12	0 00	0 00	0 00	0 00	0 02	0 15	1 40	0 36	0 90	0 76	3 74
1985 Total to Date	0 03	0 15	0 15	0 15	0 15	0 15	0 17	0 32	1 72	2 08	2 98	3 74	3 74
72 Year Average	0 40	0 34	0 24	0 11	0 02	0 00	0 09	0 38	0 40	0 22	0 20	0 53	2 93
Total to Date	0 40	0 74	0 98	1 09	1 11	1 11	1 20	1 58	1 98	2 20	2 40	2 93	2 93

The CRB reported total reservoir storage of 54.68 maf and 53.953 maf on December 31 of 1984 and 1985, respectively.

Historic Colorado River Diversions were not presented in the 1985 Water Conservation Plan. In this update, use of Colorado River water by the first-three-priority agricultural users, including IID, for the 26-year period through 1985 are presented as shown in Table 2.3. The last year that such use exceeded the "allowable" 3.85 maf was 1979, although 1981 was only slightly below. For the 26-year period shown in Table 2.3, the agricultural users exceeded 3.85 maf in 10 years. During the last four years, agricultural use has been the lowest for this 26-year period.

The Colorado River Board monthly reports include records of consumptive use of Lower Colorado River Mainstream Water, i.e., net diversions by all users in Nevada, Arizona and California. Table 2.4 presents Lower Colorado River Consumptive Use for the past four years, including total, scheduled and excess arrivals to Mexico.

Table 2.3
Historic Use of Colorado River Water by Four
First-Three-Priority Agricultural Users
(Acre-Feet)

YEAR	CVWD	IID	PVID	YPRD	TOTAL
1960	505,830	3,059,750	392,760	44,800	4,003,140
1961	521,650	3,036,000	388,550	39,660	3,985,860
1962	564,740	3,006,130	381,180	46,370	3,998,420
1963	537,640	3,062,490	367,230	45,300	4,012,660
1964	511,080	2,807,670	400,740	49,510	3,769,000
1965	514,760	2,688,150	349,400	44,080	3,596,390
1966	480,040	2,886,370	406,600	52,550	3,825,560
1967	455,950	2,769,590	364,130	48,180	3,637,850
1968	473,490	2,864,170	393,090	58,040	3,788,790
1969	486,000	2,714,480	390,780	60,390	3,651,650
1970	443,160	2,809,750	409,040	51,060	3,713,010
1971	466,170	2,938,790	465,300	48,880	3,919,140
1972	501,040	2,903,490	435,850	46,540	3,886,920
1973	511,690	3,008,680	474,670	47,850	4,042,890
1974	551,540	3,133,060	457,310	44,480	4,186,390
1975	566,300	3,046,910	451,340	46,040	4,110,590
1976	516,160	2,831,440	387,350	47,170	3,782,120
1977	498,550	2,717,190	430,880	40,800	3,687,420
1978	501,370	2,715,000	424,830	45,450	3,686,650
1979	523,370	2,843,730	462,310	48,680	3,878,090
1980	526,260	2,817,120	409,170	40,300	3,792,850
1981	447,200	2,839,490	518,090	40,890	3,845,670
1982	419,540	2,565,490	456,280	41,020	3,482,330
1983	355,340	2,509,280	322,370	20,050	3,207,040
1984	358,530	2,687,120	331,690	16,490	3,393,830
1985	336,060	2,678,390	387,190	18,170	3,419,810
AVGES.	483,595	2,843,840	409,928	43,567	3,780,930

Data taken from Colorado River Board of California Water Reports, except for the Yuma Project Reservation Division (YPRD) for the years after 1981. The 1982-and-on CRB Water Reports take into account seepage from the All-American Canal in determining YPRD uses. The above 1982-and-on YPRD values are based on the 1960-1981 method of reporting YPRD uses.

TABLE 2.4

Consumptive Use of Lower Colorado River Mainstream Water and Excess Arrivals to Mexico

	Acre-Feet			
California Users	1982	1983	1984	1985
Palo Verde Irrig. Dist.	456,280	322,370	331 690	387,190
Yuma Proj. (Res. Div.) b/	58,230	36,130	36,390	40,960
Imperial Irrig. Dist. a/	2,565,490	2,509,280	2,687,120	2,678,390
Coachella Val. Wat. Dist. a/	419,540	355,340	358,530	336,060
(Subtotal)	(3,499,540)	(3,223,120)	(3,413,730)	(3,442,600)
Fort Mojave Ind. Res. c/	24,760	24,760	24,760	24,760
Cal. Miscellaneous d/	34,000	34,000	34,000	34,000
Metropolitan Water Dist.	711,460	902,810	1,231,140	1,268,600
Total	4,269,760	4,184,690	4,703,630	4,769,960
Arizona Users				
Central Arizona Project	0	0	0	33,490
Colorado River Ind. Res. e/	334,420	277,860	299,460 g/	311,670
Gila Gravity Main Canal	507,160	465,350	527,990	550,510
Yuma Proj. (Valley Div.)	183,700	168,720	177,850	191,310
Fort Mojave Ind. Res. c/	85,130	85,130	85,130	85,130
Havasu Nat. Wildlife Ref.	41,730	22,220	41,730 f/	38,830
Arizona Miscellaneous d/	85,000	85,000	85,000	85,000
Total	1,237,140	1,104,280	1,217,160	1,295,940
Nevada Users				
From Lake Mead b/	86,860	91,140	98,540	104,300
Mohave Steam Plant	17,320	14,680	15,250	6,250
Total	104,180	105,820	113,790	110,550
Total Consumptive Use (Ariz., Cal., Nev.)	5,611,080	5,394,790	6,034,580	6,176,450
Mexico Arrivals				
Total Arrivals to Mexico	1,699,016	14,368,813	15,668,632	11,942,028
Scheduled Flow	1,500,000	1,700,000	1,700,000	1,700,000
Excess Arrivals	199,016	12,668,813	13,969,632	10,242,028

See notes on following page.

Notes (for Table 2.4):

a/ Based on measurements below Pilot Knob (assumed to be equal to USBR Article V data after credit is given for unmeasured California return flows between Imperial Dam and Pilot Knob).

b/ Return flow estimates based on averages of past returns as calculated by USBR for Article V data.

c/ Assumed equal to December 1983 use estimated by Fort Mojave Tribe.

d/ An estimated residual made by the Colorado River Board of California lumping together such items as small diversions along the river, unmeasured groundwater return flow, etc., which, when combined with other quantities listed to arrive at the State's Total, presents an estimate of the State's consumptive use of Lower Colorado River water.

e/ Includes an estimated quantity of small diversions made directly from the river downstream of Headgate Rock Dam.

f/ Flooding during 1983 and 1984 has rendered definition of consumptive use by HNWR vague. Hence, data for 1982 are being used for 1983 and 1984.

g/ November data changed from 6,560 to 12,170.

Total Colorado River reservoir storage at the end of each of the last four years has been as follows:

Year	Acre-feet
1982	54,742,000
1983	55,519,000
1984	54,680,000
1985	53,953,000

Source: Colorado River Board monthly water reports.

These figures represent about 90 percent of maximum storage capacity, and exclude dead storage, but include about 16 maf of storage below minimum operating levels. At the end of July 1983, total storage reached an unprecedented 62.0 maf, 103 percent of capacity.

Flows in the Colorado River during the past three or four years have been abnormally high as shown below:

	Flows below Parker		Flows below Yuma Main Spill	
Year	Maximum	Minimum	Maximum	Minimum
1981	17,700	1,860	3,050	479
1982	17,100	1,760	2,180	482
1983	40,500	2,010	31,300	558
1984	33,200	23,100	19,200	9,030
1985	26,900	12,300	19,700	2,700

Flows in cfs
Source: Annual Water Reports of District Water Department.

These high flows and full reservoirs currently allow for unlimited diversions by even the lowest priority users. Furthermore, high river flows are expected to continue through 1986 since the preliminary May 1 forecast of April through July inflow to Lake Powell is 161 percent of long-term average, and total system active storage at the end of March was 52.2 maf (Colorado River Board Chief Engineer's monthly report, May 5, 1986).

Salinity

High flows have also resulted in lower salinity in the Colorado River, especially at Imperial Dam. During 1985, weighted monthly salinities at

Imperial Dam averaged 609 ppm (for eleven months), compared to the 1974-1978 average of 844. Table 2.5 presents the weighted monthly salinity record at five stations for 1984 and 1985 compared to the 1974-1978 five-year averages.

Water Operations

Diversions for the District from the Colorado River at Imperial Dam into the All-American Canal (Station 60) were 2,717,806 AF in 1985. Allowing for return-flow credit in conformance with Article V of the Decree of the U.S. Supreme Court (Arizona vs. California) dated March 9, 1964, the District was charged with "consumptive use of Colorado River Mainstream water" of 2,678,390 AF. In addition, 3,844,643 AF of water was diverted for the Pilot Knob power plant during 1985, with more than 4.7 maf going through the power plant (including Yuma County transfer water).

Table 2.6 shows All-American Canal Annual Distribution of water for 1983, 1984 and 1985.

Exhibit 2-1 entitled "Water Transportation" is a revised flow diagram, replacing Exhibit III.9 in the 1985 Water Conservation Plan. Mileage along the Colorado River has been adjusted as well as flow times along the entire system.

Monthly and cumulative amounts of water delivered to users from 1983 through April 1986 are given in Table 2.7. Deliveries in 1985 of 2,335,247 AF were about the same as in 1984, and the trend in 1986 appears to follow these two previous years.

Deliveries of water by the District to the ten cities and communities in the service area are shown in Table 2.8. Average annual per capita use of 0.32 AF is indicated. The lowest use is in Heber (0.15 AF/person) with El Centro (0.26) and Calexico (0.28) also having below average per capita consumption. Assuming an average family size of four, average annual residential water use would be about 1.3 AF.

Crops

During 1985, water was delivered by the District to 511,890 acres of land as shown in Table 2.9 entitled Annual Inventory of Areas Receiving Water. The table also shows data for 1983 and 1984. Total area in crops was 509,881 acres, including 56,779 acres on multiple-cropped land. The major crop based

TABLE 2.5

WEIGHTED MONTHLY SALINITIES AT SELECTED COLORADO RIVER STATIONS 1/
(in parts per million)

Month	Below Hoover Dam 5-Year Avg. 2/ 1974-78	Below Hoover Dam 1984	Below Hoover Dam 1985	Below Parker Dam 5-Year Avg. 2/ 1974-78	Below Parker Dam 1984	Below Parker Dam 1985	Palo Verde Canal Near Blythe 5-Year Avg. 2/ 1974-78	Palo Verde Canal Near Blythe 1984	Palo Verde Canal Near Blythe 1985	At Imperial Dam 5-Year Avg. 2/ 1974-78	At Imperial Dam 1984	At Imperial Dam 1985	At Northerly International Boundary 5-Year Avg. 2/ 1974-78	At Northerly International Boundary 1984	At Northerly International Boundary 1985
Jan.	690	625	564	709	674	601	751	678	615	913	722	627	1,041	721	612
Feb.	675			706	677	610	732	692	631	835	666	582	998	719	623
March	684	653	579	699	671	583	727	680	580	805	684	629	925	716	672
April	680			700	674	584	714	704	595	801	704	624	892	704	688
May	677	625	-	698	678	595	709	720	607	822	715	620	962	741	734
June	678			695	632	601	712	658	614	812	671	601	956	683	624
July	682	618	538	688	644	581	709	646	578	797	688	586	909	637	621
August	690			686	630	567	706	688	572	800	671	609	907	660	615
Sept.	672	580	-	686	645	546	737	672	495	815	628	609	952	615	632
Oct.	680		529	689	648	541	739	669	576	854	643	603	1,070	656	632
Nov.	682	562		692	614		746	588		897	649	608	1,010	658	629
Dec.	681			702	598		731	587		877	588		999	603	

General Notes:

1/ Salinities based on "sum of constituents"

2/ 5-Year averages are arithmetic

Table 2.6

IMPERIAL IRRIGATION DISTRICT

ALL-AMERICAN CANAL ANNUAL DISTRIBUTION IN ACRE-FEET

	1985	1984	1983
Station 60 to Drop 1			
Discharge Station 60			
IID	2,717,806	2,682,749	2,562,222
CVWD	341,303	358,090	363,685
Yuma	1,463,306	1,444,361	1,462,376
Pilot Knob (IID Power)	3,844,643	3,783,912	3,406,098
Total	8,367,058	8,269,112	7,794,381
Diversions Station 60 to 1117			
Bard	62,847	55,034	50,132
Siphon Drop and Walapai	328,058	311,022	286,226
Pilot Knob			
YCWUA	1,055,855	1,078,590	1,097,751
IID (Power)	3,659,836	3,598,874	3,351,514
Spillway	140,065	187,280	117
Total to River	4,855,756	4,864,744	4,449,382
Loss Station 60 to 1117			
IID	39,425	(4,365)	52,933
CVWD	5,240	(456)	8,361
Yuma	16,546	(285)	28,267
Pilot Knob (IID Power)	44,742	(2,242)	54,467
Total	105,953	(7,348)	144,028
Discharge Station 1117			
IID	2,678,381	2,687,114	2,509,289
CVWD	336,063	358,546	355,324
Total	3,014,444	3,045,660	2,864,613
Loss Station 1117 to Drop 1			
IID	61,505	39,829	92,404
CVWD	8,950	6,208	13,598
Total	70,455	46,037	106,002

	1985	1984	1983
Drop 1 to Westside Main			
Diversion Coachella Turnout	327,113	352,338	341,726
Discharge below Drop 1	2,616,876	2,647,285	2,416,885
Diversion Drop 1 to EHL Check	1,150,980	1,136,484	1,048,841
Loss Drop 1 to EHL Check	34,482	31,995	28,009
Discharge below EHL Check	1,431,414	1,478,806	1,340,035
Diversions EHL Check to CM Check	788,491	808,270	740,586
Loss EHL Check to CM Check	21,431	20,438	17,335
Discharge below CM Check	621,492	650,098	582,114
Diversion to CM Check to WSM Check	611,312	641,778	570,980
Loss CM Check to WSM Check	10,180	8,320	11,134
Station 60 to Westside Main			
Diversion Station 60 to WSM	8,124,557	8,169,670	7,487,873
Loss Station 60 to WSM	242,501	99,442	306,508

IMPERIAL IRRIGATION DISTRICT

WATER TRANSPORTATION

HOOVER DAM TO USER

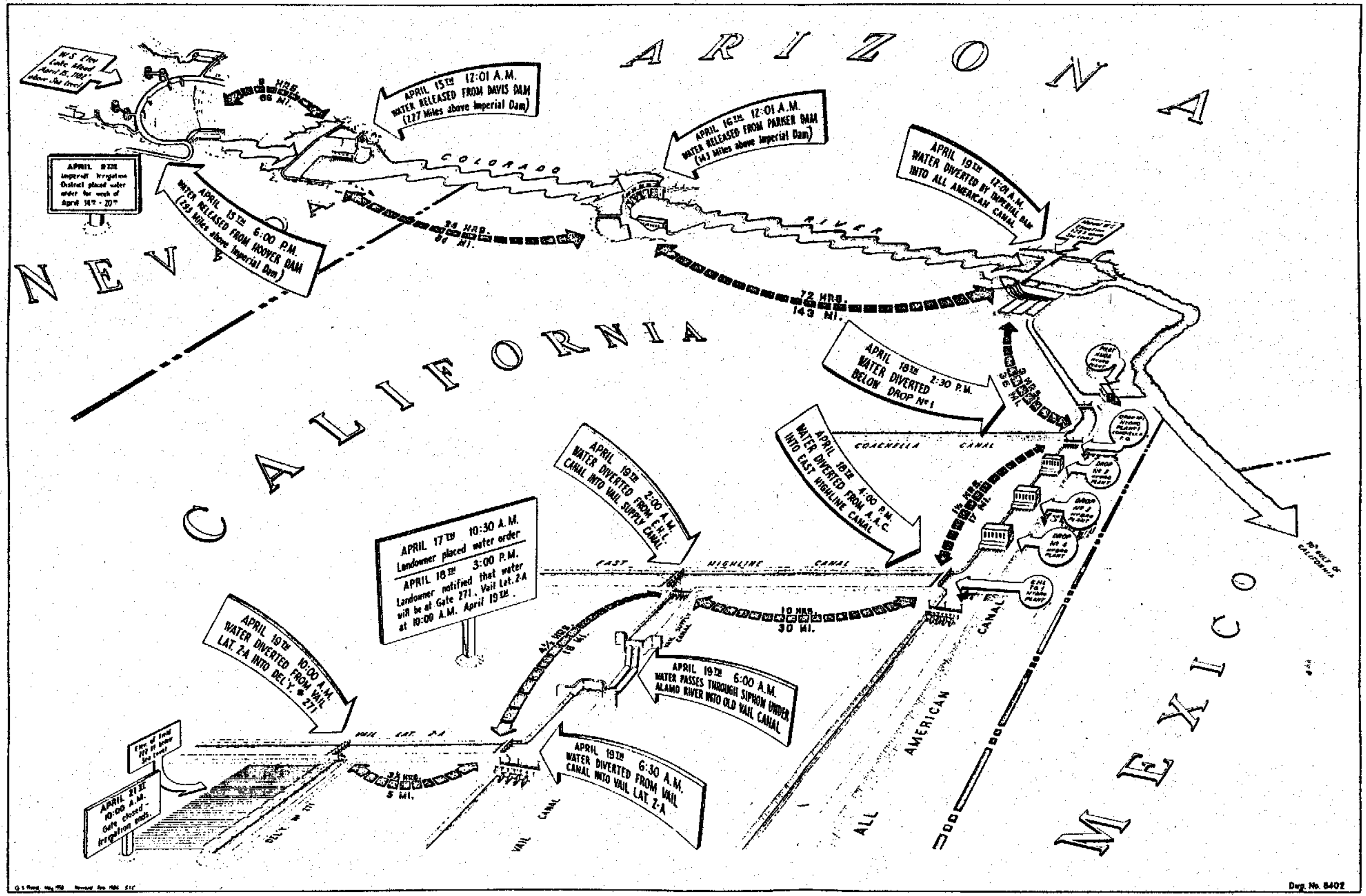


EXHIBIT 2-1

Table 2.7

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
DELIVERED TO USERS IID
ALL FIGURES IN ACRE FEET

	1983	1984	1985	1986
JANUARY	125,530	131,578	95,843	127,290
YEAR TO DATE	125,530	131,578	95,843	127,290
FEBRUARY	74,959	184,803	146,854	126,010
YEAR TO DATE	200,489	316,381	242,697	253,300
MARCH	170,780	258,377	231,738	240,804
YEAR TO DATE	371,269	574,758	474,435	494,104
ARPIL	271,948	296,610	303,508	285,464
YEAR TO DATE	643,217	871,368	777,943	779,568
MAY	257,705	263,014	268,271	
YEAR TO DATE	900,922	1,134,382	1,046,214	
JUNE	214,705	228,957	235,885	
YEAR TO DATE	1,115,627	1,363,339	1,282,099	
JULY	247,732	220,361	250,972	
YEAR TO DATE	1,363,359	1,583,700	1,533,071	
AUGUST	197,691	226,848	271,651	
YEAR TO DATE	1,561,050	1,810,548	1,804,722	
SEPTEMBER	186,729	200,331	188,734	
YEAR TO DATE	1,747,779	2,010,879	1,993,456	
OCTOBER	184,769	192,006	174,945	
YEAR TO DATE	1,932,548	2,202,885	2,168,401	
NOVEMBER	144,376	123,386	120,137	
YEAR TO DATE	2,076,924	2,326,271	2,288,538	
DECEMBER	103,319	60,057	46,759	
YEAR TO DATE	2,180,243	2,386,328	2,335,297	
TOTAL TO DATE	2,180,243	2,386,328	2,335,297	779,568

Table 2.8
Water Deliveries to Cities and Towns

Town or City	1985 Water Delivered Acre-Feet	1985 Population
Calexico	4,720.0	16,928
Holtville	1,572.2	4,678
El Centro	6,993.0	27,300
Imperial	1,825.0	3,869
Brawley	6,979.6	17,636
Westmorland	1,048.0	1,851
Calipatria	1,161.2	2,683
Niland	895.6	1,042*
Seeley	344.0	1,058*
Heber	335.0	2,221*
Totals	25,873.6	79,266

Population figures from Imperial Irrigation District's Public Information and Community Services Section, January, 1986. From Imperial County Planning Department.

Source: State Department of Finance/Population Research Unit

*Imperial County 1980 Population Estimates

Table 2.9
IMPERIAL IRRIGATION DISTRICT
ANNUAL INVENTORY OF AREAS RECEIVING WATER
YEARS 1985, 1984, 1983

I CROP SURVEY

GARDEN CROPS	ACRES 1985	1984	1983
Beans	0	0	79
Blackeyed Peas	18	0	85
Broccoli	5,560	5,050	4,427
Broccoli (Seed)	85	258	256
Cabbage	607	350	31
Cabbage, Chinese	46	9	32
Cabbage (Seed)	0	0	37
Carrots	13,361	10,053	7,402
Carrots (Seed)	0	36	104
Cauliflower	1,506	942	151
Cauliflower (Seed)	15	27	27
Celery	270	383	161
Chicory (Seed)	5	0	0
Collards	6	0	0
Cucumbers	199	146	137
Ear Corn	1,238	809	510
Eggplant	0	0	18
Endive (Seed)	0	0	18
Fava Beans	0	0	27
Fennel	0	0	3
Flowers	174	262	187
Flowers (Seed)	0	79	79
Garlic	411	523	376
Herbs, Mixed	0	51	55
Herbs (Seed)	0	111	67
Lettuce	27,679	26,772	26,086
Lettuce, Butter	24	0	0
Lettuce, Chinese	35	35	0
Lettuce, Romaine	325	0	0
Lettuce (Seed)	0	382	382
Melons			
Cantaloupes, Fall	8,431	5,110	5,319
Cantaloupes, (Seed)	10	157	141
Cantaloupes, Spring	14,782	10,216	7,944
Casaba, Fall	64	23	18
Casaba, Spring	22	152	170
Crenshaw, Fall	284	578	366
Crenshaw, Spring	186	94	49
Honeydew, Fall	646	2,185	1,046
Honeydew (Seed)	0	24	0
Honeydew, Spring	514	140	388
Kava Melons	0	4	21
Mixed, Fall	701	953	860
Mixed, Spring	198	115	270
Watermelons	5,057	4,656	4,972
Watermelons (Seed)	280	240	200
Mustard	39	19	38
Mustard (Seed)	61	25	60
Okra	95	146	96
Okra (Seed)	0	43	96
Onions	6,802	7,887	7,248
Onions (Seed)	1,382	1,715	2,886
Parsley	0	77	72
Parsnips	50	0	0
Peanuts	222	0	0
Peas	0	65	0
Peas (Seed)	4	141	137
Peppers, Sweet	0	179	120
Radishes	130	27	11
Radishes (Seed)	0	123	167
Rappini	46	123	184
Rutabagas	202	0	36
Sesame (Seed)	40	15	15
Spinach	55	48	16
Squash	549	1,009	797
Squash (Seed)	76	127	0
Sweet Basil	5	0	0
Swiss Chard	0	6	0
Swiss Chard (Seed)	0	2	0
Thyme	20	0	0
Tomatoes, Fall	40	0	0
Tomatoes, Spring	4,401	4,604	2,822
Turnips	195	0	105
Vegetables, Mixed	813	687	402
Vegetables, Mixed (Seed)	303	249	0
Waterlilies	31	16	16
Total	98,300	88,258	77,827

FIELD CROPS	ACRES 1985	1984	1983
Alfalfa	208,498	216,687	205,138
Alfalfa (Seed)	5,394	4,516	2,685
Alicia Grass	14	14	50
Barley	311	259	259
Bermuda Grass	2,077	2,786	2,816
Bermuda Grass (Seed)	17,402	13,175	16,428
Clover	0	150	150
Clover (Seed)	86	90	0
Cotton	20,744	27,316	18,079
Dichondra Grass	40	20	20
Field Corn	1,232	388	294
Grass, Mixed	179	11	30
Oats	372	464	274
Rape	0	0	267
Rye Grass	3,306	6,717	2,540
Rye Grass (Seed)	184	86	185
Sali Cornia	0	0	10
Sesbania	0	75	75
Sorghum Grain	598	1,572	1,616
Sorghum Sileage	359	861	552
Soy Beans	0	5	0
Spirulina Algae	32	32	12
Sudan Grass	15,202	24,311	10,410
Sudan Grass (Seed)	76	115	228
Sugar Beets	37,340	38,102	39,525
Triticale Grain	110	0	0
Wheat	77,057	97,043	99,507
Total	390,613	434,795	401,150

PERMANENT CROPS	ACRES 1985	1984	1983
Artichoke	249	0	0
Asparagus	5,049	3,541	2,992
Citrus			
Grapefruit	520	353	464
Lemons	870	1,045	710
Mixed	299	203	390
Oranges	355	355	356
Tangerines	51	51	113
Dates	42	103	132
Duck Ponds (Feed)	6,904	8,866	12,908
Fish Farms	724	784	1,196
Fruit, Mixed	8	3	21
Grapes	40	30	30
Guar Beans	18	0	0
Jojoba	3,005	3,005	3,005
Palms	10	9	13
Pasture, Permanent	550	473	449
Peaches	243	38	40
Pecans	31	33	40
Total	20,968	18,892	22,859
Total Acres of Crops	509,881	541,945	501,836

Note: Crops are listed for the year in which they are predominately harvested.

SUMMARY

	1985		1984		1983	
Number of Farm Accounts		6,845		6,866		6,997
Number of Owner-Operated Farm Accounts	(33.0%)	2,274	(29.0%)	1,996	(32.0%)	2,225
Number of Tenant-Operated Farm Accounts	(67.0%)	4,571	(71.0%)	4,870	(68.0%)	4,772
Average Acreage of Farm Accounts		76.83		71.53		73.67

II SUMMARY OF AREA SERVED

	ACRES		
	1985	1984	1983
Field Crops	390,613	434,795	401,150
Garden Crops	98,300	88,258	77,827
Permanent Crops	20,968	18,892	22,859
Total Acres of Crops	509,881	541,945	501,836
Total Duplicate Crops	56,779	96,223	61,089
Total Net Acres in Crops	453,102	445,722	440,747
Area Being Reclaimed: Leached	4,570	4,271	5,178
Net Area Irrigated	457,672	449,993	445,925
Area Farmable but not Farmed during Year (Fallow Land)	21,211	31,678	52,592
Total Area Farmable	478,883	481,671	498,517
Area of Farms in Homes, Feed Lots, Corrals, Cotton Gins, Experimental Farms, and Industrial Areas	16,000	13,771	13,646
Areas in Cities, Towns, Airports, Cemeteries, Fairgrounds, Golf Courses, Recreational Parks, Lakes and Rural Schools, Less Area Being Farmed	17,007	16,308	16,047
Total Area Receiving Water	511,890	511,750	528,210
Area in Drains, Canals, Rivers, Railroads, and Roads	72,874	74,056	74,018
Area below -230 Salton Sea Reserve Boundary and Area Covered by Salton Sea, Less Area Receiving Water	39,756	39,417	39,481
Area in Imperial Unit not Entitled to Water	63,933	63,933	63,933
Undeveloped Area of Imperial, West Mesa, East Mesa, and Pilot Knob Units	286,808	286,105	269,619
Total Acreage Included - All Units	975,261	975,261	975,261
*Acreage Not Included - All Units	87,029	87,029	87,029
Total Gross Acreage within District Boundaries	1,062,290	1,062,290	1,062,290

IMPERIAL IRRIGATION DISTRICT

J. R. WILSON, Manager
Water Department

*Acreage within District Boundaries that is not Included in District.

on acres, continues to be alfalfa representing about 41 percent of total cropped acreage. This trend is apparently continuing in 1986.

Salton Sea

On December 30, 1985, the elevation of the Salton Sea was -226.85 feet, compared to -226.70 feet one year earlier.

The difference of -0.15 feet compares with the 5-year average decrease in elevation of 0.06 feet. The elevation was 0.20 feet lower than two years ago at this time. It was also 0.70 feet below the high elevation for the year, which occurred on May 1, 1985.

The water surface area of the Sea at the end of 1985 was 243,600 acres, 300 acres smaller than one year earlier (based on Area/Capacity Table, Exhibit II.7 of the 1985 Water Conservation Plan).

Inflow to the Salton Sea from Imperial Valley and Mexico, including natural runoff flowing in New and Alamo Rivers was 1,092,946 AF, about 72,000 AF less than 1984. Inflow from Imperial Valley drainage was 65,541 AF less than in 1984. These figures and the components of inflow to the Salton Sea are given in Table 2.10.

The District annually evaluates evaporation rates at three locations around the Sea. Table 2.11 shows the average pan evaporation in 1985 compared to the previous year. The record shows pan evaporation was 1.63 feet below long-term average, one reason the Sea elevation was not even lower.

The salinity of the Salton Sea averaged 40,021 ppm for the year 1985, slightly lower than 1984 (1985 Water Report, page 31). As part of the studies being performed for the District, Parsons conducted a comprehensive survey of the Salton Sea. The results are reported in the District's Draft Environmental Impact Report (EIR) on the proposed Water Conservation Program and Water Transfer, dated April, 1986. Exhibit 2-2 from the EIR (Figure F-2, page F-17), shows Surface TDS Concentrations at selected sample stations, the highest concentration being only slightly below 41,000 ppm between the New and Alamo River outlets, and the low, 37,304 ppm near the central-eastern shoreline.

Salt Balance

The District prepares periodic reports on inflow and outflow of salt, based

Table 2.10

INFLOW TO SALTON SEA

	1985	1984	
Alamo Channel:			
*Crossing Line from Mexico	1,867	1,831	A.F.
Main Canal Operational Loss	1,525	1,035	A.F.
Division Operational Loss	(5,804)	(5,227)	A.F.
Drainage	511,959	566,278	A.F.
Metered at Outlet	509,547	563,917	A.F.
New River Channel:			
*Crossing Line from Mexico	260,238	267,904	A.F.
Main Canal Operational Loss	410	527	A.F.
Division Operational Loss			A.F.
Drainage	228,884	243,829	A.F.
Metered at Outlet	489,532	512,260	A.F.
Direct to Sea:			
Main Canal Operational Loss	4,573	3,471	A.F.
Division Operational Loss	4,624	4,174	A.F.
Drainage	84,670	80,947	A.F.
Total	93,867	88,592	A.F.
Summary:			
*Crossing Line from Mexico	262,105	269,735	A.F.
Main Canal Operational Loss	6,508	5,003	A.F.
Division Operational Loss	(1,180)	(1,053)	A.F.
Drainage	825,513	891,054	A.F.
Total to Sea	1,092,946	1,164,769	A.F.

ELEVATION OF THE SALTON SEA:

December 30, 1985	December 31, 1984
-226.85	-226.70

() Gain

*Computed from Meter Stations at the Boundary.

File 656.13

REVISED

Table 2.11

SALTON SEA EVAPORATION
Screened Evaporation Pans

(Averages for 3 Weather Stations)

Reported Actual Evaporation in Feet[1]

	25-Yr. Avg. 1959-1983	1984	1985	1985 Difference From Avg.	1985 Difference From 1984
January	0.29	0.28	0.24	-0.05	-0.04
February	0.35	0.33	0.27	-0.08	-0.06
March	0.58	0.56	0.45	-0.13	-0.11
April	0.79	0.73	0.65	-0.14	-0.08
May	0.98	0.83	0.82	-0.16	-0.01
June	1.07	0.88	0.89	-0.18	-0.01
July	1.09	0.79	0.91	-0.18	0.01
August	1.05	0.76	0.91	-0.14	0.15
September	0.87	0.74	0.72	-0.15	-0.02
October	0.66	0.63	0.52	-0.14	-0.11
November	0.42	0.33	0.28	-0.14	-0.05
December	0.31	0.18	0.17	-0.14	-0.01
TOTAL	8.46	7.04	6.83	-1.63	-0.21

[1]Observed pan evaporation plus rainfall.

Water Engineering

cc: General Manager
Water Manager
Water Master

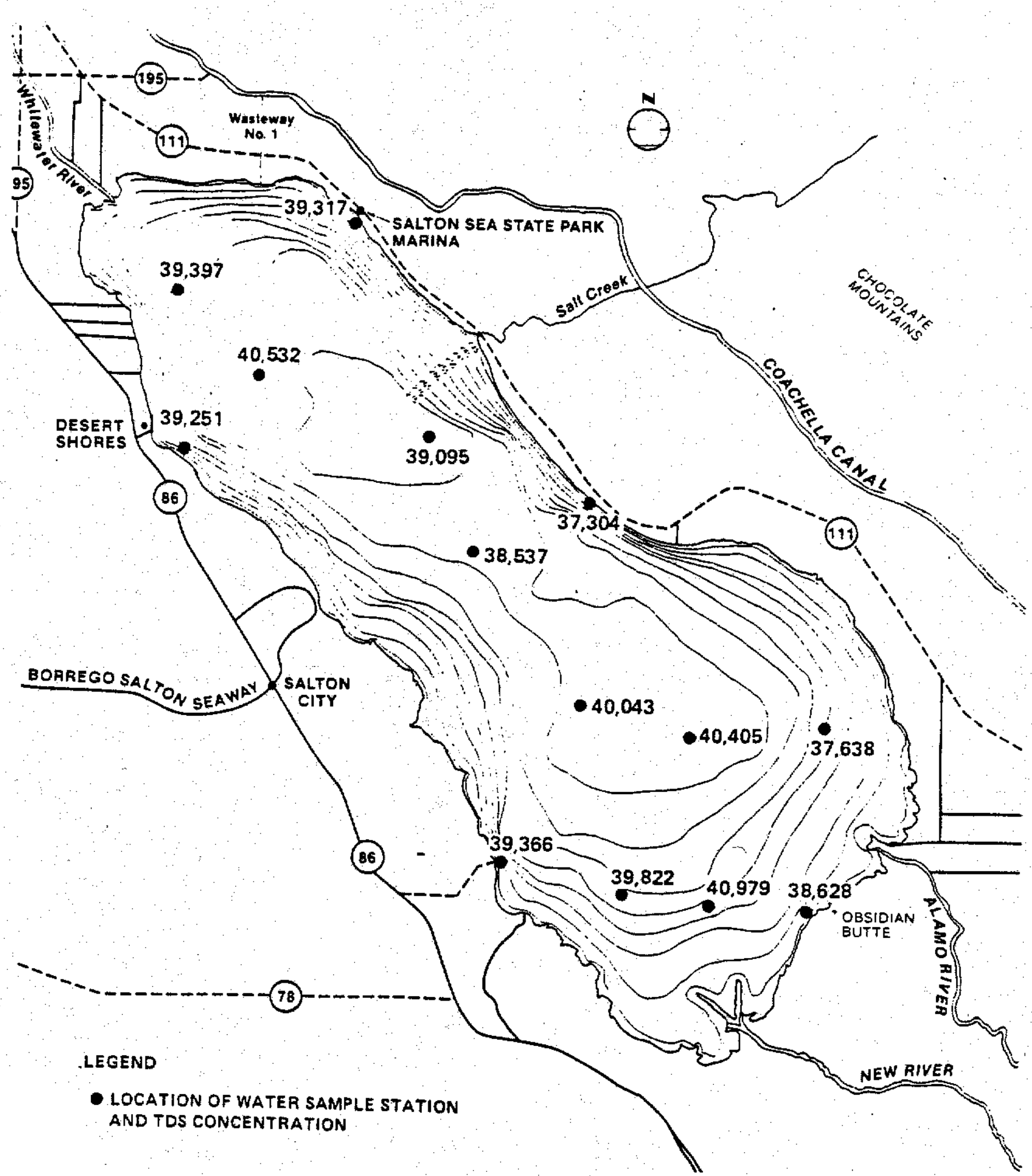


Figure F-2 - Surface TDS Concentrations
(January 21 and 27, 1986)
(Parsons, 1986)

EXHIBIT 2-2

upon water quality measurements, to determine if greater quantities of salt are being removed from the soils than are added. The data presented in Table 2.12 shows that in 1985, salt inflow from the Colorado River via the All-American Canal totalled about 2.47 million tons, while 3.3 million tons were removed from the soil by the drainage waters discharged into the Salton Sea, thus achieving a favorable balance for the 35th straight year.

Financial Update

The 1985 Water Conservation Plan at page II.21 presented records on revenues and expenditures for District Water Operations for 1983 and 1984. Tabulated below are the audited [1/] figures for 1984 and 1985:

	1985	1984
Total Water Revenues	$23,074,407	$24,402,778
Total Water Expenditures	24,854,663	17,576,323
Net Interest Income	1,227,587	1,084,524
Net Earnings (loss)	(552,669)	$ 7,910,979

Revenue decreased from that in 1984 by $1.3 million, due partly to slightly reduced water sales, but primarily to reduction in the water availability charge, which was reduced by Board action from $3.80 to $1.90 per acre (the latter figure subject to variance in rights of way credit). The basic water rate remained at $9/AF of delivered water.

Based upon Board Resolution,[2/] $1.75 of each $9/AF of revenue must be placed in the Water Conservation Fund and used only for water conservation programs. Based on 1985 water sales of 2,335,297 AF, revenues of $4,086,770 were deposited in the fund. The Water Conservation Fund balance as of December 31, 1985 was $2,983,192. Expenditures for water conservation programs during 1985, included in the foregoing Total Water Expenditures, were $6.3 million, according to the year-end unaudited cost report.

This was nearly double the $3.35 million expended for water conservation in 1984, the increase being possible due to availability of carry-over in the Water Conservation Fund.

1/ Imperial Irrigation District Combined Financial Statements December 31, 1985 and 1984, Calderon, Jaham & Osborn, and Peat, Marwick, Mitchell & Co., a joint venture, Certified Public Accountants, March 1, 1986.

2/ Resolution No. 1-79, January 9, 1979 (see Supplement 1 to 1985 Water Conservation Plan).

Table 2.12

SUMMARY OF SALT BALANCE
EXCLUDING WATER AND SALT FROM MEXICO

	INFLUENT 1/				EFFLUENT					
Year	Total Discharge AF	Tons of Salt Brought Into the Area	Weighted Average 2/ T.A.F.	Weighted Average 2/ p.p.m.	Total Discharge AF	Tons of Salt Removed	Weighted Average 2/ T.A.F.	Weighted Average 2/ p.p.m.	Tons Salt Diff.	Percent Loss or Gain
1958	2 730 876	2 723 153	1.00	735	974 045	3 341 376	3.43	2 521	618 223	22.70 gain
1959	2 840 173	2 852 019	1.00	735	1 020 963	3 401 652	3.33	2 448	549 633	19.27 gain
1960	2 983 860	3 162 485	1.06	779	1 059 804	3 558 534	3.36	2 470	396 049	12.52 gain
1961	2 957 200	3 330 087	1.13	831	1 050 700	3 572 808	3.40	2 499	242 721	7.29 gain
1962	2 951 266	3 399 464	1.15	845	1 088 965	3 806 946	3.50	2 573	407 482	11.99 gain
1963	2 991 429	3 378 583	1.13	831	1 153 827	4 050 087	3.51	2 580	671 504	19.88 gain
1964	2 770 474	3 284 284	1.19	875	905 153	3 635 121	4.02	2 955	350 837	10.68 gain
1965	2 624 363	3 406 457	1.30	955	882 962	3 819 255	4.33	3 183	412 798	12.12 gain
1966	2 817 912	3 650 447	1.30	955	1 004 685	4 148 874	4.13	3 036	498 427	13.65 gain
1967	2 719 861	3 306 261	1.22	897	1 027 970	4 139 477	4.03	2 962	833 216	25.20 gain
1968	2 806 124	3 408 548	1.21	889	1 001 027	4 012 009	4.01	2 947	603 461	17.70 gain
1969	2 675 833	3 396 105	1.27	933	962 639	3 754 477	3.90	2 867	358 372	10.55 gain
1970	2 754 898	3 488 023	1.27	933	1 020 503	3 780 732	3.70	2 719	292 709	8.39 gain
1971	2 883 969	3 666 277	1.27	933	1 092 571	3 900 990	3.57	2 624	234 713	6.40 gain
1972	2 846 613	3 541 248	1.24	911	1 063 537	3 886 592	3.65	2 683	345 344	9.75 gain
1973*	2 956 013	3 492 199	1.18	867	1 065 414	3 980 338	3.74	2 749	488 139	13.98 gain
1974*	3 072 327	3 669 832	1.19	875	1 123 492	4 204 158	3.74	2 749	534 326	14.56 gain
1975*	3 001 207	3 581 043	1.19	875	1 128 268	4 196 407	3.72	2 734	615 364	17.18 gain
1976*	2 783 630	3 263 454	1.17	860	1 084 993	4 361 658	4.02	2 955	1 098 204	33.68 gain
1977*	2 693 030	3 039 155	1.13	831	1 020 797	4 187 227	4.10	3 014	1 148 072	37.78 gain
1978*	2 671 798	2 897 906	1.08	797	995 674	3 824 323	3.84	2 823	926 417	31.97 gain
1979*	2 803 166	3 216 228	1.15	843	1 056 652	3 998 131	3.78	2 781	781 903	24.31 gain
1980*	2 769 495	3 058 785	1.10	812	1 043 241	3 988 611	3.82	2 810	929 826	30.40 gain
1981*	2 769 112	3 192 402	1.15	847	962 925	3 825 050	3.97	2 920	632 648	19.82 gain
1982*	2 515 637	2 918 781	1.16	853	888 575	3 608 490	4.06	2 985	689 709	23.63 gain
1983*	2 416 885	2 538 349	1.05	772	867 835	3 333 260	3.84	2 822	794 911	31.32 gain
1984*	2 647 285	2 654 712	1.00	737	895 034	3 360 256	3.75	2 759	705 544	26.58 gain
1985*	2 616 876	2 468 408	0.94	691	830 841	3 296 232	3.97	2 918	827 824	33.54 gain

Note: Part of the water in Alamo River from Mexico was used for irrigation in U.S. prior to January 4, 1958.
1/ Based on weekly samples at All-American Canal Station 2963 (East Highline Check) 1958 through 1972
2/ p.p.m. = 735 x T.A.F.
Prior to January. 1, 1970, all salt concentrations were obtained by evaporation and drying at 105° C.
Subsequent to January, 1970, concentrations were obtained by drying at 180°C.
*Based on weekly samples at All-American Canal below Drop 1

SECTION 3

Activities by the Board of Directors, Water Conservation Advisory Board and Water Conservation Task Group

This section describes actions taken by the District Board of Directors; the Water Conservation Advisory Board, appointed by the Board of Directors; the Water Conservation Task Group appointed by the General Manager, regarding water conservation; and related matters such as the proposed water transfer.

Actions by the Board of Directors taken from the official minutes are given in Exhibit 3-1, consisting of 11 pages. The major actions following presentation to the Board of the draft water conservation plan on January 22, 1985, included the following:

1. Acceptance of the final 1985 Water Conservation Plan on August 13, 1985;
2. The retention of Parsons Water Resources on April 16, 1985, to develop an implementation plan for programs described in the 1985 Water Conservation Plan;
3. The acceptance of the reports by Parsons Water Resources entitled Water Requirements and Water Availability Study and Water Transfer Study.
4. Adoption of the 1986 budget which included 6.5 million dollars for water conservation programs; and
5. The authorization for Parsons Water Resources to proceed with the preparation of an Environmental Impact Report.

The Water Conservation Advisory Board met regularly from June 1985 through April 1986, the minutes of these meetings are contained in Exhibit 3-2. Some of the activities by the Advisory Board included the following:

1. Review by Parsons of progress on the Water Requirement and Availability Study and the Water Transfer Study (June and September meetings).
2. Consideration and discussion of MWD/IID water transfer negotiations, and review of draft Memorandum of Understanding (MOU).
3. Review of completed Parsons reports (November meeting).
4. Review and discussion of tailwater recovery program, including field tour at Veysey Ranch.

5. Review of incentives for onfarm water conservation improvements and appointment of committee to develop and evaluate incentives.

During the first several weeks of 1986, the incentive committee appointed by the chairman met several times to develop, evaluate and recommend a program. The committee is planning to report to the full Advisory Board by mid-summer.

The in-house Water Conservation Task Group, following preparation of the draft 1985 Water Conservation Plan, continued to review and respond to comments submitted by interested parties, and to edit and prepare the final plan. During the year the Task Group reviewed the progress on the 1985 programs. Exhibit 3-3, contains notes on meetings held from June 10, 1985 through April 21, 1986. Highlights of activities reported and discussed at these meetings are as follows:

1. Implemented the Demonstration Tailwater Recovery Program. As of April 30, 1986, five tailwater recovery systems had been installed and were in operation. The sixth and last is scheduled for completion on or about July 1986.
2. Measurements for various programs, including purchasing, testing, and installing electronic recorders.
3. Grant and Loan applications.
4. USBR/IID Cooperative Studies.
5. Coordination with Parsons Water Resources.
6. Special studies: Lateral Fluctuation, Modified Demand, Irrigation Scheduling, etc.
7. Preparation of 1986 budget.
8. Review of progress on all water conservation programs, including concrete lining and tailwater monitoring.

Negotiations between the District and MWD began in 1984 for the purpose of developing an agreement to transfer conserved surplus water from the District to MWD, in exchange for MWD providing the necessary funds to implement a comprehensive water conservation program within the District.

Several meetings among IID and MWD representatives were held in 1984 (April through December), and during the first half of 1985 (January, through May), during which time a Memorandum of Understanding (MOU) was developed. A draft of the MOU, dated July 8, 1985, resulted from the year-long negotiations and was approved by the negotiating committee, subject to review and approval by the respective boards. A copy of the MOU is included in Exhibit 5-9 of this report. The Draft MOU provided that MWD would pay $10 million per year into the District's Water Conservation Fund, for which the District would make available 100,000 acre-feet of water per calendar year for use by MWD.

At a special meeting on July 9, 1985, the Board of Directors, among other conditions, authorized the Draft MOU be published, set a Public Hearing on the document for September 30, 1985, and directed that several public meetings be held during September.

On October 15, 1985, the Board rejected the Draft MOU. The negotiating committee resumed negotiations with MWD, taking into consideration the comments received at the public meetings. It was also decided that an Environmental Impact Report would be prepared for the proposed project.

The negotiating teams have met several times since October 1985, with the goal to resolve the concerns expressed by constituents at the public meetings.

EXHIBIT 3-1

IMPERIAL IRRIGATION DISTRICT

Actions and Discussions by District Board of Directors
Regarding Water Conservation Programs and Water Exchange Proposals
January 1985 through May 1986
Source: Secretary's Notes

Date	Action

January 22, 1985 - Executive Officer D. A. Twogood reviewed a preliminary Draft of the Executive Summary portion of the Water Conservation Plan developed by the District's special Task Force.

The Board approved distribution of preliminary Draft copies of the District's Water Conservation Plan to all interested parties for a sixty (60) day comment period.

Moved by Director Edwards, seconded by Director Allen, that administration of the District's Water Conservation Program and the Water Conservation Supervisor and staff be transferred from the Manager, Water Department, to the Executive Officer. Motion Carried.

March 5, 1985 - Moved by Director Benson, seconded by Director Allen, that we authorize, subject to approval by the Legal Department, the mailing of a letter to absentee landowners describing the District's Water Conservation Plan and requesting the landowners cooperation in conserving water by making suggested improvements to their land and irrigation facilities. Motion Carried.

March 26, 1985 - The General Manager and Director Allen announced that a meeting of the District Water Exchange Committee with members of the Water Conservation Advisory Committee was scheduled for Tuesday, April 9, 1985, at which time the Water Exchange Committee would make a recommendation to the Board of Directors concerning the selection of an engineering consulting firm to assist the District in its Water Conservation Program.

Moved by Director Allen, seconded by Director Benson, that the President be authorized to execute a letter directed to the water users served by the Myrtle, Munyon, Orchid, Olive and Palm Laterals requesting their cooperation during a fluctuation study of these five laterals. Motion Carried.

After a short discussion of revisions of the 21-Point Water Conservation Program proposed by the Water Conservation Task Group, it was agreed by the Board that the revisions be submitted to the Water Conservation Advisory Committee, and that a meeting of the Board and the Committee to discuss the proposed revisions be held after the next regular Board meeting scheduled for April 16, 1985.

Moved by Director Allen, seconded by Director Edwards, that the General Manager be authorized to execute a letter which, with a questionnaire, will be sent to those persons expressing an interest in participating in a pilot program of constructing, at District expense, one tailwater return system in each of the District's six water divisions. Motion Carried.

April 9, 1985 - Moved by Director Allen, seconded by Director Benson, that we accept the recommendation of the Water Exchange Committee; select the engineering firm of Parsons Corporation to assist Imperial Irrigation District in water conservation planning and development; and authorize the General Manager and Chief Legal Counsel, together with the other members of the Exchange Committee, to negotiate an Agreement with Parsons Corporation covering that firm's services to the Imperial Irrigation District. Motion Carried.

April 16, 1985 - Moved by Director Benson, seconded by Director Edwards, that the President be authorized to execute an "Agreement for Engineering and Consulting Services Letter of Intent" directed to Parsons Water Resources, Inc. Said "Letter of Intent" sets forth the terms and conditions for the preparation of a definitive Water Conservation Planning and Development Agreement between the two parties. Motion Carried

May 14, 1985 - Moved by Director Edwards, seconded by Director Allen, that the President be authorized to execute, subject to clarification of Paragraph f, Section 6, on Page 4, Agreement No. 5-Ag-30-03490 between the District and the Bureau of Reclamation. Said Agreement provides for an advance of funds to supplement available federal funds for the "Canal Lining and System Improvement Study." Motion Carried.

Mr. Melvyn Brown, Program Director, Parsons Water Resources, Inc., submitted a request for approval to proceed with initial studies and analysis in order to quantify the District's present and future water needs and determine the additional water that might be available for use by others and the potential transferees for that water, as provided for in the Agreement for Engineering and Consulting Services Letter of Intent executed by Parsons on April 19, 1985.

After some discussion it was moved by Director Edwards, seconded by Director Moore, that this matter be deferred until the June 11, 1985, Board meeting.

After further discussion Directors Edwards and Moore withdrew their Motion and it was moved by Director Benson, seconded by Director Edwards, that an adjourned Board Meeting be scheduled for 10:00 a.m., Friday, May 17, 1985, to consider the request of Parsons Water Resources, Inc., to proceed with initial studies. Motion Carried.

May 17, 1985 - The President stated that this adjourned session was being held to consider the request of Parsons Water Resources, Inc., to proceed with initial studies and analysis as provided for in the Agreement for Engineering and Consulting Services Letter of Intent previously executed by Parsons and the District.

Mr. Joseph Bratton, President of Parsons Water Resources, spoke briefly to consider the request of Parsons Water Resources, Inc., to proceed with initial studies and analysis as provided for in the Agreement for Engineering and Consulting Services Letter of Intent previously executed by Parsons and the District.

Mr. Brown outlined the work proposed to be done under the Letter of Intent. He described the studies to be undertaken and presented a tentative timetable together with estimated cost figures for performance of the work.

Moved by Director Allen, seconded by Director Benson, that we authorize Parsons Water Resources, Inc., to proceed with the initial studies and analysis described in the Letter of Intent with said work to be performed under the terms and conditions set forth in the Letter of Intent at a cost not to exceed $1,500,000.00. Motion Carried

June 11, 1985 - Mr. Don Twogood, Executive Officer, presented the Water Conservation Task Force recommendations for six sites for the installation of Demonstration Tailwater Recovery Systems. He explained the criteria used in selecting these particular fields for the program.

Moved by Director Edwards, seconded by Director Benson, that we approve the six sites and one alternate site recommended by the Water Conservation Task Force for installation of Demonstration Tailwater Recovery Systems; and authorize the preparation of 5-year contracts with the owners of these fields covering the design, construction, data recording, operation and maintenance of the tailwater recovery systems. Motion Carried.

June 25, 1985 - Mr. Mel Brown, Project Director for Parsons Water Resources, gave the Board a brief oral update of Parsons' activities. He presented the Board with copies of Report Outlines which have been developed for the first two initial studies to be undertaken. He stated that a detailed written report on all of Parsons activities to date will be provided to the General Manager on July 1.

Moved by Director Benson, seconded by Director Allen, that we approve Major Work Authorization No. 85-W-1 covering construction of the Trifolium Extension Reservoir, to be located in Section 4, T. 13 S., R. 12 E.; and authorize the Real Estate and Right of Way Section to begin negotiations for purchase of the land necessary for said Reservoir. Motion Carried.

The Board confirmed the appointment, by Director Allen, of Mr. Richard A. Lyerly, Calipatria, as a representative from Division No. 3 to the Water Conservation Advisory Board; and requested that the Secretary notify Mr. Lyerly of his appointment.

Mr. Charles Westmoreland appeared before the Board to express some concerns he had about lowering the level of Salton Sea; the status of the Water Department's accounts receivables; and Colorado River salinity in periods of low flow if part of the District's water supply is diverted upstream of Imperial Dam.

July 9, 1985 - Moved by Director Allen that we approve for publication, and public review and comment, the July 8, 1985, Draft of a Memorandum of Understanding between the Imperial Irrigation District and the Metropolitan Water District of Southern California, with direction to counsel and staff to obtain written assurance that the District's water rights will be fully protected; that a Public Hearing be scheduled for 7:00 p.m., Monday, September 30, 1985, to receive public comment on the Draft Memorandum; and that public meetings be held during the first two weeks of September in the various cities of Imperial Valley, with written comments to be received at the offices of the District until Monday, September 30, 1985.

The foregoing Motion was seconded by Director Edwards, and carried unanimously.

July 16, 1985 - Moved by Director Benson, seconded by Director Edwards, that Major Work Authorization No. 85-W-1, approved by the Board June 25, 1985, for construction of the Trifolium Extension Reservoir, include provisions for a picnic area; with fishing to be permitted but no boats or swimming to be allowed in the Reservoir. Motion Carried.

It was announced that the following decisions had been made in the closed session:

1. That Major Work Authorization No. 85-W-1, approved by the Board June 25, 1985, for construction of the Trifolium Extension Reservoir, include provisions for a picnic area; with fishing to be permitted but no boats or swimming to be allowed in the Reservoir.

2. That one-half of the payment to satisfy the judgement rendered in the Salton Bay Marina, et al, vs. Imperial Irrigation District lawsuit is to be made with Water Department funds and one-half to be made with Power Department funds.

August 13, 1985 - Moved by Director Allen, seconded by Director Moore, that we adopt a Policy, as recommended by Director Edwards, that not less than five (5%) of any funds received, through any Memorandum of Understanding or Agreement to transfer conserved water by the Board of Directors in the future, be designated for salinity control purposes either within or outside the Imperial Irrigation District, wherever the best results could be obtained. Motion Carried.

Moved by Director Moore, seconded by Director Allen, that the following Resolution No. 19-85 be adopted:

> Re: Accepting as the official plan of the District, the 1985 Water Conservation Plan submitted this date; and that we authorize distribution of the Water Conservation Plan to interested parties.

Motion Carried.

Moved by Director Moore, seconded by Director Allen, that we approve the Environmental Assessment and Initial Study for the proposed Water Transfer Memorandum of Understanding between the Imperial Irrigation District and Metropolitan Water District; and authorize the preparation of a Negative Declaration covering said project. Motion Carried.

September 10, 1985 - Moved by Director Benson, seconded by Director Moore, that the President Pro Tem be authorized to execute an Agreement between the District and Smi-ley Land & Cattle Company, covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on the NE¼ of Section 16 and a portion of the West ½ of the NW¼ of Section 15, lying west of Southern Pacific Railroad, T. 11 S., R. 14 E., S.B.B.M. Motion Carried.

Moved by Director Benson, seconded by Director Moore, that the President Pro Tem be authorized to execute an Agreement between the District and Walter D. and Marjorie A. Nilson, covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on Lots 1, 2, 4, and 5, Section 16, T. 16 S., R. 15 E., S.B.B.M. Motion Carried.

Moved by Director Benson, seconded by Director Moore, that the President Pro Tem be authorized to execute an Agreement between the District and John C. and Patricia A. Veysey, Trustees under Trust dated July 2, 1984, covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on a portion of Tract 177, T. 14 S., R. 13 E., S.B.B.M. Motion Carried.

Moved by Director Benson, seconded by Director Moore, that the President Pro Tem be authorized to execute an Agreement between the District and John R. Benson Farms, Inc., and James D. Jameson covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on a portion of Tract 117, T. 14 S., R. 14 E., S.B.B.M. Motion Carried.

Moved by Director Benson, seconded by Director Moore, that the President Pro Tem be authorized to execute an Agreement between the District and Kathleen Patricia Borchard, J. D. Edwards and Jack Boggust, as Co-Trustees of the John Vincent Borchard Trust, covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on a portion of Tracts 65 and 189, T. 14 S., R. 13 E., S.B.B.M. Motion Carried.

October 8, 1985 - Moved by Director Edwards, seconded by Director Benson, that the General Manager be authorized to advertise for and receive bids from qualified entities for the preparation of an Environmental Impact Report for the proposed Water Transfer between the Imperial Irrigation District and Metropolitan Water District. Motion Carried.

Moved by Director Edwards, seconded by Director Benson, that we defer action on a Memorandum of Understanding between the District and Metropolitan Water District for a proposed water transfer until the next Board meeting. Motion Carried.

Mike Wallman, Secretary-Treasurer of the Imperial County Farm Bureau spoke to the Board and stated that at the present time the Farm Bureau does not support the proposed Memorandum of Understanding between IID and MWD and urges the Board of Directors not to enter into any agreement with MWD at this time. Recommendations from the Farm Bureau on this matter will be forthcoming.

Rivon Nilson, Field Representative for State Senator Bergeson, read a letter from Senator Bergeson directed to General Manager Shreves concerning the negotiations between the District and Metropolitan Water District for a water swap agreement and the possibility of including discussions of the New River solutions in the swap negotiations.

Moved by Director Allen, seconded by Director Edwards, that the President be authorized to execute an Agreement between the District and Kathleen G. Mallory, Trustee of Kathleen G. Mallory Trust, dated August 3, 1984; Trust Services of America, Ltd., Trustee of Floyd L. Mallory Trust; George A. Mallory, Trustee of the George A. Mallory Trust, covering the terms and conditions under which the District will participate with the landowner in the installation and operation of a tailwater recovery system demonstration, to be located on a portion of the N. 1/2 of Tract 128, T. 13 S., R. 13 E., S.B.B.M. Motion Carried.

October 15, 1985 - The President announced that this was an adjourned meeting from last Tuesday, (October 8th), being held for the purpose of considering the proposed Memorandum of Understanding with Metropolitan Water District when all the Directors could be present.

Moved by Director Moore, seconded by Director Edwards, that we completely reject the Memorandum of Understanding in its present form. Motion Carried.

Moved by Director Moore, seconded by Director Edwards, that the President appoint a new Negotiating Committee to meet with Metropolitan Water District and present the concerns of the people of Imperial Valley expressed in the public meetings and hearing and those of Imperial Irrigation District regarding the proposed Memorandum of Understanding. Motion Carried.

Moved by Director Benson, seconded by Director Edwards, that the Imperial Irrigation District continue with an Environmental Impact Report and negotiations with Metropolitan Water District based on the proposed project of transferring 100,000 acre-feet per year of conserved water for a maximum term of thirty-five (35) years for which the transferee will pay to Imperial Irrigation District no less than $300,000,000.00. Motion Carried.

October 29, 1985 - Moved by Director Benson, seconded by Director Edwards, that the General Manager be authorized to advertise for and receive bids from qualified firms for the preparation of an Environmental Impact Report for the proposed Water Transfer between the Imperial Irrigation District and Metropolitan Water District. Motion Carried.

After lengthy discussion of a proposed "Water Conservation Planning and Development Agreement" between the District and Parsons Water Resources, Inc., the following action was taken.

Moved by Director Benson, seconded by Director Condit, that we approve the concept of the proposed "Water Conservation Planning and Development Agreement" with Parsons Water Resources, Inc., subject to the inclusion of the revisions discussed here today with the revised "Agreement" to be reviewed at an adjourned Board Meeting to be scheduled for 9:30 a.m., Friday, November 8, 1985. Motion Carried.

November 8, 1985 - Moved by Director Allen, seconded by Director Benson, that we approve the "Water Conservation Planning and Development Agreement" between the Imperial Irrigation District and Parsons Water Resources, Inc.; and authorize the President and Secretary to execute said Agreement on behalf of the District. Motion Carried.

November 19, 1985 - After a presentation by representatives of Parsons Water Resources, Inc., reviewing the Executive Summaries of the "Final Report - Water Requirements and Availability Study and Water Transfer Study" prepared by Parsons under authorization of the Board of Directors on May 17, 1985, the following action was taken.

Moved by Director Benson, seconded by Director Edwards, that we accept the "Final Report - Water Requirements and Availability Study and Water Transfer Study" and authorize Parsons to publish the number of copies required by the District for distribution. Motion carried.

Melvyn Brown, Program Director, Parsons Water Resources, Inc., presented and reviewed a proposed budget for Water Conservation Program work to be performed by Parsons during the 1986 calendar year at an estimated cost of $1,630,000.00.

After Mr. Brown's presentation, the General Manager commented that this matter would be placed on the agenda for the December 10, 1985, Board meeting.

December 10, 1985 - Moved by Director Benson, seconded by Director Edwards, that the General Manager be authorized to negotiate a contract with Parsons Water Resources, Inc., for the preparation of a Program Environmental Report covering water conservation measures, practices and projects and a Focused Environmental Report covering the potential transfer of 100,000 acre-feet of water annually to another water agency; and also, in the event a contract cannot be concluded with Parsons Water Resources, Inc., the General Manager be authorized to negotiate a contract with Westec Services, Inc., for the preparation of these Environmental Reports. Motion carried.

Mr. Mel Brown, Project Director for Parsons Water Resources, Inc., reviewed three proposed Budgets, each with a different level of expenditures, for work to be performed by Parsons Water Resources, Inc., during calendar year 1986.

Dwight Hunt, Manager, Conservation Planning, Parsons Water Resources, Inc., presented and reviewed a Feasibility Study of routing transferred water via the All-American Canal, Coachella Canal and a new pipeline to Metropolitan Water District's Colorado River Acqueduct.

D. A. Twogood, Executive Officer, reported on the District's selection by the State Department of Water Resources Office of Water Conservation to receive a grant of $25,000.00 per year for three years for development of a computerized scheduling program in cooperation with the California Irrigation Management Information System (CIMIS).

Moved by Director Benson, seconded by Director Allen, that the following Resolution No. 30-85 be adopted.

> RE: Authorizing the inclusion of three additional projects in the application previously filed for federal funding assistance with the Soil Conservation Service for increasing onfarm water use efficiency. District's involvement in the programs will be as sponsoring agency only with the Soil Conservation Service to administer the programs. Motion Carried.

Moved by Director Edwards, seconded by Director Benson, that the following Resolution No. 31-85 be adopted.

> RE: Authorizing the President to execute applications for a low-interest loan of up to $5,000,000.00 under the California Clean Water Bond Law of 1984 for financing water conservation capital projects. Motion Carried.

D. A. Twogood, Executive Officer, presented and reviewed a progress report on the 1985 Water Conservation Plan and the Water Conservation Budget proposed for 1986.

Moved by Director Benson, seconded by Director Allen, that we authorize expenditures in the amount of $950,000.00 for work to be performed by Parsons

Water Resoures, Inc., during the calendar year 1986. Motion Carried.

December 30, 1985 - Moved by Director Benson, seconded by Director Moore, that the President be authorized to execute a letter directed to Parsons Water Resources, Inc., authorizing said firm to proceed with the preparation of the Program Environmental Impact Report and Focused Environmental Impact Report, in accordance with the scope of work and schedule set forth in Parsons' proposal submitted in response to IID "Request for Proposal No. 479, Program and Focused EIRs." Motion Carried.

January 21, 1986 - The Board scheduled a Special Meeting for 7:00 p.m., Thursday, January 30, 1986, to meet with the County Board of Supervisors and discuss the District's Water Conservation Plan, 1986, and the Water Conservation Planning and Development Agreement between the District and Parsons Water Resources, Inc.

Moved by Director Benson, seconded by Director Moore, that we authorize the distribution of a "Notice of Preparation" for the preparation of a Program Environmental Impact Report on the Implementation of a Water Conservation Program by the Imperial Irrigation District and the Board of Supervisors and discuss the District's Water Conservation Plan, 1986, and the Water Conservation Planning and Development Agreement between the District and Parsons Water Resources, Inc. Motion Carried.

Moved by Director Benson, seconded by Director Moore, that we authorize the distribution of a "Notice of Preparation" for the preparation of a Program Environmental Impact Report on the Implementation of a Water Conservation Program by the Imperial Irrigation District and the Potential Initial Transfer of 100,000 AF/Year of Previously Conserved Water; schedule a Public Meeting for 7:00 p.m., Wednesday, February 5, 1986, to receive public comments and concerns which should be addressed in the Environmental Report; and authorize publication of a Notice of Public Meeting in all the local newspapers. Motion Carried.

Ron Hull, Director, Public Information and Community Services, presented a brief video showing maintenance work on the East Highline Canal during the recent cutout, and a pumpback system in operation.

Moved by Director Moore, seconded by Director Benson, that all references to the ownership, operation or maintenance of Imperial Irrigation District water conservation facilities or improvements by Parsons Water Resources, Inc., be eliminated from the contract between the District and Parsons; and the Chief Legal Counsel be directed to notify Parsons of this action. Motion Carried.

January 30, 1986 - General Manager C. L. Shreves, reviewed the procedures followed in the selection of Parsons Water Resources, Inc., as engineering consultants to the District. He then discussed the provisions and requirements of the Water Conservation Planning and Development Agreement between the District and Parsons Water Resources.

Mel Brown, Local Project Manager for Parsons Water Resources, described the studies and services performed by Parsons Water Resources up to the present date. He also described the Program and Focused Environmental Impact Reports to be prepared covering potential transfer of conserved water.

James Harmon, an attorney speaking for the Imperial Valley Water Committee, outlined four concerns the Committee had.

1. The legal issue of whether the District had the authority to transfer conserved water should be resolved before the District incurs substantial costs to implement conservation programs to create water for the purpose of transfer.

2. The District should avoid too much delegation to outside interests.

3. The Committee feels very strongly that the District should terminate its contractual relationship that exists with Parsons Water Resources.

4. The Committee does favor the preparation of a programmitcal type of Environmental Impact Report addressing the District's long -range plans, but believes other issues should be resolved first, principally legal issues.

February 10, 1986 - President Edwards called the meeting to order and stated that this special meeting had been called to discuss the letter dated February 5, 1986, from the County Board of Supervisors requesting that Imperial Irrigation District voluntarily agree to set aside the Water Conservation Plan adopted in August 1985, until the Environmental Impact Report process is completed.

Director Moore read the following letter and moved that the President be authorized to execute the original for transmittal to the County. Motion Carried.

February 10, 1986

Mr. Abe F. Seabolt, Chairman
Imperial County Board of Supervisors
940 West Main Street
El Centro, CA 92243

Dear Mr. Seabolt:

This is in response to your letter of February 5, 1986, concerning the Board of Supervisors' request that IID voluntarily agree to set aside its Water Conservation Plan adopted in August 1985, until the EIR process is completed.

For a number of reasons, it would be inappropriate, and would serve no useful purpose, for the IID to set aside its Plan. It is the District's belief that litigation concerning this matter is unnecessary and would result in a waste of County and District public funds.

As we have said repeatedly, the EIR being prepared by the District will address, among other things, all of the environmental aspects of the Plan. The District believes that all of the County's concerns will be resolved in the EIR.

If the County elects to file suit against the District, we will be forced, unfortunately, to vigorously defend the suit.

Yours truly,

LEROY E. EDWARDS
President
Board of Directors

February 18, 1986 - Doug Welch, Supervisor, Water Conservation, reviewed a proposal for development of a workable incentive program that might persuade farmers to conserve water. He recommended that a Committee, composed of farmers from different areas of the Valley who farm various types of crops, be appointed by the Water Conservation Advisory Board. This committee, together with staff personnel of the District and Parsons Water Resources, would then identify and evaluate various incentives to choose the most logical that could receive broad farmer support. Mr. Welch then presented a list of potential incentives and a criteria for evaluating these or alternative incentives. He displayed a tentative timetable for developing and implementing an incentive program for water conservation.

March 4, 1986 - Mr. Horace McCracken presented a proposal to the Board for construction of a dike around a portion of Salton Sea as a method of reducing the salinity and the level of the Sea.

Moved by Director Moore, seconded by Director Benson, that we retain the law firm of Latham & Watkins to assist District Legal Counsel in defending the County of Imperial vs. Imperial Irrigation District. Motion Carried.

March 25, 1986 - Moved by Director Allen, seconded by Director Condit, that the General Manager be authorized to execute a Contract with the State Department of Water Resources which provides a grant to the District to develop a computerized scheduling program in cooperation with the California Irrigation Management Information System (CIMIS). Said grant provides $25,000.00 for each of the following fiscal years, 1985/86, 1986/87, and 1987/88 (subject to funding availability) and shall not exceed $75,000. Motion Carried.

The Directors, General Manager and Chief Legal Counsel discussed the present status of the negotiations with Metropolitan Water District concerning a possible water sale or transfer; the possibility of specifying that a certain percentage of any revenue received from a water sale or transfer be used exclusively for onfarm conservation practices; and beginning negotiations with another agency, such as San Diego County Water Authority for a possible water sale or transfer.

The Draft Environmental Impact Report (EIR) covering an expanded water conservation program by Imperial Irrigation District and the initial transfer of 100,000 acre feet per year of conserved water, as prepared by District staff with the assistance of Parsons Water Resources, Inc.

Moved by Director Condit, seconded by Director Moore, that the Real Estate and Right of Way Section be authorized to open an escrow for the purchase of 11.35 acres of land located in Section 4, T. 13 S., R. 12 E., S.B.B.M., presently owned by Cipriano DeLira. Said land is required for construction of the Trifolium Extension Reservoir and is to be purchased for $17,025.00 or $1,500.00 per acre. Motion Carried.

April 22, 1986 - Director Allen read a prepared statement which concluded with the following motion:

1. That it is in the best interest of the District to retain the services of Parsons on an as needed basis but only under a modified agreement.

2. That the General Manager and Chief Legal Counsel review the Agreement and propose suitable amendments for discussion with Parsons, and if an agreement cannot be reached with Parsons by May 13, 1986, then Parsons be given notice of termination as provided in the current Agreement.

3. That the amendments make clear that:

   a. Any services provided by Parsons will only be provided after Board approval.

   b. Service fees to Parsons will not be tied to the transfer of water or to the cost of construction, but shall be paid under a more conventional arrangement, such as cost plus fixed fee.

   c. Parsons will be precluded from doing any construction.

   d. All services will be performed by Parsons only at the direction of the District; that Parsons will only make recommendations and that all decisions will be made by the District which will have full control and all approval rights.

April 29, 1986 - Moved by Director Condit, seconded by Director Benson, that the standby charges for a portable electric pumpback system to be installed by farmer Michael Morgan of Brawley shall be paid from Water Conservation funds for a period of five (5) years. Motion Carried.

Mr. Horace McCracken presented and described a method of reducing the salinity and level of the Salton Sea by constructing a dike around a thirty (30) square mile area within the Sea; and also described various methods of financing such a project.

The Board thanked Mr. McCracken for his presentation; but deferred action on this matter for the present.

Moved by Director Condit, seconded by Director Moore, that Resolution No. 14-86, as amended, be adopted:

Re: Expressing the District's support for Proposition 44, which will appear on the June 3, 1986, primary election ballot.

The Vice President announced that the Board had agreed in the closed session to approve a Draft of an Amended Water Conservation Planning and Development Agreement between the District and Parsons Water Resources, Inc.; to make copies of the Draft Agreement available for public review; have the text of the Draft Agreement published in the newspaper; and schedule a Public Meeting for 7:30 p.m., Tuesday, May 13, 1986, to receive public comment on the Draft Agreement.

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
May 15, 1986

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, May 15, 1986.

The roll was called and the minutes were approved as read.

Mr. Doug Welch presented some data on the IID's Demonstration Tailwater Recovery Systems. He gave a summary of John C. Veysey's system on the Newside Lateral, announcing this system was averaging 0.1% tailwater.

Mr. Steve Knell was introduced as the District's new Water Conservation Agricultural Engineer.

Mr. Twogood announced that the IID had a possiblity of receiving a loan for $2 - 3 million, at 5% interest, from the Department of Water Resources.

Chairman Brad Luckey said that the Incentives Subcommittee has had four meetings so far. Thirty incentives have been identified, and they will be evaluated in the next few weeks.

The meeting was adjourned.

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
MARCH 6, 1986

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, March 6, 1986.

The roll was called and the minutes were approved as read.

Mr. Dick Palmer of the Parsons Corporation gave a presentation on an incentive program for water conservation. He suggested:

The WCAB should appoint a comittee to develop a workable incentive program that farmers will use to conserve water;

Identify all incentive alternatives;

Develope evaluation criteria;

Evaluate all approaches;

Select and recommend to the WCAB viable incentives;

WCAB recommend implementation to District Board;

Implement program;

Evaluate results.

The chairman appointed six people to a committee for ideas only, they are: Dick Lyerly, Mark Osterkamp, Bob Richter, Brad Lucky, Larry Gilbert, and Tom Heffernan.

The meeting was adjourned. The next meeting will be held THURSDAY, May 15,1986 at 1:30 P.M., in the Board of Directors Room.

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
February 13, 1986

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, Febuary 13, 1986.

The roll was called and the minutes were approved as read.

Doug Welch reported, that at the District's request, Dick Palmer of the Parsons Corporation had put together a program for developing an "Incentive Program for Water Conservation." Mr. Welch then briefly described the proposed program which included;

The WCAB should appoint a comittee to develop a workable incentive program that farmers will use to conserve water;

Identify all incentive alternatives;

Develope evaluation criteria;

Evaluate all approaches;

Select and recommend to the WCAB viable incentives;

WCAB recommend implementation to District Board;

Implement program;

Evaluate results.

The chairman asked for comments on the proposed program. The majority of the member's present did not feel that they wanted to pursue such a program at this time. The chairman said that since there were only seven members present he was going to contact the other members of the committee to discuss the program with them and that the program would be reviewed again at the next meeting.

The meeting was adjourned. The next meeting will be held THURSDAY, March 6, 1986 at 1:30 P.M., in the Board of Directors Room.

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
January 9, 1986

The Water Conservation Advisory Board held an informal meeting at 1:30 p.m., Thursday, January 9, 1986 at the Imperial Irrigation District's Tailwater Recovery Demonstration site located at Newside, Lateral 3, gate 33.

Mr. John Veysey discussed the operation of the tailwater recovery system and Mr. Doug Welch explained the installation and operating costs. Two irrigations had been monitored since the system was installed. Mr. Doug Welch reported that tailwater was three percent on the first irrigation and no tailwater was discharged into the District drainage system on the second irrigation.

The meeting was adjourned. The next meeting will be held on Thursday, February 13, 1986 in the Board of Directors room, at 1:30 p.m..

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
November 20, 1985

The Water Conservation Advisory Board convened in a regular session at 2:00 P.M., Wednesday, November 20, 1985.

The roll was called and the secretary reported that a quorum was present. The Minutes were approved as read.

Chairman Brad Luckey was not present, so Vice-President John C. Veysey chaired the meeting.

Mr. Mel Brown and Mr. Dwight Hunt gave a presentation on the two Parsons Corp. Studies: the Water Requirements and Availablity Study and the Water Transfer Study.

Mr. Charles Shreves told the assembly that there would be no rate increase in 1986.

The next meeting will be held January 9, 1986 at 1:30 p.m..

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
October 10, 1985

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, October 10, 1985.

The roll was called and the secretary reported that a quorum was not present. The Minutes were not approved because a quorum was not present.

Mr. Larry Gilbert reported that he had presented the Water Conservation Advisory Board's Resolution No. 85-2 to the Board of Directors. Mr. Charles Shreves stated that the Imperial Irrigation District would now develope an Environmental Impact Report and start up new negotiations with the Metrololitan Water District.

The meeting was adjourned. The next meeting will be held WEDNESDAY, NOVEMBER 20 1985 at 2:00 P.M., in the IID Auditorum.

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
September 12, 1985

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, September 12, 1985.

The roll was called and the minutes were approved as read.

Doug Welch introduced Dick Lyerly who had been appointed to serve on the WCAB by Lloyd Allen.

Melvyn Brown, of Parsons Water Resources, Inc., gave a brief report on the progress of the studies that Parsons is completing for the District. The Water Requirements and Availability Study will be completed and presented to the District Board on October 18, 1985.

Charles Shreves briefly explained the Draft, Memorandum of Understanding Between The Imperial Irrigation District And The Metropolitian Water District Of Southern California.

The WCAB reviewed each idem in the Memorandum Of Understanding.

M/S (Reeves-Cox) and carried unanimously, that the following Resolution No.84-4 be adopted.

> RE: Agreement with the concepts contained in the Draft Memorandum o Understanding Between The Imperial Irrigation District And The Metropolitian Water District Of Southern California, provided suggested refinements are made.

The Chairman opened the meeting to nominations for officers to serve for the following year.

J.C. Reeves moved to nominate Brad Luckey for the office of Chairman.

M/S (Cox-Reeves) and carried, that nominations for Chairman be closed and a unanimous ballot be cast for Brad Lúckey.

Brad Luckey moved to nominate John Veysey for the office of Vice-Chairman.

M/S (Reeves-Luckey) and carried, that nominations for Vice-Chairman be closed and a unaimous ballot be cast for John Veysey.

The meeting was adjouned. The next meeting will be held October 10, 1985 at 1:30 p.m..

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
June 6,1985

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, June 6, 1985.

The roll was called and the minutes were approved as read.

Mr. Melvyn Brown, of Parsons Water Resources, Inc., gave a brief summary of the three studies that Parsons will be completing for the District this year.

Mr Gilbert announced that election of officers will be held at the next meeting in July.

The meeting was adjouned. The next meeting will be held September 12, 1985 at 1:30 p.m..

M\S (Reeves-Luckey) and carried to recommend that point number 12 of the 21 point program be revised to read; When a water user requests an adjustment in the the quantity of water delivered not to exceed two (2) feet, the District shall be obliged to honor the same if it is within the ability of the District's system to accommodate such request and the water user notifies the zanjero in advance of beginning his daily run. The zanjero of said run shall obtain approval to make said change from his respective superior or section. Requests for larger adjustments will be honored when they can be made without significant adverse effect on the system.

There was a discussion of the 21 point program rules number 13 and 14. No action was taken.

Discussion of proposed rule to have the potential for a "triple charge" follow the water when an order is moved. No action was taken.

Discussion of having the District make pan evaporation information available in a more usable form. No action was taken.

The meeting was adjourned. The next meeting will be held June 6, 1985 at 1:30 p.m..

SECRETARY'S MINUTES
WATER CONSERVATION ADVISORY BOARD
May 9, 1985

The Water Conservation Advisory Board convened in a regular session at 1:30 P.M., Thursday, May 9, 1985.

The roll was called and the minutes were approved as read.

M/S (Cox-Corfman) and carried to recommend that the escalating feature of the "triple charge" be discontinued.

M/S (Reeves-Heffernan) and carried to recommend that the second tailwater measurement be made between 9 and 15 hours after the first measurement in order for a "triple charge" to be assessed.

M/S (Sperber-Luckey) and carried to recommend that the IID, in it's lateral fluctuation study, evaluate and implement a procedure, using a combination of canal check undershot and overpour settings, to reduce the canal water level fluctuations and their effects on deliveries.

M/S (Reeves-Cox) and carried to recommend that the IID evauate in it's lateral fluctuation study and implement where practical the use of broad-crested weirs or other devices, which stabilize the water level on the farm side of the delivery gate, to reduce fluctuations in the delivery flow.

M/S (Reeves-Heffernan) and carried to recommend that when canals are being dewatered, the IID coordinate canal flow to individual users' needs so the spills can be kept to a minimum.

M/S (Cox-Sperber) and carried to recommend that the district divert as much money as possible from capital expenditures on water conservation projects, to short and long range planning and research.

Discussion of six demonstration tailwater return systems. Should they be permanent or partially portable systems? Doug Welch informed the W.C.A.B. that the District Board had decided to construct six permanent systems.

M/S (Cox-Reeves) and carried to recommend that the following be included within the Districts' Tailwater Assessment Program; An estimate of the tailwater discharge with adequate supporting date will be accepted as a basis for an assessment when an accurate overpour measurment cannot be made.

There was discussion about reservoirs, their use and design.

M\S (Cox-Reeves) and carried to recommend that point number 16 in the 21 point program be eliminated.

Secretary's Minutes
Water Conservation Advisory Board
February 14, 1985

The Water Conservation Advisory Board convened in a regular session at 1:30 p.m., Thursday, February 14, 1985.

The roll was called and the minutes were approved as read.

There was a general discussion of different methods to conserve water.

The meeting was adjourned.

EXHIBIT 3-3

Water Conservation Task Group Notes

June 10, 1985

Tailwater Recovery - The task group had met, reviewed 18 applications from landowners for pump back systems, and unanimously selected one site for each Division.

One of the major criteria leading to the selections was location in relation to well traveled roads.

The second choice for Brawley was reviewed. If selected, only 160 acres served by Lavender 5-B should be used.

Mr. Twogood will present the Task Group's recommendation to the Board on June 11, 1985. Doug Welch has prepared an outline of conditions suggested to be included in the necessary agreements. All members are to review and comment so action may begin after the Board meeting.

Water Conservation Plan - Final review being made by Randy Stocker. We expect to receive his suggestions by June 14, 1985, following which Mr. Twogood will directly supervise completion of the document.

Mr. Silva will be directly responsible for supervision of final printing, which will take two weeks or more. Tentatively, we propose to distribute limited copies (10+) to Board Members and management well before the Board meeting on July 16, 1985, at which time we recommend formal adoption by resolution.

Measurements - Mr. Bradley is continuing to install measuring stations along the East Highline Canal.

Doug Welch and his crew are continuing instrument testing - problems remain. John Replogle and others from the Phoenix Lab will be here next week to offer assistance.

Measuring stations are being installed for the 5-lateral study by Doug's crew.

USBR Computer - Jesse Silva reported that the Bureau delivered the computer to be used to store historic District measurements on the East Highline. Jesse's people are breaking it in and will begin input of data. Temporary help will be used for this project.

Parsons - Task Group members and management personnel met last week with Parsons' team.

July 9, 1985

Tailwater Recovery - The agreement is at attorney's office. All six landowners have been notified and there are no major objectives to proposed work. Doug will check with farmers to finalize amount of water to be pumped back.

We need different kinds of pumps.

George will get with Hull to make up sign, 4 x 8 both sides.

Order 8 meters (in line) 15,000 ft. of 12" diameter PVC pipe, 48-45° elbows, 6-90° elbows.

Delivery Accounting - New form has been put together to try to account for water order and water delivered. Forms will be made up and will be given to each division to use.

USBR Seepage - Brad is metering on the laterals until the BCW's can be installed.

Parsons - Parsons (Water Conservation Plan) will complete their recommendations this week.

Electronic Recorders - It looks like the best answer to date for recording water is to use Omnidata's logger with a float and potentiometer.

July 22, 1985

Water Conservation Plan - Review by Parsons (Judy Herman) continues - goal to complete changes this week (word processor currently shut down). Carlos to have Gilbert letter typed (Supplement). Goal to deliver Supplement to printers Thursday. Aiming to have 10 copies of Plan printed before August 13, 1985 Board meeting.

Quarterly Report - Chairman requested outline of work progress from all members this week for April - June quarterly report.

Tailwater Recovery - Task Group approved sign; George Wheeler to turn over to Ron Hull for early installation.

Group advised that Lynch has decided not to participate. John Benson will be notified by Welch. Also, Tom Heffernan wants to delay installation until spring. Hold decision in abeyance.

Field data complete, except one line needs to be run now on Benson land. Plat sheets drawn, design work progressing.

Pump capacity to be 3 cfs. Doug to develop tailwater graphs for each site, for determination of reservoir capacity - probably between 1 and 2 AF.

Jesse has ordered 15,000 feet of 12-inch diameter PVC Schedule 160 pipe with fittings.

Doug has taken numerous soil samples.

Goal to finalize pump sizes by/before August first, so order can be submitted.

Measurements - Doug is completing tests on electronic recorder (Omnidata) using float and potentiometer instead of pressure transducers.

Brad reports that meterings for gate ratings is continuing for the East Highline and 5-lateral studies. Metering bridges are being installed by Western Division crews. Division crews have done clearing work and helped with installation of broad-crested weirs. Brad's crews have installed recorders on most sites and data is being accumulated.

George presented revised copies of Water Order Register forms which will be put in use when printed. Use of this form is the first step to account for possible differences between water delivered and charged.

August 9, 1985

Water Conservation Plan - Mr. Twogood reported that 10 copies of the Water Conservation Plan had been copied on IBM for distribution to the Board on Thursday, August 8, 1985. The Board will act on a Resolution adopting the Plan at the regular board meeting on August 13, 1985. The document will be delivered to the print shop shortly thereafter. Also, the Supplement is being finalized for delivery to the print shop.

Tailwater Recovery - The group reviewed the plans being developed for the Benson Ranch. It was decided by the group to try to work out a joint plan, with the District installing one pump on one of the existing reservoirs, and Benson installing any other pumps and pipelines to interconnect the systems. The plans will be discussed further next week after surveys are completed.

It was reported that two pumps have been ordered; one 20 HP for Veysey and one 30 HP for Smith. Further, that we can expect the first delivery of pipe within 30 days.

It was decided to proceed with ordering gate and check valves, and meters, standardizing on 6-inch if possible.

Water Measurements - Mr. Wheeler reported that the new record sheets are being used in El Centro Division and will be distributed to others next week.

Mr. Bradley exhibited graphs of flow data for rating checks and headgates. Measurements are continuing for East Highline project.

Mr. Welch reported that he should receive a written price schedule from Omnidata for 100 electronic recorders very soon.

Mr. Welch has been discussing termination of USBR/Neutron Probe Study, including IID purchase of recorders.

General - Mr. Welch's crews are collecting soil samples, plus tailwater conductivity and temperature data. Mr. Bradley mentioned that his Section collects maximum air and minimum temperatures at several locations.

Mr. Welch and several water department staff people have been working with Steve Daniels, and report that his explanations of computer applications are excellent. It would be advantageous to have him working for the District full-time.

August 14, 1985

Task Group reviewed status of Water Conservation Plan:

Supplement being printed - complete this week.

Plan ready for printer - to be printed next week.

Tailwater Recovery - Twogood reported that Legal has approved agreement.

Final agreements to be prepared next week. George Wheeler to handle.

Silva reported that Lidco has bid to install pipe. Quotes being obtained on meters. First installation to begin week of August 26.

Wheeler to complete arrangements for signs with Hull.

<u>3.00 p.m.</u>

Reviewed status of Plan with Messrs. Shreves and Wilson.

In addition to status of tailwater recovery plans, the group recommended to Mr. Shreves that we proceed with a system for the Benson Ranch, with one pump and pipeline, working with owner to tie in adjacent systems. Mr. Shreves approved.

The 1986 Budget was discussed briefly. Mr. Shreves reported that Parsons will have a recommended program. Mr. Wilson's budget will include concrete lining, the new reservoir, and other routine programs. Mr. Welch will prepare the cooperative onfarm budget. The Task Group will discuss the 1986 program at future meetings.

Mr. Welch reported on the State Water Conservation Advisory Board meeting held on August 8, 1985. The Task Group decided that we should file for a small grant - up to $25,000 which we must match, to expand the CIMIS Program. Mr. Welch will prepare application. He reported that Westlands Water District will not apply, deferring to smaller districts.

Mr. Wheeler proposed that the Rules and Regulations need upgrading. Mr. Shreves instructed the Task Group to proceed. Mr. Wheeler is responsible for this effort.

Mr. Welch requested better cooperation from divisions in reporting delivery schedules to him, for the Tailwater and other programs. This will be discussed at the next Superintendent's meeting.

Mr. Welch reported that Mr. Gilbert has scheduled a meeting of the Water Conservation Advisory Board for Thursday, September 12, wants to discuss the water transfer program. Mr. Welch was asked to refer Mr. Gilbert to scheduled meetings between September 5 and 18.

<u>September 11, 1985</u>
An advance agenda had not been prepared but all members had been notified to discuss the 1986 water conservation budget. The committee discussed each item contained in the 1985 budget for possible extension into 1986. Budget figures were agreed to for all of the major items, including the several research and cooperative programs.

The requested budget for those programs under Doug Welch's supervision are attached. Jesse Silva was assigned the task of having the budget summary typed as soon as possible and distributed to each member of the task group.

<u>October 8, 1985</u>
<u>Tailwater Recovery</u> - Veysey System: all pipe in place; pump assembly being completed; power to be installed this, or next week.

Benson System: - pond completed; pipe to be laid this week; pump being assembled.

J. R. Smith System: - design completed.

Mallory System: design in progress, location revisions.

Others pending.

Some discussion about recordkeeping, regarding source and disposal of water.

Loan Application - Several alternatives were discussed regarding application for low-cost (5%) loan from DWR for Water Conservation projects.

It was decided to prepare, for further review, a three-element application: (1) Concrete Lining - one project. The South Alamo Canal was selected (2½ miles long).

(2) Regulating Reservoir - Trifolium

(3) Lateral Interceptor System

The three identified programs could add up to about five million dollars, the maximum loan to any entity.

Twogood referred to USBR "Opportunity" Study analyses on Spill Interception (pages 70-75).

Silva to begin preparation of application.

In other business, Wheeler reported that Divisions are using revised water order form for reporting water ordered, delivered, and charged. Also, the new pink slips are being used.

October 16, 1985
Tailwater Recovery - Jesse Silva reported that the pump for Vessey will be installed this week. Doug Welch indicated it would be three weeks before Vessey would be irrigating the north 160 acres in sugar beets. The system will be operable before that time.

On the Benson system, the pipeline will be completed this week. The pump is being fabricated.

It was the consensus of the Task Group that every effort will be made to complete the five tailwater recovery systems by mid-December. All five agreements have been executed.

Loan Application - Jesse Silva reported that he has his staff working on the elements for the application, namely, two reservoirs (Trifolium and Z), the concrete lining of the South Alamo, and the Lateral Interceptor System.

Most of the work has been done on the reservoirs. The South Alamo will have to start from scratch and the Lateral Interceptor is described in the Water Conservation Plan.

Portable Checks - The suggestion that the District install some portable checks in farm head ditches to stabilize the back pressure on certain delivery gates, was made at the Water Conservation Advisory Board meeting last week. Welch and Silva pointed out that portable checks would be considered as part of the Lateral Fluctuation Study. This study is largely dependent on the availability of recorders, but is expected to get under way at the first of the year. Manpower limitations may also be a factor, but the installation of portable checks will have a priority within this program.

Regarding the Lateral Fluctuation Study, Silva reported that the USDA, Phoenix Laboratory, has employed a man for their portion of this cooperative study.

Other - Welch reported that the first shipment of electronic recorders is due Monday, October 21, 1985.

The first recorders will be installed for the Lateral Fluctuation and the Irrigation Scheduling programs. The group discussed the importance of keeping Water Control staff informed on the electronic recorder program, since the long-range goal should be to replace chart recorders with electronic recorders throughout the District. The group discussed briefly the manpower needs to carry out the various conservation programs. It is recognized that additional manpower will not be forthcoming without MWD funds. Therefore, it will be necessary for existing personnel in the Water Department, especially in the Divisions and Water Control Section, to provide help when needed, especially for installing and moving recorders.

October 31, 1985
CIMIS Grant - Official notice of award is forthcoming.

Scheduled to have application completed by December 1, 1985. Jesse Silva and Don Twogood will go to Sacramento next week to talk to Tom Hawkins to iron out details of application.

Mr. Bradley is in process of relocating the existing recorders to the new sites, expect to finish by December 1, 1985.

Report showing percent (%) of heads checked for tailwater to heads running, shows that percentage is down to 75%, it was up to 85%.

November 7, 1985
Tailwater Recovery (a) Veysey System: system expected to irrigate this weekend; (b) Benson System: system ready to operate; (c) Reaves System: reservoir and pipe to be completed this week; (d) Mallory System: reservoir to be excavated next week; (e) Scaroni System: contacted District, we are waiting for signed agreement.

CIMIS: Awaiting formal notice; expect visit from DWR staff soon.

Loan Application: Silva reports good progress; work on schedule for South Alamo Canal appears to require 6' bottom x 80" deep. Consider raising AAC head 1' above Drop 5.

Lateral discharge study--Bradley handed out list of random locations; 13 recorders have been installed with 17 to go before target of December first. Group discussed with Sam Underwood the problem of zanjeros not reporting changes.

Other Items: October Tailwater Monitoring record was discussed. Average percentage of running heads over one cfs, was 90.0%; highest 96.4%, lowest 66.7%. Average number of running heads for October was 412.

It was noted that the level of Salton Sea was the same as last year on November 1, although cumulative inflow from IID to date is considerably less.

November 21, 1985
Tailwater Recovery Program. The Vessey pumpback system operated last week. The record showed a tailwater discharge of only three percent, apparently due to trash problems; however, water savings amounted to over three acre-feet. The recorder chart is attached.

We now have the first three systems installed and ready to run. There will be problems with the Benson system since we will be unable to measure all of the water coming from different sources. The fourth and fifth systems are in various stages of construction.

Recorders: Mr. Bradley reported that all but three lateral terminal spill recorders have been installed. The last three will be installed this week, making thirty in all.

DWR Loan Application. Jesse Silva reported that his staff is working on the application with the goal to complete it on, or about, the first week in December. He is also preparing a memorandum so that this matter can be discussed at the Board meeting of December 10, 1985. At this time the application will include three projects: Trifolium Reservoir, Concrete Lining of South Alamo Canal, and Lateral Terminal Recovery System. A reservoir at "Z" Heading may also be included.

Other Matters: Several changes in the Water Conservation Budget are being discussed with the General Manager and Manager, Finance and Accounting.

December 6, 1985
Tailwater Recovery: The Vessey system is operating and irrigation is scheduled for next week.

The Benson system is now completed and has operated through 4 or 5 irrigations; however, water cannot be measured completely as we are not getting full cooperation of the water user. Jesse Silva reports that repairs will be made to the discharge facilities by the District.

The J. R. Smith system is completed and ready for first irrigation.

The Trifolium 8 System (Mallory) Reservoir is completed but will have 6 inches of compacted clay added to the bottom.

Construction has not started on the Nilson system due to hay stacked on the pipeline alignment. Nilson will move the hay within the next 2 or 3 weeks.

Five Lateral Study: Twenty-five electronic recorders have been installed on tailwater structures.

During the East Highline cutout scheduled for the first week in January, several additional broad-crested weirs will be installed.

USBR (EHL) Study: Part-time employees are continuing to input historical data. Water Control is continuing measurements and maintenance of recorders, but is not making any computations. The charts will be sent to the USBR when requested (probably within the next month or so).

DWR Loan Application: Attached is a tabulation entitled DWR Loan Program B/C Summary, prepared and distributed by Jesse Silva. Discussion of the loan application is on the agenda for the Board of Directors meeting of December 10, 1985. The application will total $5 million and consist of 4 separate projects. It will be ready for transmittal shortly after the Board meeting next week.

Other: Mr. Bradley reports that the last recorder was installed on the lateral discharge structure December 5, 1985.

Doug Welch distributed a copy of the tailwater record on Myrtle 9 (copy attached).

January 10, 1986

Tailwater Recovery - Four installations are completed. The Nilson System will begin as soon as District crews can pull off of other work. The hay that was on the right-of-way has now been moved.

Doug will contact Steve Scaroni; the pipe is available for the Scaroni project. The schedule is to complete six installations.

Our goal will be to complete the Nilson System on or about February 1. Assuming Scaroni will execute the agreement, the goal will be to complete his installation on or about March 1.

Field Day: Doug Welch reported that 6 members of the Water Conservation Advisory Board held their regular meeting at the Veysey Ranch to observe the tailwater system in operation there. Although the pump was not running, due to minimal tailwater in storage, the system was explained by John Veysey and Doug Welch and many questions were asked and answered.

Tentatively, the task group recommends that a tailwater recovery field day be scheduled for March with widespread notification.

Lateral Fluctuation Study: Jesse Silva distributed his memorandum on modeling, dated February 2, 1986. It was reviewed and discussed briefly.

Further meetings with Parsons are scheduled next week.

Bob Lang will be working closely with Parsons on this project. We will continue to install recorders. Jesse is working on a work plan and inventory which should be completed within two weeks or so.

East Highline Studies: Bradley reports that he is accumulating data at major checks on the East Highline Canal. We are awaiting further information from the USBR.

Irrigation Scheduling Program: Doug Welch reported that he worked closely with the cooperators during the last two months or so and kept several from irrigating too soon. It was noted that those that didn't follow his advice had excessive tailwater. He reported that he now has 37 growers and 13,790 acres in the program.

1986 Program - Coordination with Parsons: A meeting is scheduled for next week with both Parsons and the USBR.

Other: Bradley reported that all of the operational discharge stations randomly selected are being recorded continuously.

Doug suggested that Denise attend the Coachella Field Day on January 17, so that he could meet with Parsons here.

George reported that the schedule for concrete lining is as follows:

January - Wisteria
February - Trifolium Extension
March - Rockwood

February 7, 1986
Dick Palmer of Parsons has talked to individual members of the Task Group about a proposed incentive program. He is scheduled to present the proposal to the Water Conservation Advisory Board on February 13, 1986.

Mr. Shreves has asked Doug Welch to present the proposal to the Board of Directors on February 18, 1986.

Jesse Silva reported that Water Engineering is furnishing substantial records to Parsons and Environmental Sciences for the EIR.

It was reported that the pipeline for the Nilsen tailwater recovery system is scheduled to be installed next week. Work will continue until the installation is completed.

Protective relays have been replaced on two of the larger pumps which were previously cutting out.

Doug Welch reports continued problems with irrigators pulling grade boards on tailwater structures eliminating the record. Jesse Silva will write a follow-up letter to Steve Scaroni advising him to respond by March 1, 1986, whether he wants to participate in the tailwater program.

Dr. Charles Burt is scheduled to visit the District on February 12. Parsons has been contacted and will be present. Dr. Burt will make a presentation on the work he has done over several years on System Automation.

A tentative schedule was discussed to complete the Water Conservation Plan update, with June 1 being set as a goal.

The 1985 Water Report will be printed soon. Tables from that report will be used in the Plan update. The general format was discussed, the main elements being:

a) Progress during 1985, including work by Parsons.

b) The 1986 program, including progress during the first quarter.

c) Suggested new programs for consideration.

A brief discussion was held regarding incentive programs. It was suggested that an escalating rate structure would be the quickest to implement. Any program based on measuring deliveries and tailwater would be expensive and would take considerable time to implement.

The group was requested to be prepared to suggest alternative incentive programs for consideration by the proposed Incentive Subcommittee.

Silva, Bradley and Welch were requested to prepare inventories of measuring stations and recorders installed for each of the several water conservation programs, and submit same by the next meeting. It is estimated that we have approximately 40 recording sites installed and operating.

Doug Welch reported that he is having trouble getting several landowners to sign the permission letter of agreement, allowing us to install broad-crested weirs and recorders on head ditches and tailwater structures. He was requested to compile a list of those unwilling to sign the agreement. Doug Welch passed out a graph of flows on two checks located on Myrtle Lateral which demonstrate the type of records we are trying to develop (copy attached).

March 7, 1986

Tailwater Recovery Program - The Nilson system is complete except for the power connection.

Steve Scaroni has returned the signed agreement form. The design is complete and materials have been ordered.

Veysey System - Doug reported that there will be two or three more irrigations on the sugar beets.

Benson System - Doug reports he is getting very few measurements as a result of too much tailwater and the complications of the system (tailwater from other fields, tailwater recovery being put on other fields, removal of grade boards by irrigators, etc.). There are undetermined flows going to the drains.

Regarding a field day, Doug Welch was urged to attempt to set a field day in late March or early April. A 10:00 a.m. time was suggested.

Water Conservation Plan Update: Twogood presented an outline of subject items (copy attached), for update of the water conservation plan. A proposed target date is June 1, 1986. George Wheeler has been instructed to review the 1985 Water Department Report for record material for the update.

1986 Program: (a) Loan Application: Jesse Silva has been in touch with Don Heath of DWR, who reported to him that there will be approximately 1 week delay in the decision on the loans, from this date.

(b) CIMIS Grant: Doug reported that Patty Seamstram contacted him advising that they need a resolution supplementing District Resolution 52-85. Doug will check on this.

(c) USBR Cost-Share Program: Jesse Silva reported that the District's matching costs are being computed to determine the payment due to the USBR.

Recorder Inventory: Bradley presented the group two inventory lists. The first lists the East Highline stations and the second lists stations being monitored for the operational discharge study (random systemwide locations). Copies of these lists are attached. Bradley also submitted a table showing the East Highline annual losses for the period 1964 through 1985 (copy attached).

Doug Welch presented a complete list of recorder locations for the irrigation scheduling program, as well as the lateral fluctuation study; altogether the lists show the location of 172 recorders (copies attached).

5. Other. (a) Doug Welch advised the Task Group that he has had trouble getting a few landowners to sign the standard letter granting permission to the District to enter property. A few landowners are reluctant to sign because of the third or fourth paragraphs of the letter which was approved by the District's legal counsel. Doug will check with Mr. Carter to see if these paragraphs can be modified or deleted.

(b) Doug Welch also presented a graph showing tailwater for the irrigation on February 5, 1986, to deliveries on Newside 30A and 33 (Veysey pumpback), copy attached.

Twogood passed out copies of Doug Welch's quarterly report for the quarter ending 12/31/85, to the members of the group that had not previously received a copy.

Twogood furnished copies of a letter dated October 7, 1985, from Professor John Merriam and advised that Mr. Merriam will be here on March 20, 1986, and will meet with the task group, Parsons people and others, in the Water Department conference room at 8:30 a.m.

The group briefly discussed the Parsons incentive program and members were asked to provide suggestions to Welch and Twogood, who will represent the District on the Water Conservation Advisory Board subcommittee.

April 21, 1986
Tailwater Recovery Program. The pump for the Scaroni pumpback system has been ordered - anticipated delivery 30 to 60 days.

The Benson tailwater system problems were discussed by the task group. It will be necessary to install valves or caps on the discharge end of the system to avoid damage to the pipe such as occurred recently. The irrigator also broke the cast iron valve handle. A replacement has been ordered. All necessary repairs have been made, and a cap for the discharge line will be installed. Doug Welch reported that the Westmorland office failed to advise his office that Trifolium 8, Delivery 153 (Mallory pumpback), was running recently. As a result, our records are incomplete, although we have total flow values.

Lateral Fluctuation Study: A trial run on the Myrtle lateral has been scheduled for next week, April 28. Karen Holdsworth is in charge for the Water Department. Doug's crews will be collecting onfarm records. Doug reported that the farmer on the end of the Myrtle (Slater) still has not given permission to install broad-crested weirs in his head ditch. An effort will be made to accomplish this.

CIMIS. A portion of the recorders recently ordered will be charged to the CIMIS program. At this moment the District has not received a copy of the executed contract.

DWR Loan - Status: George Wheeler reported that the District has still not been notified on the award of a loan to the District.

Water Conservation Plan Update: Twogood reported that material has been gathered for the update such as minutes of this task group, minutes of the Advisory Board, and other information related to the District's water conservation program during 1985 and 1986. George Wheeler was given the assignment to assemble appropriate tables from the 1985 Water Department report for inclusion in the update.

Other: (a) Twogood will distribute copies of the 1986 1st quarter reports (water conservation) to the members of the task group.

(b) George Wheeler asked for comments from the task group members on the revisions to the rules and regulations sections on water deliveries (Regulation Nos. 8 and 9). The task group members had no specific comments but suggested that George should incorporate those suggestions from the divisions and move ahead with obtaining approval of the revised regulations.

(c) George Wheeler discussed the problem of keeping records on water moves. Although there is some improvement there is still water being moved by water users without the knowledge of District personnel. It was suggested that flagrant violators be assessed the gate moving charge.

(d) George reported that two requests have been received recently, one by Keith Sharp (informal) and a written request from Michael Morgan, requesting District participation in tailwater recovery systems. George distributed a water department analysis in response to Michael Morgan's letter (copy attached).

It was moved, seconded and unanimously approved, that the task group recommend that the District waive the standby charge only, for electric energy used on all tailwater recovery systems using electric pumps. Twogood will convey this information and recommendation to the General Manager.

MICHAEL MORGAN
PUMPBACK

A recent request by Michael Morgan Farms to meet with Water Personnel stated the desire to use portable electric pumps at proposed pumpback sites. They would prefer 3-Phase power. There is considerable cost in extending 3-Phase power to the locations tabulated in Figure 1 and shown in Figure 2.

Depending on the horsepower required and the distance to 3-Phase lines, power engineers give the following rules of thumb for installation:

1. Power consumption for 3-Phase is same as for single-phase motors;

2. If horsepower needed is less than 15 HP use single-phase motors if three-phase power is not readily available;

3. If horsepower needed is greater than 15 HP then either:

   a. Obtain 3-Phase power if its within 1/2 to one mile;

   b. Use phase converter on single phase power, and use 3-Phase motors.

To minimize pumping head he could:

1. Build reverse grade long ponds back to the high side of his field;

2. Pump to an adjacent downstream field;

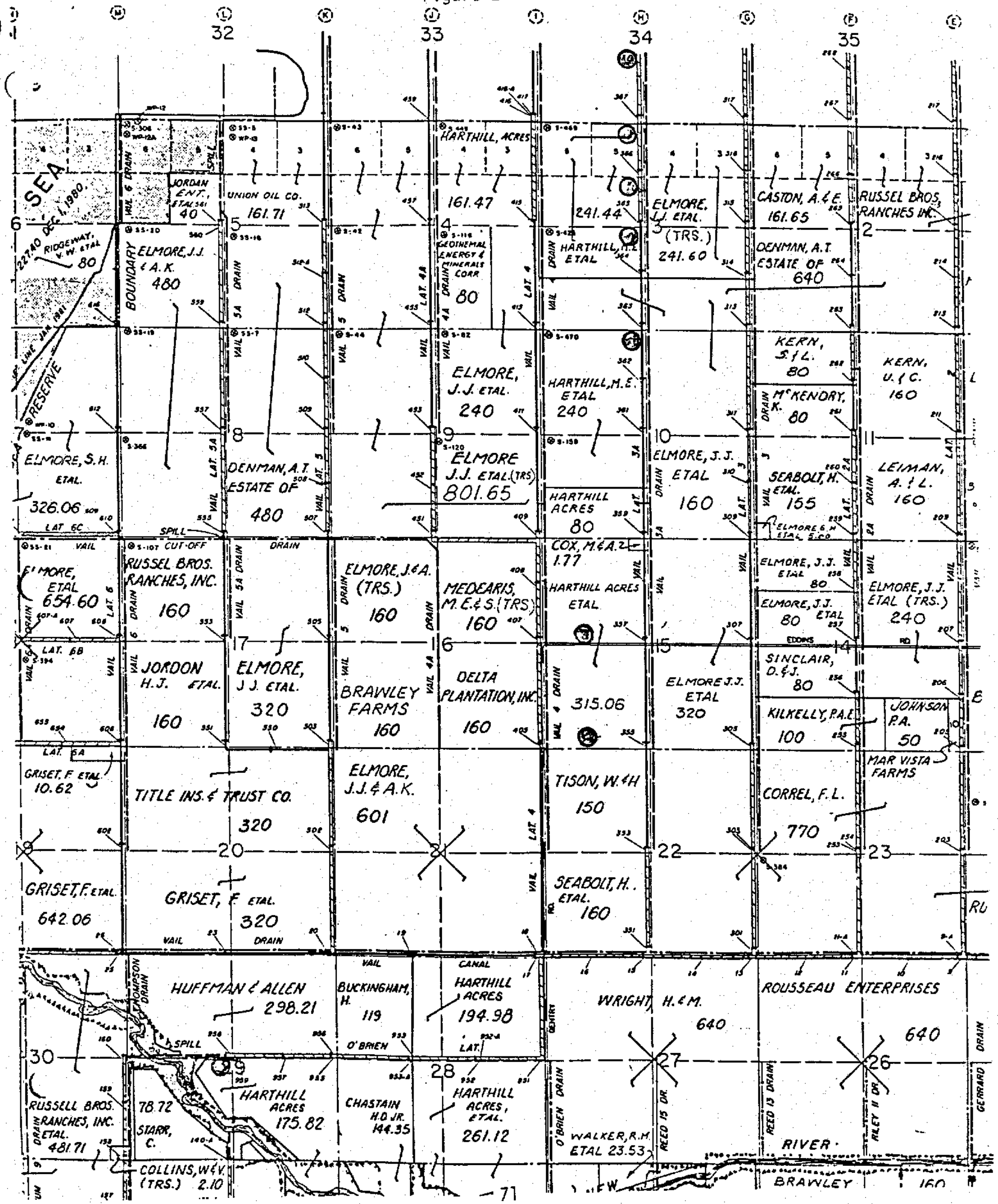
3. Oversize his return line;

4. Relevel his field to drain towards the center, closer to the high side wherever possible.

Figure 1

Location	Acres (+/-)	Dist. to 3-Ø (ft)	Cost ($)	Conn. Fee ($)	Total ($)
Vail 355	150	0	0	200	200
Vail 357	150	2,640	7,920	200	8,120
Vail 362	120	2,650	7,950	200	8,150
Vail 364	80	1,200	3,600	200	3,800
Vail 365	80	0	0	200	200
Vail 366	80	1,600	4,800	200	5,000
Vail 367	160	1,600	4,800	200	5,000
O'Brien 959	30	5,800	17,400	200	17,600

Figure 2


SEA
RESERVE
RIDGEWAY, V.W. ETAL 80
JORDAN ENT., ETAL 40
UNION OIL CO. 161.71
HARTHILL, ACRES 161.47
241.44
ELMORE, J.J. ETAL. (TRS.) 241.60
CASTON, A.&E. 161.65
RUSSEL BROS. RANCHES INC.
ELMORE, J.J. & A.K. 480
BOUNDARY DRAIN
GEOTHERMAL ENERGY & MINERALS CORP. 80
HARTHILL, M.E. ETAL
DENMAN, A.T. ESTATE OF 640
KERN, S.&L. 80
KERN, U.&C. 160
ELMORE, J.J. ETAL. 240
HARTHILL, M.E. ETAL 240
McKENDRY, K. 80
ELMORE, S.H. ETAL. 326.06
DENMAN, A.T. ESTATE OF 480
ELMORE J.J. ETAL (TRS) 801.65
HARTHILL ACRES 80
ELMORE, J.J. ETAL 160
SEABOLT, H. ETAL. 155
LEIMAN, A.&L. 160
COX, M.&A. 1.77
ELMORE, ETAL 654.60
RUSSEL BROS. RANCHES, INC. 160
ELMORE, J.&A. (TRS.) 160
MEDEARIS, M.E.&S. (TRS) 160
HARTHILL ACRES ETAL
ELMORE, J.J. ETAL 80
ELMORE, J.J. ETAL (TRS.) 240
JORDON H.J. ETAL. 160
ELMORE, J.J. ETAL. 320
BRAWLEY FARMS 160
DELTA PLANTATION, INC. 160
315.06
ELMORE J.J. ETAL 320
SINCLAIR, D.&J. 80
KILKELLY, P.A.E. 100
JOHNSON P.A. 50
MAR VISTA FARMS
GRISET, F. ETAL 10.62
TITLE INS. & TRUST CO. 320
ELMORE, J.J. & A.K. 601
TISON, W.&H 150
CORREL, F.L. 770
GRISET, F. ETAL. 642.06
GRISET, F. ETAL. 320
SEABOLT, H. ETAL. 160
VAIL DRAIN
VAIL CANAL
HUFFMAN & ALLEN 298.21
BUCKINGHAM, H. 119
HARTHILL ACRES 194.98
WRIGHT, H.&M. 640
ROUSSEAU ENTERPRISES 640
RUSSELL BROS. RANCHES, INC. ETAL. 481.71
78.72
STARR, C.
HARTHILL ACRES 175.82
CHASTAIN H.D. JR. 144.35
HARTHILL ACRES, ETAL. 261.12
WALKER, R.H. ETAL 23.53
COLLINS, W.&V. (TRS.) 2.10
RIVER
BRAWLEY 160
32
33
34
35

SECTION 4

Consulting Work by Parsons Water Resources

Following the submission of the Draft Water Conservation Plan to the Board of Directors on January 22, 1985, the General Manager sent letters dated February 7, 1985, to several engineering firms inviting proposals for engineering services (design and construction). All firms were furnished copies of the 1/31/85 Draft Plan.

Six of the major engineering firms in the country responded with proposals. These firms are:

- Bechtel Corporation
- Bookman-Edmonston
- CH2M Hill
- Harza Engineering
- Morrison-Knudson
- Parsons Corporation

On March 18 and 19, 1985, the District Water Exchange Committee plus other District staff, listened to verbal presentations from the firms' representatives, reviewed the written proposals, and subsequently prepared a recommendation.

On April 9, 1985, the Board of Directors accepted the recommendation of the Committee by selecting the engineering firm of Parsons Water Resources (Parsons) to assist the District in water conservation planning and development.

A Letter of Intent was executed on April 19, 1985, which set forth the terms and conditions for a definitive water conservation planning and development agreement between the District and Parsons.

The intent of the letter was that the District and Parsons would cooperatively undertake a program that would (1) quantify the District's present and future water needs, (2) determine the additional water that might be available for use by others and identify the potential transferees thereof, and (3) provide for the planning, engineering, designing, financing, construction and implementation of the water conservation and transfer programs (collectively referred to as the "Program").

The Letter of Intent provided that, until a final contract was negotiated, Parsons, as approved by the District, would "...undertake initial studies and analysis in order to quantify the District's present and future water needs and determine the additional water that might be available for use by others and the potential transferees for that water."

The Board of Directors, on May 17, 1985, authorized Parsons to proceed with initial studies. Parsons' request for approval to proceed with the work, dated May 10, 1985, described seven tasks as follows:

Task No.	Description
1000	Program Management, Control, and Administration
1020	Program Procedures
2000	Water Requirements and Availability Study
4000	Water Transfer Study
5000	Water Conservation Implementation Plan
6000	Program Studys and Reports
7000	Program Support Services (As required)

Parsons submitted monthly progress reports detailing the work. The following paragraphs summarize Parsons' work for each reporting period, as presented in the monthly or periodic reports.

Progress Report No. 1, July 1, 1985

- Completing personnel mobilization.
- Concluding an acceptable subcontract agreement with Bookman-Edmonston Engineering, Inc.
- Establishing an appropriate field office in Imperial.
- Establishing our program management office at Corporate Headquarters in Pasadena.
- Establishing program cost and schedule controls.
- Commencing work on the initial study tasks with emphasis on field site and operational orientation of Parsons personnel, coordination and interface with IID counterparts, data collection, IID review of definitive study tasks methodology and report outlines, review of

existing data and reports, and public information with respect to the water conservation program.

- Commencing preparation of program procedures for the initial study phase.
- Providing technical assistance and support services as requested by the District.
- Developing an acceptable water conservation development and planning agreement between the District and Parsons.

Progress Report No. 2, August 1, 1985

- The 50% submittal of the Water Requirements and Availability Study was prepared and transmitted to the District for review on July 23. Subsequently, an IID staff/Parsons review meeting was held on July 26, with participation by the District staff and Parsons team members.
- Several Parsons team members provided assistance to the District in finalizing the IID Water Conservation Plan.
- The Parsons Program Procedures were completed and issued as scheduled on July 26.
- With considerable assistance from the District, the Parsons field office in Imperial was completed and is now in use by Parsons Personnel.

  Parsons continued to particiate in the Public Information/Public Relations activities on an as-required basis. On July 8, Parsons presented an overview of the Water Conservation Program to the Farm Bureau Directors in El Centro. Throughout July, numerous personal contacts were also made with agricultural representatives and farmers to obtain their input into the planning process.
- The proposed IID Water Conservation Planning and Development Agreement between the District and Parsons was found acceptable by Parsons on July 2. Mr. J. K. Bratton presented an overview of the proposed agreement to the Board of Directors on July 16. Final action on the agreement by the board was deferred until the October 15 board meeting.
- Parsons legal advisors continued to assist the District in support of Water Transfer Agreements. Presentations concerning the proposed IID/MWD Memorandum of Understanding were given to the board by Parsons legal advisors on July 9 and July 15. On July 24, Parsons provided a draft letter to the President of the Board of Directors requesting

certain assurances from MWD with respect to protection of IID water rights and reliability of continued payments to IID. Concurrently, Parsons also provided a memorandum from its legal advisors (Messrs. Fellmeth and Gumpel) concerning the proposed water transfer agreement between the IID and MWD.

- Parsons continued the data collection and analysis activities required to prepare the Water Transfer Study.

Report No. 3, September 1, 1985

- The Final Draft (90%) Water Requirements and Availability Report was submitted to the District for review on August 27.
- A District staff/Parsons review meeting was held on August 30 to review the report and to discuss major findings and issues.
- Parsons continued to provide assistance to the District in support of the proposed water transfer agreement.
- A number of personnel contacts with farmers were made by our Chief Agriculturist, Dick Palmer, in order to obtain their input into our study effort and to identify any concerns with respect to the Water Conservation Program.

Report No. 4, October 1, 1985

- The Draft Final (90%) Water Requirements and Availability Report was reviewed with the District on August 30.
- The Interim (50%) Submittal of the Water Transfer Study was submitted to the District on September 3.
- An IID/Parsons review meeting was held on September 6 to review the report and obtain District comments.
- On September 11, Mr. Leonhard and representatives of the IID met with officials of MWD, Coachella and Palo Verde Irrigation Districts to discuss the Proposed IID/MWD water transfer agreement.
- Parsons is currently providing technical assistance to the District in revising its Negative Declaration of Environmental Impacts associated with the Proposed Water Transfer Memorandum of Understanding between the IID and MWD.
- A number of personal contacts with farmers continue to be made by our Chief Agriculturist Dick Palmer, in order to obtain their input into our study effort.

Report No. 5, November 1, 1985

- On October 25, 1985, a "Final Review" of the revised Water Requirements and Availability Study (WRAS) was held in Pasadena with the IID staff and Water Exchange Committee of the Board.
- The Draft Final (90%) submittal of the Water Transfer Study (WTS) was submitted on October 15, and a review meeting was held with the IID staff on October 18.
- Parsons attended all IID Board of Directors meetings held during October.
- Additional meetings attended included the Senate Subcommittee hearing on water marketing, the New River Task Force meeting, the "Southern California 2001" water symposium, and the Regional Economic Development, Inc. (REDI) Community Forum on tourism and geothermal industry development in the Imperial Valley.
- On October 29, Mr. Roddey, President of the Parsons Corporation, was the keynote speaker at the Imperial Valley Beet Growers Association dinner.
- A draft bid Package for contracting out the preparation of the Environmental Impact Report (EIR) was prepared and submitted to the District on October 23, 1985.
- Dick Palmer, Parsons' Agriculturist, summarized the water conservation suggestions from thirty farmer meetings and conducted additional one-on-one meetings with farmers to obtain their input into our study effort.

Report No. 6, December 1, 1985

- On November 8, 1985, a "Final Review" of the revised Water Transfer Study (WTS) was held with the IID staff and Water Exchange Committee of the Board.
- The final Water Requirements and Availability Study (WRAS) was also completed during this Period and was transmitted to the District on November 8, 1985.
- Presentations of both the WRAS and WTS were given to the Board of Directors on November 19, 1985.
- On November 20, a similar presentation of the study results was given to the Water Conservation Advisory Board.

- Progress continued on computer-aided design activities and the first elements of the data base were entered into memory.

Report No. 7, April 1, 1986

- On December 10, the proposed CY 1986 budget and scope of work were presented to the Board of Directors. After a discussion of several funding and scope of work alternatives, the Board of Directors approved a reduced level of work for Parsons in 1986. Authority for Parsons to proceed with this work was provided on December 12, 1985.
- At the board meeting on December 10, Parsons Water Resources was selected by the Board to assist the District in the preparation of IID's Program Environmental Impact Report. Authority to Proceed with this work was provided to Parsons on December 30, 1985.
- Parsons continued implementation planning work in December, focusing primarily on development of the mathematical model of the irrigation system.
- On January 17, a program review meeting was held with the District staff to discuss and confirm tasks and schedules. This meeting resulted in several changes to the 1986 schedule, confirmation of various work scopes, and the District's decision to cease work on the computer-aided design activities pending evaluation of other mapping alternatives.
- Parsons actively participated in all discussions and negotiations between the IID and MWD concerning the initial transfer of 100,000 AF/year of conserved water. Meetings were held on February 14 and March 5 in San Diego, and on March 12 in Pasadena.
- Developed a draft Proposed amendment to the 1932 Water Diversion and Delivery Contract between the District and the U.S. Department of the Interior (DOI).
- On March 27, a presentation was given by Parsons at a public meeting in El Centro to obtain public understanding and support of the Water Conservation Program.

<u>Water Requirements and Availability Study</u>

The purpose of the "Water Requirements and Availability Study" is to quantify the Imperial Irrigation District's present and future water needs and to determine the additional water that could be made available for use by others.

This determination was based on an analysis of Colorado River water supply to the District, future water requirements of the District to the year 2010, and water conservation projects and measures that could reasonably be implemented over a 12- to 14-year period.

Parsons submitted the final report entitled "Water Requirements and Availability Study" to the District on November 8, 1985, in accordance with the April 19th Letter of Intent. The study had three major objectives:

1. Define water requirements that are estimated to exist during the planning period (1985-2010).

2. Examine a broad array of water conservation methods to determine the technical and economic feasibility of those methods, to analyze their relative value, and to determine which should be implemented and to what extent.

3. Determine the amount of conserved water that can be made available for use by others, considering water supply requirements and implementation of conservation measures.

The findings of the study are:

1. The IID share of the 3.85 million AF/year allocated to California's agricultural agencies in the Seven-Party Agreement will be available with greater than 99% certainty through the year 2010.

2. The current baseline water demand within the IID is 2,770,000 AF/year (considering the conservation that has already occurred). This baseline amount represents the most probable demand, based on current and historical evidence.

3. If no further conservation takes place, the projected baseline water demand for the year 2010 is 3 million AF/year.

4. (a) The total amounts of water that could be conserved through new economically feasible IID projects, and that which has already been conserved by past IID projects, are estimated to be:

Time Period	Amount Conserved (AF/year)
Pre-1986	138,000
New projects (1986-1997)	358,000
Total	496,000

(b) The pre-1986 conserved amount of 138,000 AF/year can be considered as available for use by others now.

(c) The 358,000 AF/year estimated to be conservable by new projects is based on undertaking a major effort to implement the more cost-effective conservation actions during the period 1987-1998.

5. (a) When the baseline water requirements for the year 2010 are adjusted for conservation measures, the net demand would be 2,642,000 AF.

   (b) The IID demands for water in year 2010, assuming implementation of the new program and considering the pre-1986 conservation measures, would be less than the IID's Seven-Party Agreement allocation.

6. There is good quality groundwater with a volume exceeding 700,000 AF available for use as a reserve during periods when demand exceeds supply. The capital cost of developing a strategic reserve capable of supplying 300,000 AF/year (the amount of reserve required during a year of maximum planning demand) is $32,000,000, which has been included in the cost of the conservation program.

7. (a) The estimated capital cost of the new (post-1985) conservation program is $600,360,000 (in 1985 dollars).

   (b) The largest cost item of the new program is construction of a desalination plant, estimated to cost $335,000,000. The merit of constructing this high-cost item would have to be assessed carefully, considering benefits, costs, and financing means.

8. The amount of water potentially available for use by others will be the amount that has been and will be conserved, up to the total limit of 496,000 AF/year.

Water Transfer Study

Parsons submitted the final report entitled "Water Transfer Study" to the District on November 18, 1985.

The "Water Transfer Study" was intended to identify and evaluate potential State of California transfer candidate water agencies that could beneficially use additional water that could become available as the result of the District's water conservation efforts. This determination was based on an evaluation and analysis of water users within 12 hydrologic study areas in California, water supplies and demands through the year 2010, water conveyance capacities and constraints, operational compatibility, cost of alternative water supplies, and a willingness to enter into a transfer agreement. The Executive Summary presents principal findings and an overview of the study.

The conclusions of this study are as follows:

1. The demand for water in Southern California will continue to grow over the next 25 years as a result of population increase. This is particularly true in the south coast plain.

2 Water supplies in Southern California will be adversely impacted by the increasing diversion of Colorado River water to Central Arizona.

3 California laws and policies concerning water conservation and beneficial use support the transfer of District-conserved water.

4. Transfer of conserved water surplus to local needs from the Imperial Irrigation District is feasible.

5. The most appropriate transferees to receive conserved District water are located in the south coastal plain of Southern California.

6. The most advantageous and easily implemented water transfer arrangement would involve transfer of District-conserved water to the MWD. Transfer to the San Diego County Water Authority would also be feasible but would probably be more difficult to arrange. Although more difficult, transfer to Kern County through a third-party exchange system is feasible if economic conditions change.

7. Receiving conserved water from the District is an attractive alternative to other sources because of its present and future firm availability, location, and relative cost.

1986 Scope of Work

Parsons submitted a "Request for CY 1986 Budget Approval and Authority to Proceed with Work," dated November 15, 1985, to the District Board of Directors on November 19, 1985. On December 10, 1985, following approval of the District Operating Budget for 1986, the Board authorized Parsons to proceed with the work as requested except that expenditures would be limited to $950,000 for work performed by Parsons during 1986 (not including preparation of the EIR).

During the first four months of 1986, Parsons work on the Water Conservation Implementation Plan included the following (refer Progress Report No. 7):

- Continued computer-aided drafting activities with emphasis on topography, infrastructure alignment, and boundaries;
- Continue development of the mathematical model;
- Direct work toward establishing design criteria and delineating program elements to be included in the first three years of the implementation plan.

Several review meetings were held during this period between District and Parsons staff to coordinate work activities.

The first submittal by Parsons was to be the Mathematical Model Report, scheduled for June 1986, followed by the 50% submittal on the Water Conservation Implementation Plan, also in June.

Environmental Impact Report (EIR)

At the regular meeting of August 13, 1985, the Board of Directors approved the Environmental Assessment and Initial Study for a proposed 100,000 AF water transfer per the Draft MOU, and authorized the preparation of a Negative Declaration covering the project.

Subsequently, the documents were appropriately prepared and distributed for comments. Although an official public hearing on the Negative Declaration had been set for October 29, 1985, sufficient comments and questions were received during meetings and the public hearing on September 30, 1985, on the MOU, to indicate that an Environmental Impact Report focused on the proposal should be prepared.

The Board, on October 8, 1985, authorized the General Manager to invite bids from qualified entities for the preparation of a Program EIR for the implementation of up to 500,000 AF/year of water conservation projects and measures, and for the potential transfer of up to 250,000 AF/year of Colorado River water presently allotted to the District. Further, the Board authorized preparation of a Focused EIR for the potential transfer of 100,000 AF/year of conserved water to another agency.

Seventeen consulting firms were invited to submit proposals by December 2, 1985, for preparation of the two EIRs.

At a special meeting on December 10, 1985, the Board of Directors selected Parsons Water Resources to prepare the Program and Focused EIRs, and authorized Parsons to proceed in accordance with their proposal.

In accordance with the California Environmental Quality Act (CEQA), the District issued a Notice of Preparation (NOP) on January 22, 1986. This notice was sent to the State Clearing House, all local public agencies, and everyone else who might be concerned with the issue. A thirty-day response period started with the Notice.

A notice was published for a Public Meeting to be held in the District Auditorium on February 5, 1986, for the purpose of providing and receiving information about the preparation of the EIR on the District's water conservation and transfer programs. The meeting was well attended (over 100 people), and comments were received from ten persons, following a general presentation by Parsons' representatives of their studies and findings to date.

It was explained that the Focused EIR was to address the impacts of transferring up to 100,000 AF/year of water already conserved by the District's long-term water conservation program which began in 1954 with the first concrete-lining projects.

A preliminary draft EIR (PDEIR) was submitted by Parsons to the District on March 17, 1986, followed by a joint staff meeting on March 24, 1986, for Parsons to receive District policy guidance, direction and review comments. District staff continued to review progress on the draft EIR.

The Draft EIR was presented by Parsons to the Board of Directors on April 15, 1986. Parsons' representatives presented an overview of the DEIR. The Board accepted the DEIR, authorized distribution, set a sixty-day period for review and comment, and scheduled a Public Hearing for April 28, 1986, to receive public comment on the report.

The Draft EIR contains ten chapters and nine appendices, and covers the following major subjects:

- Background Information
- Description of Proposed Conservation Program
- Initial Transfer
- Water Conservation Program Alternatives
- Existing Conditions
- Beneficial and Adverse Impacts
- Mitigation Measures
- Growth-Inducing Impacts
- Short-Term Beneficial Uses vs. Long-Term Environmental Impacts

The Executive Summary of the DEIR offers a brief description of the significant environmental effects and mitigation measures. Only a few of the impacts will be listed here as follows:

1. The first 100,000 AF/year of water transferred <u>would not have any significant environmental effect</u> because this water has already been conserved and is not entering the IID's system.
2. Water conservation will ensure that the IID's water availability is <u>increased</u> by conserving 500,000 AF/year and transferring only 250,000 AF/year.
3. Reduction of the current level of the Salton Sea, by reducing losses and, therefore, inflow to the Sea will reduce penalty payments by the existing high sea level.
4. Overall, there will be local and regional economic benefits from conservation expenditures, lower farm production costs and the inflow of money from outside sources for operation and maintenance of the irrigation systems, and payment of costs for environmental mitigation measures.

Table 1-2 of the DEIR Executive Summary contains a complete listing of the potential significant adverse impacts and mitigation measures.

As this Update is being prepared, comments are being received from concerned individuals and agencies. The sixty-day comment period will end on June 16, 1986, with scheduled completion of the final EIR in mid-summer 1986.

SECTION 5

Accomplishments January 1985 through April 1986

This section will describe the water conservation programs proposed and accomplished for calendar year 1985, the proposed and budgeted programs for 1986, and the accomplishments through the first four months of 1986.

Table VI.1 in the 1985 Water Conservation Plan was a summary of programs planned for calendar year 1985. Budgeted expenditures totalled about $6.4 million. The water conservation fund balance on December 31, 1984 was $2,787,300. Anticipated revenue for water conservation, based on 2.3 maf in water sales and accruals into the Water Conservation Fund at $1.75/AF was about $4 million, thus providing total conservation funds of about $6.8 million.

Table 5.1 compares 1985 actual expenditures with major water conservation work order numbers. Total expenditures for conservation as reported by the Finance and Accounting "Operating Report" dated 12/31/85, were:

Table 5.1
1985 Budget and Actual Expenditures
For Water Conservation

Work Order No.	Item	Expenditure	Budget
640.1 - 640.2	Reservoirs	23,876	$1,200.000
657.5000	Concrete Lining	$3 245,308	2 250,000
660.0 - 660.2	Tailwater Monitoring	483,968	444,000
660.3	Tile Recorders, Misc. Programs	53,361	194,400 1/
660.4 - 670.2	Lateral Fluctuation	0	100,000
671.5	USBR Cooperative Studies	41,169	162,000
661.1 - 661.3	Irrigation Scheduling	215,018	188,600
671.6	Tailwater Recovery	632,757	300,000
671.7	Electronic Recorders	343,514	2/
671.2	Elder Evaporation Pond	913	102,300
680.0 - 681.0	Parsons' Studies	1,241 145	1,500,000
Total		$6,281,029	$6,441,300

1/ Distributed from miscellaneous programs including personnel training, conservation education, additional personnel, etc.

2/ Included in other programs (Tailwater Recovery, Lateral Fluctuation, Irrigation Scheduling, etc.

Source: Concrete Lining per Water Department
All other figures from monthly "Operating Report" dated 12/31/85

The 1986 Budget submitted by the Water Conservation Task Group, prepared by program categories and adjusted to that approved by the Board of Directors, totals $7,928,000 and are shown in Table 5.2.

The 1986 budget assumed that loan funds in the amount of about $3 million will be available from the California Department of Water Resources by mid-year.

Actual expenditures for water conservation during the first four months of 1986 by work order category, is presented in Table 5.3.

A description and discussion of the loan application made by the District on December 9, 1985, is given later in this section.

Table 5.2

WATER CONSERVATION BUDGET
1986

PROGRAM	COST THOUSAND
WATER BALANCE ACCOUNTING	
Tailwater Monitoring	$ 50
Leaching Requirement	60
Electronic Recorders	280
STRUCTURAL PROGRAMS	
Canal Lining	2,250
Regulatory Reservoir (land purchase)	200
Lateral Interceptor System	250
Elder Evaporation Pond	110
OPERATIONAL PROGRAMS	
Remote Control Study	60
Samples & Tests, Drainage	24
ADMINISTRATIVE PROGRAMS	
Tailwater Assessment	300
EDUCATIONAL PROGRAMS	
Pilot Tailwater Recovery Systems	100
Conservation Education	2.5
Field Irrigation Demonstration	2.5
Irrigation Training	10
COOPERATIVE PROGRAMS	
USBR Cooperative Study	132
USDA Lateral Fluctuation	100
Irrigation Scheduling	260
SCS Water Conservation	40
RESEARCH PROGRAMS	
Mid Lateral Reservoir Study	50
CIMIS/Computerized Water Mgmt. Study	142
Water Requirement and Availability Study (Parsons)	1,500
SUBTOTAL	5,923
OVERHEAD CHARGES	2,005
TOTAL	$7,928

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Task Group
9/11/85
Rev. 10/30/85

Table 5.3
Water Conservation Expenditures
January through April 1986

Work Order No.	Item	Expenditure
640.1 - 604.2	Reservoirs	--
657.5000	Concrete Lining	$ 718,028
660.0 - 660.2	Tailwater Monitoring	97 452
660.3	Tile Recorders	33,831
660.4 - 670.2	Lateral Fluctuation	44 761
671.5	USBR Cooperative Studies	25 845
661.1 - 661.3	Irrigation Scheduling	38 289
671.6	Tailwater Recovery	75 617
671.7	Electronic Recorders	358 994
671.2	Elder Evaporation Pond	--
680.0 - 681.0	Parsons' Studies	376 692
Total Expenditures		$1 769 509

Source: Concrete Lining per Water Department
All other figures from monthly "Operating Report" dated 4/30/86

The following paragraphs describe the progress and status of the 1985 and 1986 water conservation programs as of April 30, 1986.

Canal Lining

The District continued its concrete-lining program by adding 30.52 miles during 1985, and another 6.24 miles during the first four months of 1986.

Concrete lining is a proven water conservation program. Seepage reduction is the primary goal, but other benefits have become apparent based on over thirty years of experience, including the following:

1. Reduce or eliminate Hydrilla and other aquatic and nonaquatic weeds from canals and adjacent rights of way.
2. Reduce or eliminate weed seeds from canal bank from falling into water and spreading to water users' fields.
3. Reduce exposed surface area to lessen evaporation loss.
4. Reduce the amount of rights of way required.
5. Improve the overall system.
6. Improve local operations.
7. Cooperate with adjacent landowners for major improvements.

Table 5.4 is a Summary of Concrete Lined Canals of the District, showing the miles of farm ditches and District canals lined from 1955 through 1985. Including the mileage lined through April 1986, the cumulative total of District canals lined is 907.03 miles, which means that nearly 57 percent of the District's conveyance system has been concrete lined.

Table 5.5 gives the cost breakdown for the 1985 program, showing that over $2.7 million was expended on the program. Table 5.6 provides the same information for 1986, and shows that a total of $718,028 has been expended so far in 1986. The General Manager authorized a limit of $750,000 for concrete lining until sufficient funds become available to complete the budgeted program - $2.25 million - for 1986 (see Table 5.2), through water-sale accruals, loan funds, or other sources.

A program has been developed to estimate water savings due to concrete lining. Canal seepage and surface evaporation are calculated for each section of canal before and after lining. Soil permeabilities are estimated from

Table 5.4

SUMMARY OF CONCRETE LINED CANALS

Year	Concrete Lined Farm Ditches		Concrete Lining of District Canals: For Private Maintenance		Concrete Lining of District Canals: For District Maintenance		Totals	
	Length (Miles)	Cumulative Length (Miles)	Length (Miles)	Cumulative Length (Miles)	Length (Miles)	Cumulative Length (Miles)	Annual	Cumulative
1955	103.00	298.90	1.15	1.15	.50	1.30	104.65	301.35
1956	125.60	424.50	4.05	5.20	1.66	2.96	131.31	432.66
1957	128.90	553.40	4.53	9.73	3.15	6.11	136.58	569.24
1958	98.40	651.80	4.97	14.70	3.11	9.22	106.48	675.72
1959	115.70	767.50	7.56	22.26	4.07	13.29	127.33	803.05
1960	122.10	889.60	4.60	26.86	3.62	16.91	130.32	933.37
1961	89.50	979.10	4.41	31.27	10.10	27.01	104.01	1,037.38
1962	93.30	1,072.40	1.60	32.87	17.67	44.68	112.57	1,149.95
1963	118.30	1,190.70	5.74	18.61	27.54	72.22	151.58	1,301.53
1964	110.80	1,301.50	3.53	42.14	50.52	122.74	164.85	1 466.,8
1965	80.70	1,382.20	.76	42.90	54.35	177.09	135.81	1,602.19
1966	72.30	1,454.50	.75	43.65	68.24	245.33	141.29	1,743.48
1967	62.90	1,517.40	.40	44.05	60.24	305.57	123.54	1,867.02
1968	67.50	1,584.90	1.02	45.07	51.68	357.25	120.20	1,987.22
1969	73.00	1,657.90	.27	45.34	56.11	413.36	129.38	2,116.60
1970	66.10	1,724.00	.61*	45.95*	38.74*	452.10*	105.45*	2,222.05*
1971	63.10**	1,787.10**	.93	46.88	35.85	487.95	99.88**	2,321.93**
1972	61.20	1,848.30	1.21	48.09	36.20	524.15	98.61	2,420.54
1973	71.50	1,919.80	1.11	49.20	29.94	554.09	102.55	2,523.09
1974	94.50	2,014.39	1.00	50.20	31.17	585.26	126.67	2,649.76
1975	56.80	2,071.10	2.44	52.64	38.39	623.65	97.63	2,747.39
1976	68.00	2,139.10	.77	53.41	38.25	661.90	107.02	2,854.41
1977	60.30	2,199.40	.30	53.71	34.63	696.53	95.23	2,949.64
1978	33.40	2,232.80	-	53.71	19.20	715.73	52.60	3,002.24
1979	25.50***	2,258.30***	-	53.71	21.79	737.52	47.29***	3,049.53***
1980	37.40***	2,295.70***	-	53.71	21.36	758.88	58.76***	3,108.29***
1981	43.60***	2,339.30***	-	53.71	27.30	786.18	70.90***	3,179.19***
1982	36.20	2,375.50	-	53.71	18.52	804.70	54.72	3,233.91
1983	24.10	2,399.60	-	53.71	23.08	827.78	47.18	3,281.09
1984	21.40	2,421.00	-	53.71	43.49	870.27	43.48	3,344.98
1985	24.80	2,445.80	-	53.71	30.52	900.79	55.32	3,400.30

* Correction 3/22/72
** Correction 1/73
*** Correction 2/17/83
Mileage on District canals shown includes structures

Table 5.5

1985 CONCRETE LINING COSTS

Canal	Legal Description	Estimated Cost C/L	Actual Cost C/L	Diff.C/L	Est. C&B	Act. C&B	Diff. C&B	Mileage
Wormwood	dels. 52-65	123,293.00	74,675.00	48,618.00	29,534.00	21,227.00	8,307.00	1.24
Eucalyptus	dels. 110-113	109,000.00	86,122.00	22,878.00	23,369.00	29,555.00	-6,186.00	.98
Palm	hdg.-del. 2; dels. 6-7; del. 7A-Holtville Mn. Dr. xing.	62,927.00	48,370.00	14,557.00	31,153.00	19,825.00	11,328.00	.90
Eucalyptus	dels. 74-75; 85A-92	122,496.00	116,889.00	5,607.00	26,285.00	30,658.00	-4,373.00	1.11
Mulberry	x-over-del. 7; dels. 8-9	59,939.00	52,648.00	7,291.00	24,521.00	16,789.00	7,732.00	1.03
Ash Lateral 15	hdg.-del. 101	68,952.00	72,865.00	-3,913.00	22,308.00	30,874.00	-8,566.00	.80
"E"	dels. 30-37	78,823.00	73,126.00	5,697.00	43,318.00	12,128.00	31,190.00	1.49
Pear	dels. 29-30	93,060.00	67,781.00	25,279.00	23,265.00	6,459.00	16,806.00	.80
Oxalis	dels. 3-5; 12-21	88,673.00	80,359.00	8,314.00	39,105.00	16,417.00	22,688.00	1.48
Pampas	hdg.-del. 4	45,975.00	44,193.00	1,782.00	26,500.00	12,994.00	13,506.00	.78
Mulberry	dels. 13-17	68,787.00	67,436.00	1,351.00	34,394.00	27,081.00	7,393.00	1.46
Peach	dels. 30-32; 33-34	52,430.00	49,233.00	3,197.00	28,837.00	19,455.00	9,382.00	.99
Ash Lateral 15	dels. 101-108	102,280.00	86,144.00	16,136.00	28,127.00	27,820.00	307.00	.93
Wormwood Lat. 7	del. 103-Wormwood Canal	69,831.00	69,921.00	-90.00	36,860.00	27,738.00	9,122.00	1.55
Dahlia Pipeline	W. line Tr. 65, 16-13 (590')	-	-	-	37,150.00	29,889.00	7,261.00	.11 P/L
Sumac	del. 46-Lat. 4 Hdg.	113,400.00	92,708.00	20,692.00	20,412.00	18,876.00	1,536.00	.86
Lavender Lat. 1-A	hdg.-end	31,303.00	29,134.00	2,169.00	14,828.00	8,692.00	6,136.00	.62
Sumac Lat. 1	hdg.-del. 13	16,709.00	16,026.00	683.00	6,836.00	5,746.00	1,090.00	.29
Township	hdg.-siphon; dels. 4-6	60,278.00	54,771.00	5,507.00	36,348.00	28,720.00	7,628.00	1.06
Nutmeg	dels. 11-A-15	49,380.00	47,800.00	1,580.00	23,688.00	19,331.00	4,357.00	1.00
Wormwood Lat. 3	hdg.-end	118,675.00	106,175.00	12,500.00	49,890.00	50,886.00	-996.00	1.90
Bryant	hdg.-end (cancelled)	-	-	-	-	1,797.00	-1,797.00	-

COSTS85

1 of 2

1985 CONCRETE LINING COSTS

Canal	Legal Description	Estimated Cost C/L	Actual Cost C/L	Diff.C/L	Est. C&B	Act. C&B	Diff. C&B	Mileage
"E"	dels. 37-41	50,806.00	47,579.00	3,227.00	26,740.00	28,878.00	-2,138.00	1.01
Dandelion	del.6-end	52,367.00	50,650.00	1,717.00	22,991.00	79,397.00	-56,406.00	.98
Newside	dels. 23-40	149,968.00	142,407.00	7,561.00	58,181.00	59,328.00	-1,147.00	2.45
"G"	del. 24-Hwy. 111	128,308.00	113,795.00	14,513.00	66,135.00	54,433.00	11,702.00	2.51
Elder	Lat. 5 Hdg.-del. 70	261,680.00	218,813.00	42,867.00	46,044.00	77,202.00	-31,158.00	1.94
		2,179,340.00	1,909,620.00	269,720.00	826,819.00	762,115.00	64,704.00	30.16
								.36*
								30.52

	1985 Estimated Cost	3,006,159.00
	+ Est. Engineering Costs	39,776.00
		$3,045,935.00
12-31-85	1985 Actual Cost	2,671,735.00
"	Actual Eng. Costs	42,286.00
		$2,714,021.00
	Difference - 12-31-85	331,914.00

*.36 of a mile - Dahlia - 1984 job completed in 1985

COSTS85.1

Table 5.6

1986 CONCRETE LINING COSTS

Canal	Legal Description	Estimated Cost C/L	Actual Cost C/L	Diff.C/L	Est. C&B	Act. C&B	Diff. C&B	Mileage
Trifolium Ext.	hdg.-del. 8	166,200.00	157,110.00	9,090.00	39,050.00	39,918.00	-868.00	1.34
Rockwood	dels. 167-172-C	127,556.00	130,296.00	-2,740.00	53,966.00	78,956.00	-24,990.00	1.85
Rockwood Lateral 8	hdg.-del. 166-C	25,242.00	27,373.00	-2,131.00	14,614.00	7,782.00	6,832.00	.50
Wistaria	dels. 59-73	150,720.00	134,634.00	16,086.00	37,680.00	67,875.00	-30,195.00	1.43
Dandelion	dels. 4-6	64,735.00	67,363.00	-2,628.00	32,368.00	15,466.00	16,902.00	1.11
Dogwood Lateral 2 (pipeline in lieu of concrete lining)		-	-	.00	19,300.00	6,050.00	13,250.00	(.40)
Birch P-2 Canal (pipeline in lieu of concrete lining)		-	-	.00	25,000.00	12,017.00	12,983.00	(.19)
		534,453.00	516,776.00	17,677.00	221,978.00	228,064.00	-6,086.00	6.23* .59**

1986 Est. Cost -	$712,131.00
Est. Eng. Costs-	8,248.00
	$720,379.00
+ pipelining	44,300.00
1986 Est. Cost	$764 679.00
6-31-86 1986 Act. Cost -	744,840.00
6-31-86 Act. Eng. Cost -	9,792.00
(includes pipelining)	$754,632.00
Difference	$ 10,047.00

*concrete lined
**pipelined

drainage investigation well logs. A permeability of 0.07 foot per day is assumed for concrete sections. Surface evaporation is estimated using an average pan evaporation rate of 8.5 feet per year and a pan coefficient of 0.69. The necessary earth and concrete cross-section measurements are taken from plan and profile drawings and entered into a computer worksheet which automatically calculates water savings.

The following is a summary of the work done this year:

Canal	Length (Miles)	Water Conserved (AF/Year)
Wistaria Canal	1.43	221
Trifolium Extension	1.34	170
Dandelion	1.11	121
Rockwood Lateral 8	0.5	50
Rockwood	1.86	307

The average annual unit water savings is thus 139 AF/mile.

The total water savings from the 1985 concrete lining program has been estimated to be 4,000 acre-feet per year. Cumulative annual water savings resulting from the concrete lining program through 1985 are estimated by the task group to be about 60,000 acre-feet per year.

Table 5.7 gives annual costs for concrete lining from 1954 through 1985, and shows total expenditures to be $34.9 million. When 1986 costs are added, the total is about $35.6 million.

Prior to preparation of the 1987 budget requests later this year, a schedule will be prepared for the next year's canal lining program.

Seepage Recovery

Operation and maintenance of the twelve seepage recovery systems along the East Highline Canal continued through 1985, with 14,721 acre-feet of seepage being recovered and returned to the canal. This figure is slightly below previous annual amounts for no apparent reason, as shown in Table 5.8. Costs shown are for electric power only, as calculated in the Water Department Engineering and vary slightly from cost reports.

Table 5.7

Imperial Irrigation District
Concrete Lining
1954 - 1986

Year	IID Costs	Landowner Costs	Total
1954	$ 5,189	$ -	$ 5,189
1955	4,231	2,490	6,721
1956	23,892	11,591	35,483
1957	19,793	4,252	24,045
1958	24,839	6,169	31,008
1959	41,934	20,628	62,562
1960	28,355	16,780	45,135
1961	68,715	37,819	106,534
1962	153,452	93,663	247,115
1963	304,903	123,678	428,581
1964	755,877	162,639	918,516
1965	639,895	106,100	745,995
1966	999,598	228,415	1,228,013
1967	1,032,525	192,839	1,225,364
1968	887,255	182,643	1,069,898
1969	1,034,195	219,608	1,253,803
1970	753,061	129,885	882,946
1971	743,133	165,756	908,889
1972	890,306	193,966	1,084,272
1973	761,873	165,877	927,750
1974	926,410	206,840	1,133,250
1975	1,509,594	298,273	1,807,867
1976	1,641,464	309,045	1,950,509
1977	1,448,962	276,319	1,725,281
1978	902,106	171,569	1,073,675
1979	1,112,430	188,718	1,301,148
1980	1,325,038	239,964	1,565,002
1981	2,004,615	387,783	2,392,398
1982	1,915,304	256,388	2,171,692
1983	1,808,892	198,330	2,007,222
1984	3,105,290	26,968*	3,132,258
1985	3,431,773	-	3,431,773
	$30,304,899	$4,624,995	$34,929,894

*This amount was actually deposited by landowners before the resolution was passed by the Board of Directors that allowed the IID to take over all concrete lining costs. The amount was later refunded to the landowners.

Table 5.8

WATER RECOVERY DRAINS PARALLEL TO EAST HIGHLINE CANAL

Year	DP-17 Plum to Pine Acre-Feet Recovered	DP-17 Cost	DP-18 Pear to EHL Lat. 10 Acre-Feet Recovered	DP-18 Cost	DP-19 EHL Lat. 10 to Lat. 11 Acre-Feet Recovered	DP-19 Cost	DP-20 Oat to Oasis Acre-Feet Recovered	DP-20 Cost	DP-21 Highway 80 to EHL Lat. 8 Acre-Feet Recovered	DP-21 Cost	DP-22 EHL Lat. 8 to Pear Acre-Feet Recovered	DP-22 Cost	DP-23 Oak to Moss Acre-Feet Recovered	DP-23 Cost
1970	1,321	479	1,416	533	658	332	653	314	1,088	447	621	328	925	361
1971	1,349	487	1,455	544	570	304	640	309	1,053	436	593	317	1,351	533
1972	1,207	451	1,388	526	568	306	599	295	1,123	456	652	332	1,297	519
1973	1,130	432	1,410	531	511	284	589	287	936	431	658	334	1,272	513
1974	1,109	590	1,363	680	599	384	587	304	889	532	588	385	1,340	700
1975	1,072	790	1,220	889	512	448	301	263	932	606	499	437	1,190	927
1976	984	755	1,084	839	470	422	371	314	865	717	507	461	1,269	948
1977	1,060	928	663	643	397	428	397	384	885	878	347	371	1,347	1,119
1978	977	977	559	679	390	462	441	439	911	915	242	438	1,298	1,272
1979	1,113	1,252	693	841	260	406	515	528	921	1,104	243	524	1,298	1,510
1980	922	1,245	676	992	194	339	475	630	778	1,102	281	580	1,313	1,796
1981	948	1,335	788	1,195	390	367	309	780	866	1,350	643	822	1,334	1,774
1982	1,089	1,913	811	1,648	377	435	258	1,125	860	1,796	482	997	1,240	2,198
1983	1,154	2,221	938	2,157	355	598	206	1,204	860	2,066	494	1,351	1,150	2,482
1984	1,066	2,206	842	2,087	288	591	249	1,224	902	2,036	456	1,268	1,215	2,535
1985	905	1,562	875	1,793	300	761	338	975	722	1,403	459	1,040	1,105	1,917

Year	DP-24 Ohmar to Oleander Acre-Feet Recovered	DP-24 Cost	DP-25 Orange to Ohmar Acre-Feet Recovered	DP-25 Cost	DP-26 Oxalis to Orange Acre-Feet Recovered	DP-26 Cost	DP-27 EHL Lat. 11 to Lat. 12 Acre-Feet Recovered	DP-27 Cost	DP-28 Oasis to Orient Acre-Feet Recovered	DP-28 Cost	Totals Acre-Feet Recovered	Totals Cost	Average Power Cost Per Acre-Foot
1970	-	-	-	-	-	-	-	-	-	-	6,682	2,794	0.42
1971	406	143	-	-	-	-	-	-	-	-	7,417	3,073	0.41
1972	1,854	653	1,361	627	-	-	-	-	-	-	10,049	4,165	0.41
1973	1,795	636	1,489	648	3,309	1,120	2,731	1,012	-	-	15,830	6,228	0.39
1974	1,850	884	1,109	603	3,714	1,825	3,195	1,548	2,369	1,063	18,712	9,498	0.51
1975	1,460	1,124	1,300	995	3,368	2,362	3,046	2,097	3,094	1,822	17,994	12,760	0.71
1976	1,388	1,168	1,370	1,195	3,126	2,387	3,062	2,271	3,296	2,092	17,792	13,569	0.76
1977	1,760	1,388	1,210	1,388	3,047	2,665	2,947	2,566	3,244	2,412	17,304	15,170	0.88
1978	1,833	1,569	1,322	1,544	3,704	3,475	3,039	2,863	3,255	2,633	17,971	17,266	0.96
1979	1,639	1,827	1,146	1,780	3,332	3,777	3,014	2,469	3,449	3,383	17,623	20,401	1.16
1980	1,625	2,138	1,113	2,061	3,357	4,469	2,883	3,836	3,499	3,983	17,116	23,171	1.35
1981	1,456	1,915	1,249	2,139	3,235	4,339	3,021	4,040	3,321	3,923	17,560	23,979	1.37
1982	1,523	2,346	1,188	2,741	3,460	5,966	2,947	5,213	3,148	4,956	17,383	31,334	1.80
1983	1,478	2,666	1,287	3,137	3,373	6,788	2,794	5,691	3,052	5,928	17,142	36,289	2.12
1984	1,440	2,690	1,120	3,092	3,280	5,539	3,280	5,539	2,669	5,807	16,807	34,614	2.06
1985	1,604	2,237	1,008	2,480	1,870	3,219	2,544	4,087	2,991	4,565	14,721	26,039	1.77

Mileage: .50 Mile - Total 6.00 Miles
Power costs calculated in Engineering Section

Table 5.9 provides a breakdown of all annual costs. Based on this data, average unit costs in 1985 were $3.17 per acre-foot ($46,685 ÷ 14,721 AF), indicating a favorable benefit/cost ratio of 2.8:1 ($9 ÷ 3.17).

During their 1985 studies, Parsons estimated that seepage recovery pumps along the All-American Canal between Drop 3 and Allison Check annually recover about 8,000 acre-feet (EIR, Table 2.2, page 2-9), which is in addition to the East Highline recovery pumps.

Regulating Reservoirs

The District continued to operate and maintain the four existing regulating reservoirs. The monthly quantities diverted into and released from each reservoir during 1985 is shown in Table 5.10. The total water diverted into the four reservoirs for the year was 110,301 acre-feet.

During the first four months of 1986, about 37,000 acre-feet of water was stored temporarily in the reservoirs, based on records shown in Table 5.11.

No detailed analysis has been undertaken to date, to estimate the net annual amount of water conserved by these reservoirs. The Task Group believes that a conservative estimate of total savings is in the range of 15,000 to 25,000 acre-feet per year.

Two additional reservoirs are in the planning stages and were among those identified in the Plan (Exhibit VI.5). The first, currently designated "Trifolium Reservoir" is nearing final design, and is scheduled for construction later this year, dependent upon availability of funds. A general site for the second has been selected near the "Z" Lateral heading.

The Trifolium Reservoir was one of the four projects for which a loan application was submitted to the Department of Water Resources (DWR). Funds are expected about August 1986, or later. Design work is nearly complete, a Negative Declaration is being prepared, one parcel of land has been acquired, and a second parcel is in escrow. As a related project, a 1.34-mile section of the Trifolium Extension Canal was concrete lined earlier this year (see Table 5.6).

Table 5.9

COST OF WATER RECOVERY SUMPS

			Annual Cost for All Sumps						Average Annual Cost Per Sump					
Year	Total No.	Weighted Average	Labor	Material	Equip.	Total Maint.	Power	Total Power Maint.	Labor	Material	Equip.	Total Maint.	Power	Cost Per Sump
1968	6	2	$ 582	$ 152	$ 148	$ 882	$ 872	$ 1 754	$ 291	$ 76	$ 74	$ 441	$ 436	$ 877
1969	6	6	2 406	675	702	3 783	2 591	6 374	401	112	117	630	432	1 062
1970	7	7	1 576	500	243	2 319	2 828	5 147	225	71	35	331	404	735
1971	8	7	1 876	72	123	2 071	3 037	5 108	268	10	18	296	434	730
1972	11	9	2 332	199	123	2 654	4 130	6 784	259	22	14	295	459	754
1973	11	11	3 847	46*	392	4 193	5 791	9 984	350	4*	35	381	527	908
1974	12	12	3 426	287	274	3 987	9 674	13 661	285	24	23	332	806	1 138
1975	12	12	3 756	379	302	4 437	12 450	16 887	313	32	25	370	1 037	1 407
1976	12	12	2 053	103	78	2 234	13 283	15 517	171	9	6	186	1 107	1 293
1977	12	12	3 683	527	620	4 830	15 217	20 047	307	44	52	403	1 268	1 671
1978	12	12	2 324	1 154	170	3 648	17 232	20 880	194	96	14	304	1 436	1 740
1979	12	12	3 760	1 251	1 160	6 171	20 299	26 470	313	104	97	514	1 692	2 206
1980	12	12	3 593	278	531	4 402	23 180	27 582	300	23	44	367	1 932	2 299
1981	12	12	9 388	9 332	1 471	20 191	23 060	43 251	782	778	123	1 683	1 921	3 604
1982	12	12	9 430	4 598	1 400	15 428	31 501	46 929	786	383	117	1 286	2 625	3 911
1983	12	12	7 391	944	1 646	9 981	34 999	44 980	616	79	137	832	2 916	3 748
1984	12	12	5 204	854	689	6 747	29 170	35 917	434	71	57	562	2 431	2 993
1985	12	12	13 342	3 872	3 484	20 698	25 987	46 685	1 112	322	290	1 724	2 166	3 890

*Credit
Costs are from the Cost Report

Table 5.10

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

RESERVOIRS IN ACRE FEET FOR 1985

	SINGH			FUDGE			SHELDON			SPERBER		
	TO	FROM	NET	TO	FROM	NET	TO	FROM	NET	TO	FROM	NET
JANUARY	1,691	1,790	(99)	1,783	1,863	(80)	1,826	1,854	(28)	1,283	1,412	(129)
FEBRUARY	2,005	2,110	(105)	1,744	1,688	56	2,346	2,343	3	1,576	1,698	(122)
MARCH	2,922	2,731	191	2,116	2,164	(48)	4,053	4,145	(92)	2,600	2,464	136
APRIL	3,199	3,122	77	2,130	2,088	42	2,547	2,346	201	2,595	2,655	(60)
MAY	3,165	3,297	(132)	2,175	2,054	121	2,343	2,305	38	2,685	2,534	151
JUNE	2,954	2,971	(17)	2,113	2,132	(19)	2,129	2,018	111	3,387	3,352	35
JULY	3,906	3,777	129	2,056	2,057	(1)	2,152	2,092	60	3,515	3,512	3
AUGUST	2,504	2,584	(80)	2,063	2,040	23	2,205	2,160	45	3,255	3,084	171
SEPTEMBER	2,293	2,190	103	2,094	1,988	106	1,939	2,010	(71)	2,785	2,809	(24)
OCTOBER	2,420	2,351	69	1,951	1,995	(44)	2,014	2,022	(8)	2,173	2,132	41
NOVEMBER	1,956	1,889	67	1,863	1,758	105	2,061	1,921	140	1,920	1,812	108
DECEMBER	1,262	1,375	(113)	1,873	1,996	(123)	1,869	1,969	(100)	805	798	7
TOTAL	30,277	30,187	90	23,961	23,823	138	27,484	27,185	299	28,579	28,262	317
AVERAGE DAILY C.F.S.	41.8	41.7	0.1	33.1	32.9	0.2	38.0	37.5	0.4	39.5	39.0	0.4

Table 5.11

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

RESERVOIRS IN ACRE FEET FOR 1986

	SINGH			FUDGE			SHELDON			SPERBER		
	TO	FROM	NET	TO	FROM	NET	TO	FROM	NET	TO	FROM	NET
JANUARY	2,657	2,592	65	1,971	1,924	47	1,998	1,969	29	1,400	1,397	3
FEBRUARY	2,425	2,417	8	1,927	1,896	31	2,103	1,979	124	1,612	1,628	(16)
MARCH	2,801	2,816	(15)	2,336	2,323	13	2,099	2,073	26	3,075	3,070	5
APRIL	2,959	2,982	(23)	2,419	2,444	(25)	1,989	2,065	(76)	3,096	3,161	(65)
MAY												
JUNE												
JULY												
AUGUST												
SEPTEMBER												
OCTOBER												
NOVEMBER												
DECEMBER												
TOTAL	10,842	10,807	35	8,653	8,587	66	8,189	8,086	103	9,183	9,256	(73)
AVERAGE DAILY C.F.S.	45.6	45.4	0.1	36.4	36.1	0.3	34.4	34.0	0.4	38.6	38.9	(0.3)

Remote Control

The remote control facilities for the irrigation system were not expanded in the past year. However, the three stations on the upper reaches of the All-American Canal (Drop No. 1, East Highline Check and Turnout, and Allison Check) were upgraded with new equipment. The old vacuum-tube system was replaced with new transistorized telemeter equipment. This made the reading and operating of these stations more accurate and reliable. Also, repair parts are more readily available than the old, obsolete type. The telephone system to service these remote sites is being upgraded during 1986.

State Water Conservation Loan Programs

The Clean Water Bond Law of 1984. This law provides $10 million to the DWR to be loaned to water agencies for use in conducting cost-effective, capital outlay water conservation programs. The maximum loan for a single project is $5 million, the interest rate will be 50 percent of average state general obligation bonds sold in the prior year (i.e., about 5 percent), and shall be repaid in 25 years or less.

The District submitted an application for a loan to the DWR on December 9, 1985, consisting of four projects as follows:

Project	Amount Requested	B/C Ratio
Trifolium Reservoir	$1,600,000	3.80:1
Spill Interceptor	670,000	4.17:1
Concrete Lining South Alamo Canal	680,000	3.48:1
Concrete Lining Program	2,050,000	2.27:1

At the ACWA Spring Conference the DWR announced on May 7, 1986, that the District was one of seven chosen for further review. It was also announced that the B/C ratio for those seven ranged from 13:1 to 3.5:1. This indicates that the first two projects listed above are eligible. By letter dated May 5, 1986, from David N. Kennedy, Director, DWR, the District was notified of its selection on a priority list of loan applicants. The letter advised that additional information would be required on the feasibility of the District's project, such as environmental documentation, water rights, plans and specifications, legal authorities, and ability to repay the loan.

As of May 30, 1986, no further communication has taken place. The District intends to finalize the negotiations for the loan expeditiously.

Water Conservation and Water Quality Act of 1986

Assembly Bill No. 1982 passed the legislature and was signed by the Governor early this year. The legislation is subject to voter referendum which appears on the June 3, 1986, primary ballot as Proposition No. 44. If passed by the voters, this legislation will provide $150 million in loan funds for two major purposes: (1) construction of Agricultural Drainage Water Management Facilities, and (2) voluntary, cost-effective capital outlay water conservation programs. The first purpose will be administered by the State Water Resources Control Board (SWRCB). By letter dated May 5, 1986, the District indicated to the SWRCB its interest in applying for a loan, if Proposition No. 44 passes, for construction of combination storage and evaporation ponds for better management of agricultural drainage water, and also provide recreation and wildlife habitat areas.

The District staff will recommend that a separate application be filed with the DWR for a low-interest loan for water conservation projects, under the 1986 Act, for the maximum amount of $5 million to help fund eligible conservation programs for 1987 and 1988. At this time it appears that the application will be for additional reservoirs, spill interceptors, or other capital outlay projects having favorable B/C ratios since the competition for the limited loans will be statewide.

SCS Grant Application

In cooperation with the Soil Conservation Service (SCS), the District submitted an application in December 1985, for federal assistance under Public Law 566.

Several programs were proposed in this project which were intended to be a part of the District's overall water conservation plan by focusing work on the farm side of the system. Specific programs included were:

- °Determining optimum slope by soil type for land leveling
- °Concrete lining head ditches
- °Cutting length of run where feasible
- °Installation of tailwater recovery systems
- °Training for irrigation scheduling methods

Due to an acreage limitation the District submitted three separate applications pairing the six divisions.

Westmorland-Calipatria Division
Brawley-Holtville Division
Imperial-El Centro Division

The purpose of each project is to conserve water by increasing onfarm water-use efficiency. This will be accomplished by concrete lining head ditches to reduce seepage, leveling fields to increase water infiltration, and constructing tailwater pumpback systems to reuse irrigation runoff.

All three projects would be on a 50/50 cost-sharing basis, with each farmer eligible for a maximum $100,000. It is assumed that SCS provides 100 percent of the technical design work and that the total funds available for each application will be subject to Congressional approval. The total amount requested for the three projects is $209,982,200.

The District's involvement will be as the sponsoring agency, and SCS would handle the administration of the actual program.

The State Department of Conservation has reviewed the applications and has agreed in part to their merit and conformance to Public Law 566. Since this program will require federal funds, it is not expected to progress very fast, if at all, this or even next year.

In its transmittal dated February 10, 1986, of the application to the SCS State Conservationist, the Acting Director of the California Department of Conservation stated the following:

> "The three projects combined would cost over $205 million, nearly 70 times the State's P.L. 566 annual budget. A complete multi-year funding of these projects through P.L. 566 does not seem realistic under present funding and work load levels. Nevertheless, portions of the projects could independently qualify for P.L. 566 funding, and merit consideration.
>
> Though it is not a stated purpose of the projects, increased irrigation efficiencies should allow for better water table level and soil salinity management, both soil conservation problems of great concern in California."

It is understood that a meeting will be scheduled by SCS later in 1986 for the purpose of assigning priorities to the District's and other applicants' projects.

Water Balancing Accounting

Delivery Accounting. The Task Group reviewed the accounting procedures used for water operations for many years and suggested changes in the Water Order Register. Water operations personnel, primarily Division Superintendents and Zanjeros were requested to develop new procedures and forms especially so that changes in orders, deliveries, and charges could be recorded.

Starting September 1, 1985, Zanjeros began to report amount of water delivered through each delivery gate and also report charges to water users separately. Some water users will not, or cannot, use all the water they have ordered. In the past, the water user was charged for at least the amount of his order even if the water was not delivered through his delivery gate. Some of this water was used for operation in system or, in some instance, returned to the system to be salvaged.

The new method of charging out water will provide a complete record of water actually delivered through each delivery gate, to each field, and cost of water billed to water user will be separate.

Exhibit 5-1 is a typical Zanjero Run Sheet, being a complete printout which has replaced the Water Order Register. This program will continue to be monitored by the Task Group.

Tailwater Monitoring

The Tailwater Program has been continued to date under the same 13- and 21-Point Program rules as before. The percentage of incoming water below Drop No. 1 going to the Salton Sea has gradually declined during this period, a measure of the impact of tailwater monitoring and other conservation efforts. Natural flows are included in the inflow, which were as follows:

1984 .. 34%;
1985 .. 32%
January through April 1985 .. 33.5%
January through April 1986 .. 32.8%

6/20/86
16:45:15
WT0060

ZANJERO RUN SHEET
DIVISION-B RUN-MES
DELIVERY DATE 5/29/86

PAGE

CANAL/GATE	CONF	NAME		DAY ORD	CFS/ STK	C/O	ORDER NO.	PRESS MEAS	DELVRD	CHG	CROP CODES ACRES
MAP-000-B-001 (Maple)	WA	VALLEY PROPERTIES INC		1	12.0	1X	35030	______	______	______	301 80
MAP-022- -001 (Maple)	WA	ORITA LAND & CATTLE CO		2	12.0	1	34694	______	______	______	339 145
CANAL MAP TOTALS			1 ORDERS		12.0			1.0 LOSS		13.0 TOTAL CFS	
MES-011- -001 (Mesquite)	WA	RUTHERFORD BROS		1	15.0	1X	34963	______	______	______	301 72
MES-023- -001 (Mesquite)		LYNCH, WALTER P		996	12.0		32740	______	______	______	301 148
MES-025- -001 (Mesquite)		COWELL, DICK		1	14.0		34475	______	______	______	301 150
CANAL MES TOTALS			2 ORDERS		26.0			2.0 LOSS		28.0 TOTAL CFS	
MLN-004- -001 (Mullen)	WA	BOB MEYER FARMS		2	15.0		34900	______	______	______	301 144
CANAL MLN TOTALS			1 ORDERS		15.0			1.0 LOSS		16.0 TOTAL CFS	
MUN-002- -001 (Munyon)	WA	OLESH JR, THOMAS		1	16.0		34661	______	______	______	301 126
MUN-004- -001 (Munyon)	WA	OLESH JR, THOMAS		2	9.0	1	34655	______	______	______	301 109
MUN-022- -001 (Munyon)		JAMES TAYLOR INC		1	16.0		34651	______	______	______	301 144
CANAL MUN TOTALS			3 ORDERS		41.0			2.0 LOSS		43.0 TOTAL CFS	

EXHIBIT 5-1

Exhibit 5-2 is a series of six tables, entitled Tailwater Monitoring Summary, for each third month from January 1985 through April 1986, showing deliveries ("heads") and tailwater monitoring ("checks"). The heads checked have consistently been in the 90 - 93 percent range. The number of monthly assessments (triple or multiple charge for excessive tailwater) ranges from 11 to 141, for all months during this period. The 16-month average was 76.

Table 5.12 is a record of monthly monetary assessments for excessive tailwater for the 16-month period ending April 30, 1986. Total assessments in 1985 amounted to $249,443. This program must be continued, but ways to improve it need to be sought. The Water Conservation Advisory Board has been asked to respond to this need, but the process is difficult and slow.

Table 5.13 is a summary of charges for unauthorized gate adjustments, which totalled $5,100 in 1985.

USBR/IID Cooperative Study

This study is described on page VI.22 of the Plan. It has been undertaken in accordance with the three-year agreement between the Bureau and the District executed June 2, 1985. The Bureau has designated the study "Concrete Lining and System Improvement Study" (CLSI). The work program is estimated to cost $972,000, with the District's share being $486,000 in payments or in-kind services over the three-year period.

Prior to the agreement, a staff-level meeting was held on March 20, 1985, to develop the scope of work. The letter dated April 1, 1985 to Mr. Shreves from the Bureau (Exhibit 5-3) describes the outcome of that meeting. On June 5 and 6, 1985, Bureau personnel again met with District staff to discuss the status of the study. Exhibit 5-4 is a Memorandum regarding that meeting.

For the East Highline Canal (EHL) loss study, three meter stations were activated to measure flows. The stations are located on the EHL Canal below Lateral 11 Check, below Oak Check, and below Nectarine Check. These flow measurements will be used to rate the check gates.

Below Lateral 11 Check a meter boat was installed attached to a cable stretched across the canal. This station was activated August 1, 1985, and has been metered daily 74 percent of the time since that date. After a year of metering at this station it will become the upper measuring point for a

TAILWATER MONITORING SUMMARY

MONTH: JANUARY, 1985

	HEADS RUNNING			HEADS SPILLING OVER 15%			
				FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	PER CENT	HEADS	PER CENT	HEADS	PER CENT
1	34	10	29.4%	0	0.0%	0	0.0%
2	39	22	56.4%	2	5.1%	0	0.0%
3	54	38	70.4%	2	3.7%	1	1.9%
4	60	40	66.7%	3	5.0%	2	3.3%
5	59	53	89.8%	2	3.4%	0	0.0%
6	68	52	76.5%	3	4.4%	2	2.9%
7	93	72	77.4%	2	2.2%	0	0.0%
8	54	44	81.5%	2	3.7%	0	0.0%
9	81	73	90.1%	3	3.7%	3	3.7%
10	94	92	97.9%	4	4.3%	2	2.1%
11	106	102	96.2%	3	2.8%	1	0.9%
12	127	111	87.4%	0	0.0%	0	0.0%
13	102	91	89.2%	3	2.9%	1	1.0%
14	165	149	90.3%	5	3.0%	1	0.6%
15	222	214	96.4%	22	9.9%	4	1.8%
16	231	219	94.8%	17	7.4%	5	2.2%
17	288	281	97.6%	17	5.9%	1	0.3%
18	322	292	90.7%	14	4.3%	2	0.6%
19	307	301	98.0%	20	6.5%	9	2.9%
20	250	230	92.0%	9	3.6%	4	1.6%
21	316	285	90.2%	12	3.8%	1	0.3%
22	358	330	92.2%	19	5.3%	4	1.1%
23	344	317	92.2%	19	5.5%	5	1.5%
24	369	338	91.6%	28	7.6%	6	1.6%
25	365	351	96.2%	25	6.8%	7	1.9%
26	330	310	93.9%	21	6.4%	3	0.9%
27	230	217	94.3%	12	5.2%	6	2.6%
28	303	286	94.4%	15	5.0%	5	1.7%
29	362	339	93.6%	13	3.6%	4	1.1%
30	423	380	89.8%	25	5.9%	6	1.4%
31	441	416	94.3%	23	5.2%	8	1.8%
TOTAL	6597	6055	91.8%	345	5.2%	93	1.4%

TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

NET

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
TAILWATER MONITORING SUMMARY

MONTH: APRIL, 1985

	HEADS RUNNING			HEADS WITH OVER 15% TAILWATER DISCHARGE			
				FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	%	HEADS	%	HEADS	%
1	638	484	75.9%	34	5.3%	8	1.3%
2	539	500	92.8%	18	3.3%	7	1.3%
3	590	529	89.7%	17	2.9%	6	1.0%
4	644	567	88.0%	24	3.7%	7	1.1%
5	646	581	89.9%	16	2.5%	5	0.8%
6	610	567	93.0%	12	2.0%	4	0.7%
7	433	395	91.2%	12	2.8%	6	1.4%
8	562	526	93.6%	25	4.4%	5	0.9%
9	619	576	93.1%	24	3.9%	5	0.8%
10	607	590	97.2%	23	3.8%	6	1.0%
11	602	583	96.8%	23	3.8%	6	1.0%
12	636	576	90.6%	22	3.5%	3	0.5%
13	578	547	94.6%	11	1.9%	1	0.2%
14	519	485	93.4%	14	2.7%	7	1.3%
15	570	566	99.3%	11	1.9%	2	0.4%
16	632	577	91.3%	21	3.3%	3	0.5%
17	646	611	94.6%	20	3.1%	2	0.3%
18	661	589	89.1%	24	3.6%	4	0.6%
19	617	519	84.1%	21	3.4%	8	1.3%
20	562	491	87.4%	18	3.2%	6	1.1%
21	508	445	87.6%	13	2.6%	3	0.6%
22	535	502	93.8%	15	2.8%	5	0.9%
23	571	542	94.9%	22	3.9%	2	0.4%
24	573	537	93.7%	15	2.6%	4	0.7%
25	580	520	89.7%	23	4.0%	5	0.9%
26	589	538	91.3%	12	2.0%	4	0.7%
27	557	514	92.3%	6	1.1%	1	0.2%
28	449	446	99.3%	8	1.8%	4	0.9%
29	565	496	87.8%	16	2.8%	3	0.5%
30	584	528	90.4%	24	4.1%	9	1.5%
31							
TOTAL	17422	15927	91.4%	544	3.1%	141	0.8%

*TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

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IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
TAILWATER MONITORING SUMMARY

MONTH: JULY, 1985

DATE	HEADS RUNNING TOTAL	HEADS RUNNING CHECKED	HEADS RUNNING %	HEADS WITH OVER 15% TAILWATER DISCHARGE: FIRST CHECK HEADS	FIRST CHECK %	ASSESSED HEADS	ASSESSED %
1	450	424	94.2%	4	0.9%	1	0.2%
2	462	431	93.3%	10	2.2%	0	0.0%
3	460	409	88.9%	6	1.3%	1	0.2%
4	465	401	86.2%	3	0.6%	0	0.0%
5	471	438	93.0%	3	0.6%	0	0.0%
6	482	453	94.0%	5	1.0%	0	0.0%
7	422	381	90.3%	4	0.9%	0	0.0%
8	452	417	92.3%	6	1.3%	2	0.4%
9	427	404	94.6%	8	1.9%	1	0.2%
10	434	390	89.9%	7	1.6%	0	0.0%
11	466	420	90.1%	9	1.9%	0	0.0%
12	469	408	87.0%	7	1.5%	1	0.2%
13	462	413	89.4%	2	0.4%	0	0.0%
14	440	409	93.0%	3	0.7%	0	0.0%
15	469	416	88.7%	10	2.1%	0	0.0%
16	468	435	92.9%	12	2.6%	0	0.0%
17	470	415	88.3%	6	1.3%	0	0.0%
18	477	440	92.2%	8	1.7%	0	0.0%
19	443	395	89.2%	2	0.5%	0	0.0%
20	385	350	90.9%	6	1.6%	0	0.0%
21	318	292	91.8%	3	0.9%	0	0.0%
22	365	343	94.0%	4	1.1%	0	0.0%
23	393	372	94.7%	7	1.8%	0	0.0%
24	461	414	89.8%	8	1.7%	0	0.0%
25	462	406	87.9%	9	1.9%	0	0.0%
26	469	425	90.6%	10	2.1%	1	0.2%
27	468	406	86.8%	5	1.1%	1	0.2%
28	437	397	90.8%	4	0.9%	1	0.2%
29	452	405	89.6%	8	1.8%	1	0.2%
30	458	408	89.1%	12	2.6%	0	0.0%
31	459	417	90.8%	8	1.7%	1	0.2%
TOTAL	13816	12534	90.7%	199	1.4%	11	0.1%

*TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

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IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
TAILWATER MONITORING SUMMARY

MONTH: OCTOBER, 1985

	HEADS RUNNING			HEADS WITH OVER 15% TAILWATER DISCHARGE			
				FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	%	HEADS	%	HEADS	%
1	327	297	90.8%	8	2.4%	0	0.0%
2	397	358	90.2%	9	2.3%	2	0.5%
3	428	370	86.4%	11	2.6%	3	0.7%
4	426	385	90.4%	14	3.3%	4	0.9%
5	442	386	87.3%	3	0.7%	1	0.2%
6	378	327	86.5%	7	1.9%	0	0.0%
7	448	397	88.6%	7	1.6%	2	0.4%
8	436	400	91.7%	8	1.8%	1	0.2%
9	459	418	91.1%	9	2.0%	1	0.2%
10	432	288	66.7%	6	1.4%	0	0.0%
11	326	274	84.0%	7	2.1%	3	0.9%
12	332	297	89.5%	7	2.1%	0	0.0%
13	313	275	87.9%	4	1.3%	1	0.3%
14	348	317	91.1%	4	1.1%	0	0.0%
15	398	378	95.0%	12	3.0%	2	0.5%
16	429	398	92.8%	20	4.7%	4	0.9%
17	435	393	90.3%	10	2.3%	1	0.2%
18	444	412	92.8%	15	3.4%	4	0.9%
19	416	401	96.4%	14	3.4%	1	0.2%
20	353	327	92.6%	11	3.1%	2	0.6%
21	420	383	91.2%	8	1.9%	2	0.5%
22	447	410	91.7%	6	1.3%	3	0.7%
23	461	423	91.8%	18	3.9%	8	1.7%
24	463	411	88.8%	13	2.8%	7	1.5%
25	453	430	94.9%	8	1.8%	2	0.4%
26	421	400	95.0%	7	1.7%	1	0.2%
27	370	328	88.6%	5	1.4%	1	0.3%
28	434	399	91.9%	11	2.5%	3	0.7%
29	436	395	90.6%	20	4.6%	9	2.1%
30	439	404	92.0%	12	2.7%	4	0.9%
31	456	410	89.9%	9	2.0%	3	0.7%
TOTAL	12767	11491	90.0%	303	2.4%	75	0.6%

*TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

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IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
TAILWATER MONITORING SUMMARY

MONTH: JANUARY, 1986

	HEADS RUNNING			HEADS WITH OVER 15% TAILWATER DISCHARGE FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	%	HEADS	%	HEADS	%
1	128	102	79.7%	3	2.3%	0	0.0%
2	228	207	90.8%	4	1.8%	3	1.3%
3	304	277	91.1%	16	5.3%	5	1.6%
4	290	269	92.8%	6	2.1%	2	0.7%
5	245	221	90.2%	5	2.0%	0	0.0%
6	174	166	95.4%	6	3.4%	4	2.3%
7	180	161	89.4%	6	3.3%	1	0.6%
8	232	219	94.4%	5	2.2%	1	0.4%
9	262	240	91.6%	8	3.1%	1	0.4%
10	320	307	95.9%	16	5.0%	6	1.9%
11	334	301	90.1%	8	2.4%	3	0.9%
12	248	248	100.0%	8	3.2%	1	0.4%
13	314	292	93.0%	13	4.1%	7	2.2%
14	315	304	96.5%	16	5.1%	2	0.6%
15	264	257	97.3%	13	4.9%	2	0.8%
16	306	286	93.5%	14	4.6%	4	1.3%
17	294	271	92.2%	9	3.1%	3	1.0%
18	271	250	92.3%	3	1.1%	1	0.4%
19	218	203	93.1%	3	1.4%	0	0.0%
20	294	271	92.2%	12	4.1%	4	1.4%
21	297	276	92.9%	12	4.0%	3	1.0%
22	280	266	95.0%	12	4.3%	7	2.5%
23	330	312	94.5%	25	7.6%	8	2.4%
24	313	294	93.9%	18	5.8%	9	2.9%
25	321	291	90.7%	9	2.8%	4	1.2%
26	220	203	92.3%	5	2.3%	2	0.9%
27	303	288	95.0%	11	3.6%	3	1.0%
28	315	292	92.7%	15	4.8%	5	1.6%
29	334	318	95.2%	15	4.5%	6	1.8%
30	300	258	86.0%	7	2.3%	1	0.3%
31	205	189	92.2%	9	4.4%	5	2.4%
TOT	8439	7839	92.9%	312	3.7%	103	1.2%

*TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

NET

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION
TAILWATER MONITORING SUMMARY

MONTH: APRIL, 1986

				HEADS WITH OVER 15% TAILWATER DISCHARGE			
	HEADS RUNNING			FIRST CHECK		ASSESSED	
DATE	TOTAL	CHECKED	%	HEADS	%	HEADS	%
1	492	465	94.5%	13	2.6%	2	0.4%
2	504	467	92.7%	12	2.4%	3	0.6%
3	524	483	92.2%	11	2.1%	1	0.2%
4	515	468	90.9%	12	2.3%	3	0.6%
5	513	469	91.4%	8	1.6%	2	0.4%
6	406	388	95.6%	12	3.0%	1	0.2%
7	487	448	92.0%	16	3.3%	3	0.6%
8	543	503	92.6%	13	2.4%	2	0.4%
9	582	540	92.8%	19	3.3%	5	0.9%
10	632	573	90.7%	9	1.4%	2	0.3%
11	603	563	93.4%	11	1.8%	0	0.0%
12	575	530	92.2%	8	1.4%	0	0.0%
13	422	392	92.9%	6	1.4%	1	0.2%
14	426	401	94.1%	10	2.3%	3	0.7%
15	466	423	90.8%	19	4.1%	5	1.1%
16	469	431	91.9%	16	3.4%	2	0.4%
17	575	510	88.7%	15	2.6%	3	0.5%
18	592	511	86.3%	15	2.5%	4	0.7%
19	560	523	93.4%	11	2.0%	4	0.7%
20	494	447	90.5%	9	1.8%	2	0.4%
21	587	537	91.5%	10	1.7%	3	0.5%
22	627	584	93.1%	9	1.4%	3	0.5%
23	639	592	92.6%	12	1.9%	1	0.2%
24	629	558	88.7%	5	0.8%	0	0.0%
25	622	571	91.8%	16	2.6%	3	0.5%
26	599	514	85.8%	8	1.3%	1	0.2%
27	452	412	91.2%	5	1.1%	1	0.2%
28	561	502	89.5%	18	3.2%	4	0.7%
29	586	518	88.4%	18	3.1%	2	0.3%
30	606	529	87.3%	6	1.0%	1	0.2%
TOT	16288	14852	91.2%	352	2.2%	67	0.4%

*TOTAL HEADS RUNNING DOES NOT INCLUDE HEADS OF 1 C.F.S. OR LESS.

Table 5.12
Water Assessment

Year	Month	Amount Assessed	Year	Amount Assessed
1985	January	$ 28 053 64	1986	$ 26 793 00
	February	35 469 00		19 720 80
	March	39 227 80		24 930 00
	April	36 307 80		17 704 80
	May	21 308 40		
	June	10 141 20		
	July	5 382 00		
	August	17 254 80		
	September	14 722 20		
	October	18 599 40		
	November	17 395 20		
	December	5 531 40		

Table 5.13
Gate Charges

Year	Month	Charge	Year	Charge
1985	January	$ 1 100 00	1986	$ 800 00
	February	600 00		700 00
	March	500 00		100 00
	April	300 00		
	May	300 00		
	June	300 00		
	July	500 00		
	August	300 00		
	September	500 00		
	October	400 00		
	November	200 00		
	December	100 00		

United States Department of the Interior

BUREAU OF RECLAMATION
LOWER COLORADO REGIONAL OFFICE
P.O. BOX 427
BOULDER CITY, NEVADA 89005

IN REPLY
REFER TO: LC-757
453.

APR 1 1985

Mr. Charles L. Shreves
General Manager
Imperial Irrigation District
P.O. Box 937
Imperial, California 92251

Dear Mr. Shreves:

On March 20, Messrs. Joseph Kitchen and Michael Stuver of my staff met with Messrs. Beuford Bradley and Jesse Silva in your office to discuss initial work items to be performed by the Imperial Irrigation District (District) as part of its contribution to the Canal Lining and System Improvement Study. Initial work items include rating several control structures and measuring deliveries to selected laterals along the East Highline Canal. Methods for making selected historic operational data available for analysis were also finalized. Work to be accomplished is summarized below.

Five water control structures along the East Highline Canal will be rated by your Water Department staff to develop flow versus pond elevation rating equations. The structures to be rated are:

1. Check 11
2. Weir 16
3. Oak Check
4. Nectarine Check
5. Flowing Wells Check

Twenty-five laterals diverting from the East Highline Canal were selected for installation of measuring and recording devices to measure flows delivered to the laterals. Several of the selected laterals are presently equipped with measuring and recording devices to make measurements for other District studies. These sites are adequately equipped for our needs. A few other laterals situated between the Oak and Nectarine checks cannot be equipped with measuring devices. These laterals will be measured at approximately 4-hour intervals by the hydrographers and patrolmen as they make their rounds.

The selected laterals that the District will equip with measuring and recording devices are as follows:

1. Lateral 12
2. Lateral 13
3. Lateral 14
4. Lateral 16
5. Palm Lateral
6. Orchid Lateral

EXHIBIT 5-3

7. Osage Lateral
8. Oak Lateral
9. Moss Lateral
10. Magnolia Lateral
11. Mesquite Lateral
12. Maple Lateral
13. Mullen Lateral
14. Myrtle Lateral
15. Myrtle "A" Lateral
16. Munyon Lateral
17. Mulberry Lateral
18. Mulva Lateral
19. Mayflower Lateral
20. Marigold Lateral
21. Standard Lateral
22. Narcissus Lateral
23. Nettle Lateral
24. Nutmeg Lateral
25. Nectarine Lateral

A number of the Bureau of Reclamation's (Reclamation) water stage recorders, used on earlier studies within the District, are now on temporary loan to your Conservation Supervisor for use on the irrigation scheduling demonstration program. These recorders may be used as necessary to accomplish the above monitoring.

Selected historical operational data needed for the seepage loss analysis will be compiled on a micro-computer that Reclamation will provide. We anticipate having this machine, along with necessary data entry programs, available to setup in your water dispatcher's office in mid-April. Actual data entry would be accomplished during the next several months by part-time or summer employees hired by the District. We will provide initial training for these employees.

We appreciate the help your staff has provided to get this study started. Please feel free to coordinate with Mr. Joseph Kitchen, (702) 293-8468 or Mr. Michael Stuver (702) 293-8552 as needed to keep the study proceeding in a timely manner.

Sincerely yours,

ACTING FOR Roy O. Gear

N. W. Plummer
Regional Director

UNITED STATES GOVERNMENT

Memorandum

UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION
LOWER COLORADO REGIONAL OFFICE
P.O. BOX 427
BOULDER CITY, NEVADA 89005

LC-737/453.

June 18, 1985

To: Regional Planning Officer

From: Mr. Michael D. Stuver, Hydraulic Engineer

Subject: Travel Report, Imperial Irrigation District Headquarters

1. Travel period: June 5-6, 1985

2. Travelers: Mr. Smith L. Patterson, Computer Equipment Specialist
Mr. Michael D. Stuver, Hydraulic Engineer

3. Place or offices visited: Imperial Irrigation District, Operating Headquarters, Imperial, California

4. Purpose of trip: Deliver and install Datapoint computer in Imperial Irrigation District (District) office and train District personnel to enter historical operations data.

5. Synopsis of trip: On the afternoon of June 5, the computer system was installed in the Watermaster's office where the historical records are stored. After insuring that the hardware was working properly, initial orientation and training were provided to Mr. Carlos Z. Villalon and Mrs. Penny Kosciusko, District staff members who will supervise data entry. Both have had experience with the IBM PC computer and learned operation of the Datapoint very quickly.

Use of the data entry program was explained on the following morning. Several hours were spent entering actual historical data to familiarize Mrs. Kosciusko with program operation and data entry procedures. Several minor problems were found in the program during data entry but were quickly resolved and corrected.

On June 6, Mr. Michael Stuver met with District Water Department staff members, Mr. George Wheeler, Mr. Beuford L. Bradley, Mr. Jesse P. Silva, Mr. Carlos Z. Villalon, and Mr. Douglas Welch to discuss status of the Canal Lining and System Improvement Study. The following items were discussed.

<u>East Highline Canal Seepage</u>

Mr. Michael Stuver reported that (1) the computer and data entry program are ready to begin entering daily historical operational data, (2) the data entry program for hourly gate opening and pond elevation data will be developed within the next few weeks, (3) the seepage analysis computer program will be developed during the summer, and (4) field collection of design and environmental data has started. Mr. Stuver suggested that a field inspection of the East Highline Canal would be beneficial for the Reclamation personnel who will be developing the seepage analysis program. A short visit was tentatively scheduled for one day during the week of June 17.

EXHIBIT 5-4

LM

Recorder Installation

Mr. Bradley indicated that all but four recorders have been installed on the previously selected laterals. Broad-crested weirs must be constructed before the other four recorders can be installed. Water department personnel have started taking flow measurements to rate some of the small check structures on several laterals.

East Highline Canal Check Structure Rating

Metering station installation is nearly complete for all check structures. No flow measurements have been taken yet.

System Scheduling Demonstration Program

Operation of a typical system scheduling program was explained and potential benefits to the District were discussed. District personnel pointed out that some District operating practices like open-ended water orders would make system scheduling difficult to accomplish. In addition, the farmers' practice of ordering water for next-day delivery would minimize effectiveness of system scheduling. An opinion was expressed that farmers would always have to order water for next-day delivery because they can not know, even using the neutron moisture gage, when to schedule water any further in advance. (Experience on other irrigation projects has shown that irrigations can be accurately scheduled as much as four days in advance by using the neutron moisture gage). Concern was also expressed that numerous other District conservation programs would detract from the attention and emphasis that should be given to a system scheduling demonstration program. Therefore, it was mutually agreed that a system scheduling demonstration program would not be conducted as part of the Canal Lining and System Improvement Study. Further, the Water Management and Conservation Program funds previously set aside for the District demonstration program would be made available to support a demonstration program in another District.

6. Conclusions:

(1) The East Highline Canal seepage study is progressing on schedule, and (2) the proposed system scheduling demonstration will not be conducted as part of the current study.

Michael D. Stroh

cc: Charles L. Shreves, General Manager, Imperial Irrigation District, P.O. Box 927, Imperial, California 92251 monitored stretch of the EHL Canal, with Lateral 16 Weir being the lower point.

The laterals between these two points currently are being monitored by water-level recorders. In addition to the loss study this station is also being used to determine the discharge at the head of the EHL Canal. This is necessary due to the lack of a satisfactory method to measure the discharge through the power plant.

The check gates at Lateral 11 Check have already been rated, using the metered discharge that is being made daily. The rating table is being revised periodically as more meterings become available.

For the measurements below Oak Check, a meter boat was installed in the same manner as the one at Lateral 11 Check. This station was activated July 19, 1985, and has been metered daily 92 percent of the time since that date. After a year of metering at this station it will become the upper measuring point for a second monitored stretch of the EHL Canal, with Nectarine Check being the lower point. The laterals between these two points are being monitored continuously by water level recorders.

For the measurements below Nectarine Check, a meter bridge was already in place when this study began. This station was reactivated July 29, 1985, and has been metered 93 percent of the time since that date. These meterings will be used to rate the Nectarine Check gates and in the study as stated above. In addition to the loss study these measurements have already been used to rate the gates for normal operations.

The records taken at these three main stations are being collected and stored in the Water Control Office and will be delivered to the U.S. Bureau of Reclamation (USBR) upon request.

For the EHL Canal loss study the following lateral headings are being monitored using water-level recorders furnished by the USBR.

Lateral 12	Mullen Lateral	Marigold Lateral
Lateral 13	Myrtle Lateral	Standard Lateral
Lateral 14	Munyon Lateral	Narcissus Lateral
Moss Lateral	Mulberry Lateral	Nettle Lateral
Magnolia Lateral	Malva 1 Lateral	Nectarine Lateral
Mesquite Lateral	Malva 2 Lateral	
Maple Lateral	Mayflower Lateral	

Each overpour structure has been individually rated by taking several current meter measurements.

In addition to the water-level recorder measurements taken on these lateral headings, the hydrographers are recording all pertinent information observed, so that recorder sheets may be readily translated into discharge figures. They list any malfunction of the instrument, tampering with the gate or weir, and the amount of water being diverted to a delivery gate, if any, above the lower measuring point. These recorder sheets and information are being collected and stored in the Water Control Office and will be delivered to the U.S. Bureau of Reclamation when requested.

The District hired two part-time data-entry people from June 1985 through April 1986, to input historical water-flow records into the microcomputer furnished by the Bureau. As of April 30, 1986, hourly gage height records at all EHL Checks for the twelve years 1973 - 1984 had been entered into the computer for final analysis by the USBR. In addition, average daily flows at the head of each EHL lateral above Flowing Wells, taken from daily log sheets, had been entered for the years of 1979 - 1984. As of April 30, 1986, Bureau personnel are testing the computer program with about two years of records.

As a part of this study, annual records of flows in the EHL Canal have been analyzed to compute total losses. Table 5.14 shows annual amounts of water in acre-feet at the EHL heading, sum of all deliveries, and the resultant total loss for each year from 1964 through 1985. This data indicates that the average annual total loss in the EHL Canal is 64,303 AF, with annual variations from 39,038 AF (61% of average) to 112,188 AF (174% of average).

Electronic Recorders

Historically, the District has made numerous measurements of flows required for operational purposes. Within the last several years, this policy has changed and measurements are currently being made of canal spills, lateral headings, field deliveries, tailwater and tile drainage. Water-level recorders with strip-charts have been used in the past to measure these flows. With the increase in water monitoring has come an equivalent increase in labor to collect and process the data.

In recent years a number of companies have developed electronic data logging equipment which substantially reduces the amount of labor required to monitor

Table 5.14
IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

E.H.L. LOSS IN ACRE FEET

	TOTAL	DELIVERED	LOSS	LOSS DAILY AVERAGE	PER CENT OF LOSS
1964	1,131,931	1,081,572	50,359	138	4.45
1965	1,064,464	1,024,452	40,012	110	3.76
1966	1,169,745	1,115,604	54,141	148	4.63
1967	1,138,030	1,080,086	57,944	159	5.09
1968	1,186,972	1,117,534	69,438	190	5.85
1969	1,137,167	1,061,785	75,382	207	6.63
1970	1,143,193	1,082,351	60,842	167	5.32
1971	1,188,594	1,133,784	54,810	150	4.61
1972	1,167,407	1,106,077	61,330	168	5.25
1973	1,212,024	1,172,986	39,038	107	3.22
1974	1,280,242	1,241,138	39,104	107	3.05
1975	1,260,300	1,205,719	54,581	150	4.33
1976	1,176,609	1,109,179	67,430	184	5.73
1977	1,135,595	1,069,630	65,965	181	5.81
1978	1,119,367	1,067,295	52,072	143	4.65
1979	1,192,313	1,102,970	89,343	245	7.49
1980	1,164,482	1,113,243	51,239	140	4.40
1981	1,182,092	1,105,189	76,903	211	6.51
1982	1,081,853	992,914	88,939	244	8.22
1983	1,028,782	960,391	68,391	187	6.65
1984	1,117,364	1,032,151	85,213	233	7.63
1985	1,132,868	1,020,680	112,188	307	9.90
TOTAL	25,411,394	23,996,730	1,414,664	3,873	5.57
AVERAGE	1,155,063	1,090,760	64,303	176	5.57

and report water flows. In 1985, an extensive survey of electronic recorders on the market was made. Approximately twenty companies were contacted and their equipment was evaluated. Ten of the companies contacted sent representatives to Imperial Valley to demonstrate their products.

The recorders evaluated used the following types of technology to monitor water flows:

Ultrasonic
Infra-red
Pressure transducer
Electromagnetic induction
Variable electrical resistance

Six of the recorders were selected for preliminary testing.

The equipment selected for detailed testing were those manufactured by Omnidata International, Montedoro-Whitney and Hess Geotechnical Corp.

Testing consisted of running the instruments through a series of temperature regimes in combination with varying humidity and water quality conditions.

The Easy Logger manufactured by Omnidata International using a float and potentiometer was finally selected for use by the District for its several water measurement programs. The Easy Logger is presently being used exclusively in the Lateral Fluctuation Study and is being phased into the Irrigation Scheduling Program.

Lateral Fluctuation Study

This program is described in the Plan on page VI.22. The first requirement of this program was to install continuous recorders on the lateral headings, checks, and deliveries. The goal of the program is to identify structural problems, and operational procedures which cause fluctuations in flow, resulting in variable deliveries to water users.

The amount of water delivered to a farm depends on the rate of flow and the length of time the water is allowed to run. The District delivers water in 24-hour units and the rate of flow is set at each delivery gate to match the total quantity of water desired. However, if the water level in a canal changes after a delivery gate has been set, the delivery flow rate will change. This can cause inaccurate deliveries.

There are several possible causes for water-level fluctuations in a canal. Some possible causes include:

1. The release of water ponded behind an upstream check;
2. opening or closing an upstream delivery gate;
3. water backing up in a head ditch;
4. an increase or decrease in the level of a main supply canal; and
5. having an irrigator move his water from one delivery to another.

Understanding how these fluctuations affect other deliveries is essential to increasing water delivery efficiency.

To get the most value from the program, recorders are being installed in all or most tailwater structures also, and selected structures in the drains.

It should be noted that the contribution by the USDA, although important in the final analysis, has been minimal in the initial stage - that of installing recorders and collecting and recording the raw data.

It is planned to ultimately monitor at least four, and perhaps five laterals, namely Palm, Orchid, Olive, Munyon and Myrtle, altogether serving approximately 100 farm deliveries.

Since the end of 1985, chart-type and electronic recorders have been installed at nearly all scheduled locations on the Myrtle and Munyon laterals. Several broad-crested weirs have been installed at recorder locations where necessary (below certain lateral headings and farm head ditches).

Trial runs to determine flow- and water-levels have been completed on both laterals. Data will be studied on a preliminary basis to determine first the best data gathering/data summarizing approach and second meeting basic technical goals. These basic technical goals include:

1. Providing a complete water balance for the area served in conjunction with the water conservation's tailwater monitoring study.
2. Calibrating a transient flow model developed by the District.
3. Calibrating a steady state model developed by Parsons.

Close communication has been kept by involved parties at key points in the study to review all completed work.

A steady state hydraulic model is currently being developed by Parsons Water Resources, Inc. This computer model will simulate the water surface profile in a canal under specified flows and pond heights.

A transient flow model is being developed by the District. This program will be used as a subroutine in the steady state model. Flow and head data collected from Myrtle and Munyon Laterals will be used to calibrate model coefficients. Values of Manning's roughness coefficient will be determined for each reach between checks. Headgate coefficients will be determined for each delivery.

The schedule for the program, as of April 1986, is as follows:

Phase I (to May 1,1986)

1. Constructing broad-crested weirs and stilling wells.
2. Installing and programming data loggers.

Phase II (May 11 to June 1, 1986)

1. Collecting data for one to two-week period.
2. Using this data to test the steady state model.
3. Determining Manning roughness coefficients and delivery gate coefficients.
4. Planning subsequent data collection periods based on findings.

Phase III (June 1 to September 1, 1986)

1. Using the combined steady state and transient model to simulate fluctuations.
2. Determining why fluctuations occur.

Phase IV (September to December 30, 1986)

1. Testing possible solutions.
2. Writing a report on findings.

Operational Discharge

This program is described in the Plan on page VI.12 under the heading "Spill Monitoring Program."

In order to develop a water balance for the District an operational discharge study was developed. Due to the large number of discharge locations (241) a sampling method was implemented. All discharge locations on main canals and 30 randomly-selected lateral stations are being monitored.

In the system wide operational discharge study, the random selection of representative laterals has been made and the discharge at the end of each lateral is now being monitored. Water-level recorders were installed at the following sites in October and November, 1985, and 24-hour data is being collected.

Holt	Stanley Lateral 1
EHL Lateral 10	Oakley
EHL Lateral 14	Moorehead
Ash Lateral 6	Moss
Ash Lateral 45	Malva 1
Pomelo	Marigold
Oasis	Sumac Lateral 1
Wistaria Lateral 6A	Spruce Lateral 3
Wormwood	Trifolium Lateral 5
Dogwood Lateral 10	Trifolium Lateral 9
Daffodil	Trifolium Extension Lateral 9
Redwood	Lateral "E"
Elder	Lateral "S"
Elder Lateral 13	Niland Lateral 2
Eucalyptus Lateral 10	Vail Lateral 4

The recorder sheets are being computed by Water Control personnel and a report of the results given to the Water Engineering Section for analysis.

Table 5.15 consisting of six sheets presents operational discharge records for each of the District's six water operations divisions from November 1985 through April 1986. Average daily flows for each lateral are also shown. The majority are considerably less than 1 cfs.

Table 5.15
IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

HOLTVILLE

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

	HOLT	E.H.L. LATERAL 10	E.H.L. LATERAL 14	ASH LATERAL 6	ASH LATERAL 45	POMELO	OASIS
1985							
NOVEMBER	7.0	8.2	0.9	3.0	1.5	33.3	14.1
DECEMBER	17.7	12.9	2.3	3.2	9.8	11.3	12.1
1986							
JANUARY	25.1	6.1	4.1	1.3	12.5	28.6	15.1
FEBRUARY	23.0	7.9	0.2	2.5	7.2	13.3	14.2
MARCH	15.2	15.2	3.3	4.2	4.0	10.5	10.7
APRIL	16.2	8.5	1.9	1.8	2.2	13.9	10.1
TOTAL	104.2	58.8	12.7	16.0	37.2	110.9	76.3
DAILY AVERAGE	0.8	0.4	0.1	0.1	0.2	0.7	0.4

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

EL CENTRO

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

1985	WISTARIA LATERAL 6A	WORMWOOD	DOGWOOD LATERAL 10	DAFFODIL	REDWOOD
NOVEMBER	8.1	28.6	4.1	1.0	4.2
DECEMBER	0.0	6.0	0.5	3.2	2.7
1986					
JANUARY	3.7	6.2	1.1	3.1	0.0
FEBRUARY	3.2	5.7	1.4	1.6	6.8
MARCH	2.4	1.6	0.9	1.6	12.5
APRIL	9.9	2.8	0.6	1.2	20.9
TOTAL	27.3	50.9	8.6	11.7	47.1
DAILY AVERAGE	0.2	0.3	.0	0.1	0.3

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

IMPERIAL

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

1985	ELDER	ELDER LATERAL 13	EUCALYPTUS LATERAL 10
NOVEMBER	60.7	18.3	
DECEMBER	64.8	26.1	0.7
1986			
JANUARY	54.5	18.8	1.1
FEBRUARY	39.0	22.6	0.0
MARCH	69.7	26.9	1.2
APRIL	34.6	11.9	7.2
TOTAL	323.3	124.6	10.2
DAILY AVERAGE	2.0	0.7	0.1

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

BRAWLEY

	STANLEY LATERAL 1	OAKLEY	MOORHEAD	MOSS	MALVA 1	MARIGOLD
1985						
NOVEMBER	6.6	18.7	1.4	16.5	0.8	16.1
DECEMBER	0.0	22.9	10.1	34.7	3.4	29.2
1986						
JANUARY	3.1	23.2	20.1	21.1	4.1	15.1
FEBRUARY	1.2	23.6	27.2	21.0	3.9	13.0
MARCH	6.1	23.7	34.5	25.8	5.6	15.6
APRIL	1.5	25.2	4.5	32.4	8.4	7.5
TOTAL	18.5	137.3	97.8	151.5	26.2	96.5
DAILY AVERAGE	0.1	0.8	0.7	1.0	0.2	0.6

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

WESTMORLAND

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

1985	SUMAC LATERAL 1	SPRUCE LATERAL 3	TRIFOLIUM LATERAL 5	TRIFOLIUM LATERAL 9	TRIFOLIUM EXTENSION LATERAL 9
NOVEMBER		4.8	13.0	3.9	
DECEMBER	3.7	16.7	11	18.1	23.3
1986					
JANUARY	24.3	11.7	11.2	21.1	21.9
FEBRUARY	15.6	2.1	15.1	23.2	5.3
MARCH	14.9	9.5	8.6	8.5	0.3
APRIL	11.4	2.1	24.5	23.5	10.6
TOTAL	69.9	46.9	83.4	98.3	61.4
DAILY AVERAGE	0.5	0.3	0.6	0.8	0.5

IMPERIAL IRRIGATION DISTRICT
WATER CONTROL SECTION

CALIPATRIA

DIVISION OPERATIONAL DISCHARGE
IN C.F.S.

1985	LATERAL "E"	LATERAL "S"	NILAND LATERAL 2	VAIL LATERAL 4
NOVEMBER	12.7	0.0	2.0	3.4
DECEMBER	12.8	0.0	14.8	9.3
1986				
JANUARY	13.4	9.5	9.4	1.0
FEBRUARY	7.5	2.1	16.5	7.4
MARCH	8.4	9.1	28.2	9.1
APRIL	14.3	8.0	37.7	9.0
TOTAL	69.1	28.7	108.6	39.2
DAILY AVERAGE	0.4	0.2	0.7	0.2

A preliminary analysis of the random samples on 30 laterals shown in Table 5.15 can be summarized for the first quarter of 1986:

Days recorded - 2,424
Days with flow at the head - 1,838
Days without flow at the head - 553
Days with discharge - 1,621
Days without discharge - 770
Days with discharge and flow at head - 344,
  average discharge = 0.8 cfs
Days with discharge and without flow at head 1,277,
  average = 0.4 cfs

The sample data indicates that:

Twenty-three percent of the time a lateral is dry.
Sixty-seven percent of the time there will be operational discharge, regardless of the flow/no flow condition.
Average discharge with flow is twice that of the dry lateral (0.8 vs. 0.4 cfs).

Extrapolating the data to the whole system:

Total recorded days - 2,424.
Total discharge - 1,112.2 cfs-days.
Average discharge per day - 0.46/site.

First Quarter - Districtwide operational discharge:

$$(241 \text{ sites}) \times \left(\frac{0.46 \text{ cfs}}{\text{Day/Site}}\right) \times \left(\frac{89 \text{ days}}{\text{Year}}\right) \times \left(\frac{1.98 \text{ AF}}{\text{cfs-days}}\right) = 19{,}536 \text{ AF}$$

After one year of monitoring data is available, a more complete picture will emerge. Since discharge depends on the flow within the lateral, quarterly totals may vary considerably. Additionally other items will be investigated:

1. Identifying problem laterals.
2. Developing a profile for each lateral operational discharge.
3. Identifying areas that could profit from the the use of reservoirs or spill interceptors.

Tile Drain Discharge

As a part of the leaching requirements study, as well as contributing to an understanding of water balance within the District, an annual report is prepared to provide estimates of the total tile drain discharge within the District. Table 5.16 is the most recent report based on the period from August 1984 to May 1985, which shows the total estimated tile discharge for the year 1984 to be between 246,067 AF and 266,621 AF.

Hydrilla

In the section of this report on canal lining, the widespread occurrence of Hydrilla in the District's system, is listed as a factor in determining priorities for lining.

The District has completed four years of research on developing methods of controlling hydrilla in the waterway system. Hydrilla continues to be a serious problem, spreading rapidly throughout the entire system. Mechanical methods are effective although very expensive and may stimulate regrowth later in the summer. Chemical studies have shown that experimental compounds, compatible with crops, potable water and fisheries, are not effective against hydrilla in flowing water.

Research conducted in cooperation with Coachella Valley Water District has demonstrated the economical and effective use of triploid grass carp to consume aquatic vegetation. The District is currently using a variety of this fish called the "triploid" grass carp because it is assumed to be sterile, thereby reducing the concern of overpopulating District canals, thus having a negative impact on other resident fish, such as the largemouth bass, channel catfish, flathead catfish, and bluegill.

During the summer of 1985, 7,800 fish were placed in about 1.5 miles of the All-American Canal with very heavy hydrilla growth. The high stocking rate resulted in total removal of all hydrilla in about 8 weeks.

More recently, about 50,000 small (about 8 inches and 1/4 pound) triploid grass carp have been stocked into about 90 percent of the hydrilla-infested waters of the All-American Canal, Central Main Canal, Westside Main Canal system, and Sheldon and Fudge Reservoirs.

The District has initiated a large-scale operational program with triploid grass carp, and will continue to monitor the impacts of this program.

Table 5.16
IMPERIAL IRRIGATION DISTRICT

TILE DRAIN DISCHARGE
Progress Report
Based on Measured Discharge from Sumps
August 1984 to May 1985

Sumps in Program	235
Sumps with valid measurements	222
Miles tiled (222 sumps)	3,098
Acreage tiled (222 sumps)	41,899
Calculated discharge, g.p.m. (222 sumps)	16,000
Calculated discharge, g.p.m. each sump	72
Calculated discharge in A.F. per year (222 sumps)	25,808 A.F.

Acre Feet per year, per sump: 25,808 A.F. / 222	116.25 A.F.
Assume 514 sumps operating: Total discharge for year	59,754 A.F.

Estimated total tile effluent for 1984, based on 222 sump tests made during the period August 1984 to May 1985

Cumulative miles of tile as of December 1984	29,538
Discharge for 3,098 miles of tile	25,808 A.F.
Discharge per mile of tile	8.33 A.F.
Total discharge (29,538 x 8.33)	246,067 A.F.
Cumulative acres tiled as of December 1984	432,857
Discharge for 41,899 acres	25,808 A.F.
Discharge per acre tiled	0.62 A.F.
Total discharge (432,857 x 0.62)	266,621 A.F.

Note: Sump discharge determined by calculating KWH per acre foot of water pumped from field tests. Annual discharge then computed from total KWH taken from power bills for the period August 1984 to May 1985.

Demonstration Tailwater Recovery Program

Demonstration Tailwater recovery systems - also designated "pumpbacks" - were installed on five fields during 1985. The sixth system will be installed about mid-year 1986.

One system is being installed in each District water division located as follows:

Newside Lateral 3-A
Central Main 15
"Q" Lateral, 13/15
Trifolium Lateral 8, 153
Ash Lateral 61-E
Central Main 1-A

The total capital, operation and maintenance costs of these systems are paid by the District from the Water Conservation Fund, except the energy charge component of the power bill, which the water user pays.

Table 5.17 is a cost summary of the first four systems installed. The major physical data is given in Table 5.18. Exhibit 5-5 consisting of five sheets, show the layout for each of the five systems completed and in operation.

The purpose of this program is to determine the effectiveness, potential problems and associated costs of tailwater recovery systems on different soils, slopes, crops, etc. Delivery, tailwater, recycled tailwater, water salinity, soil salinity, and temperature are being monitored.

The tailwater recovery systems were designed to capture irrigation water that runs off the low end of the field, store it for a short period of time (hours), and then reapply it to the same field or one nearby.

The pumping units are designed for minimal maintenance. A drainage headwall guides the water into the sump and a 48-inch diameter RCP manhole is used as a sump. Trash pumps with 3-inch solids bypass capacity were installed at all locations. Pump and motor protection has been provided. The discharge line is 12-inch diameter, Class 160 PVC pipe. Excess operational pressures were foreseen. There have been some problems in the operation of the systems; some have been design-related; tailwater boxes have been changed to 42-inch; leaks have occurred due to construction methods; debris has clogged the line. Operational problems seem to be caused primarily by the operators.

Table 5.17

TAILWATER PUMPBACK SYSTEMS

COST SUMMARY

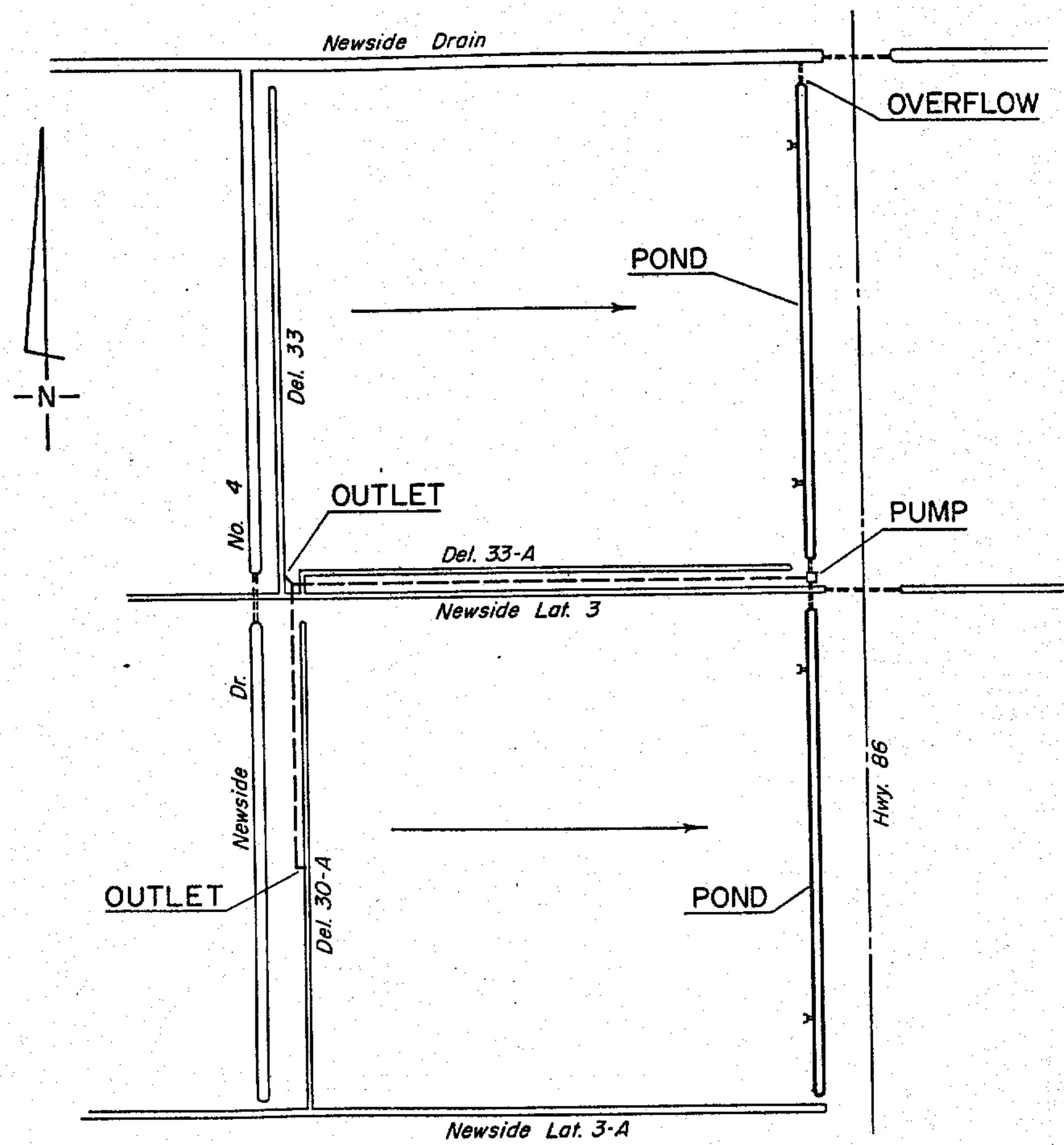
SYSTEM OWNER	PUMP		PIPELINE		POND		TOTAL
	MATERIAL	LABOR	MATERIAL	LABOR	MATERIAL	LABOR	
VEYSEY	11,116	3,655	29,615	12,663	2,243	8,906	68,198
BENSON	9,858	2,303	49,115	16,276	2,786	1,858	79,950
SMITH	8,617	4,116	40,611	12,911	2,485	4,919	72,583
MALLORY	21,881	2,149	35,231	10,359	2,843	2,741	75,204
NILSON							
SCARONI							

TW4
(25)

Table 5.18
TAILWATER PUMPBACK SYSTEMS
SUMMARY

SYSTEM	COST ($)	AREA SERVED (AC)	SERVICE LINE		PUMP		STORAGE VOLUME (AF)
			SIZE (PVC)	LENGTH (FT)	HP	CAPACITY (CFS)	
VEYSEY	68,198	320	12"	3,425	20	3	4
BENSON	79,950	440	12"	6,700	30	3	10
SMITH	72,583	175	12"	5,450	30	3	3.0
MALLORY	75,204	188	12"	5,200	20	3	3.7
NILSON		155	12"	5,100	20	3	2.8
SCARONI		138	12"	2,420	15	3	3.2

TW5
(25)

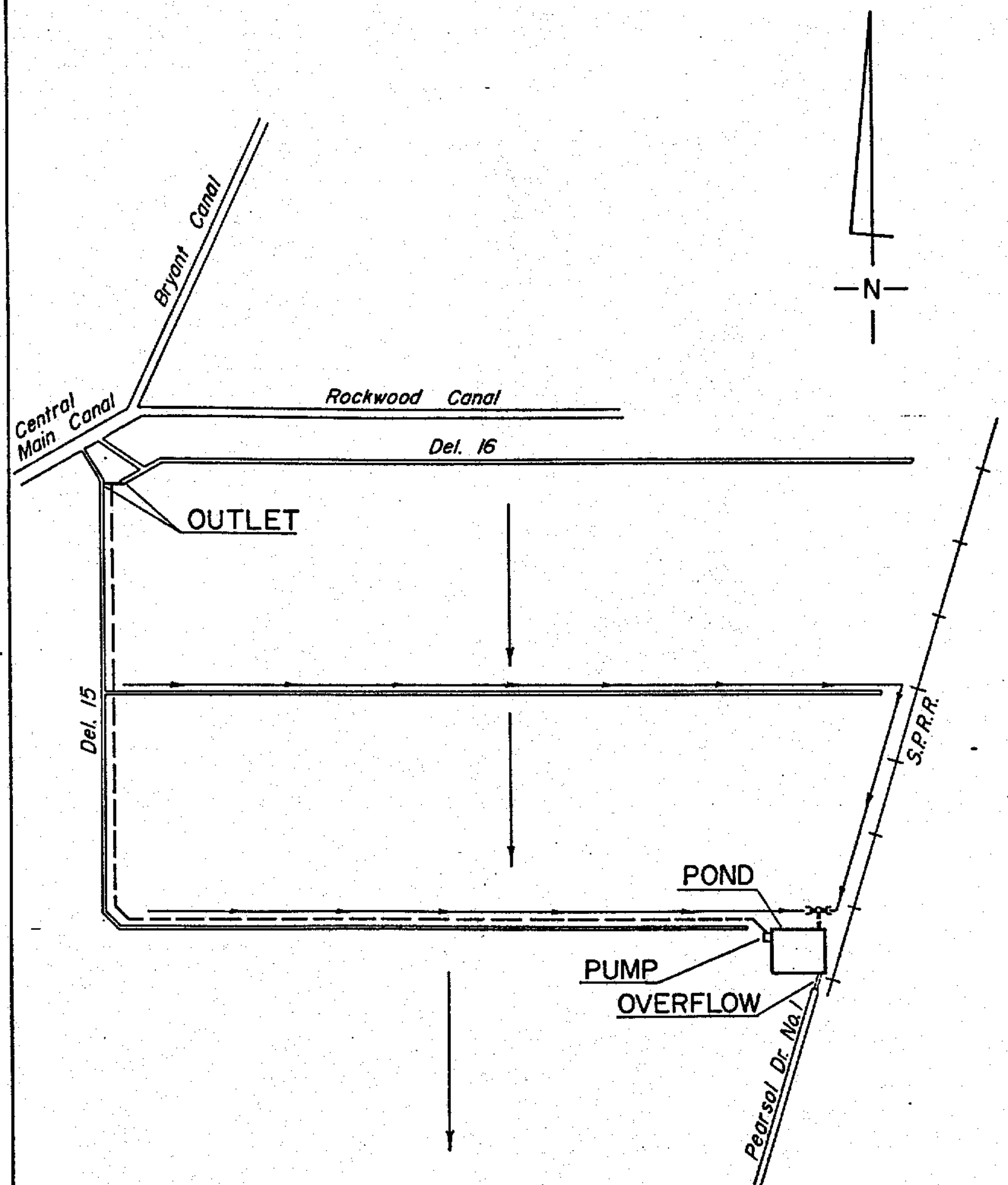


Refer Dwg. 12F-6930

VEYSEY PUMPBACK

TR.S 65, 177, and 189
T. 14 S. - R. 13 E.

EXHIBIT 5-5 Dwg. L-2885

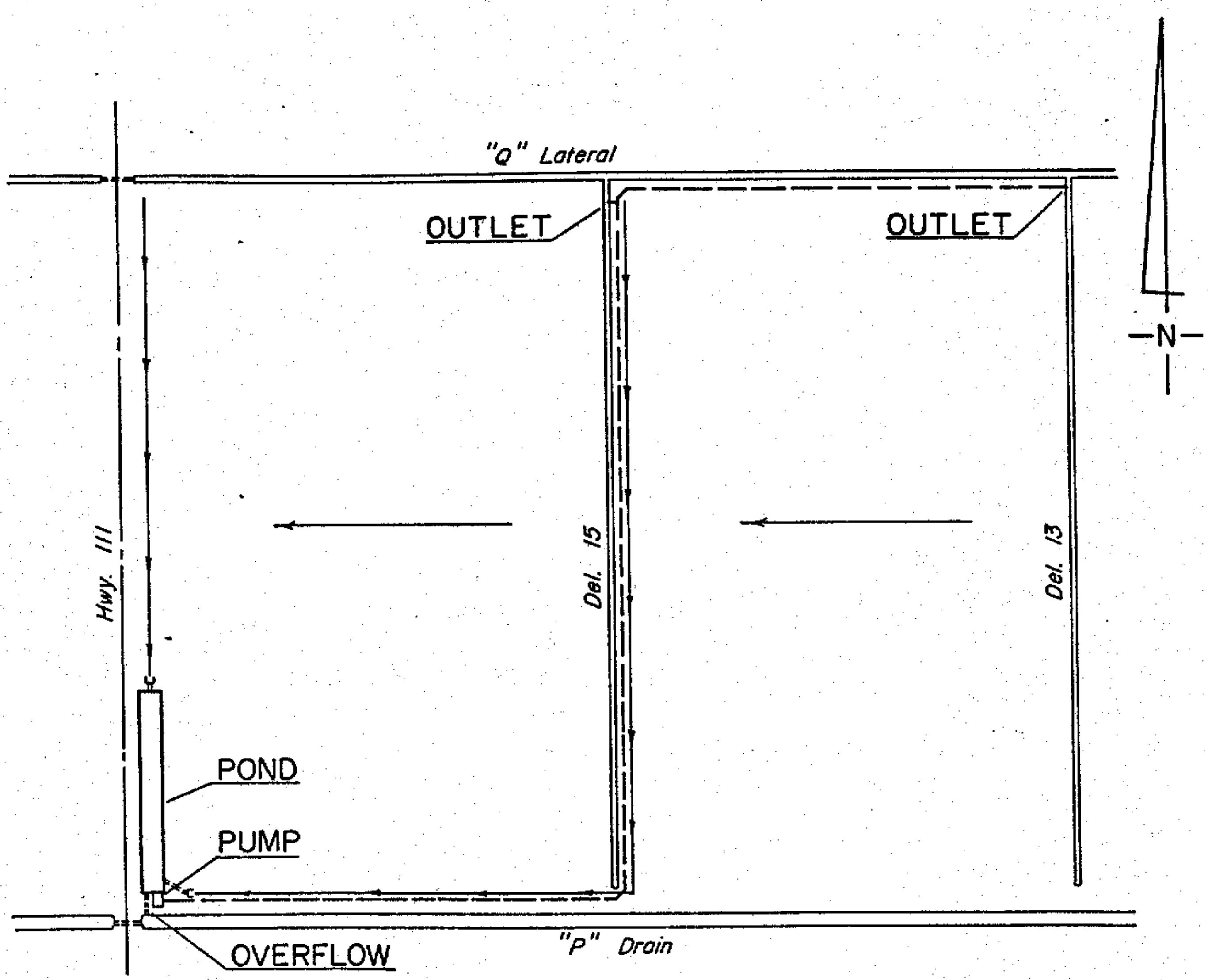


Refer Dwg. 12F-6932

BENSON PUMPBACK

TRACT 117
T. 14 S. - R. 14 E.

Dwg. L-2886



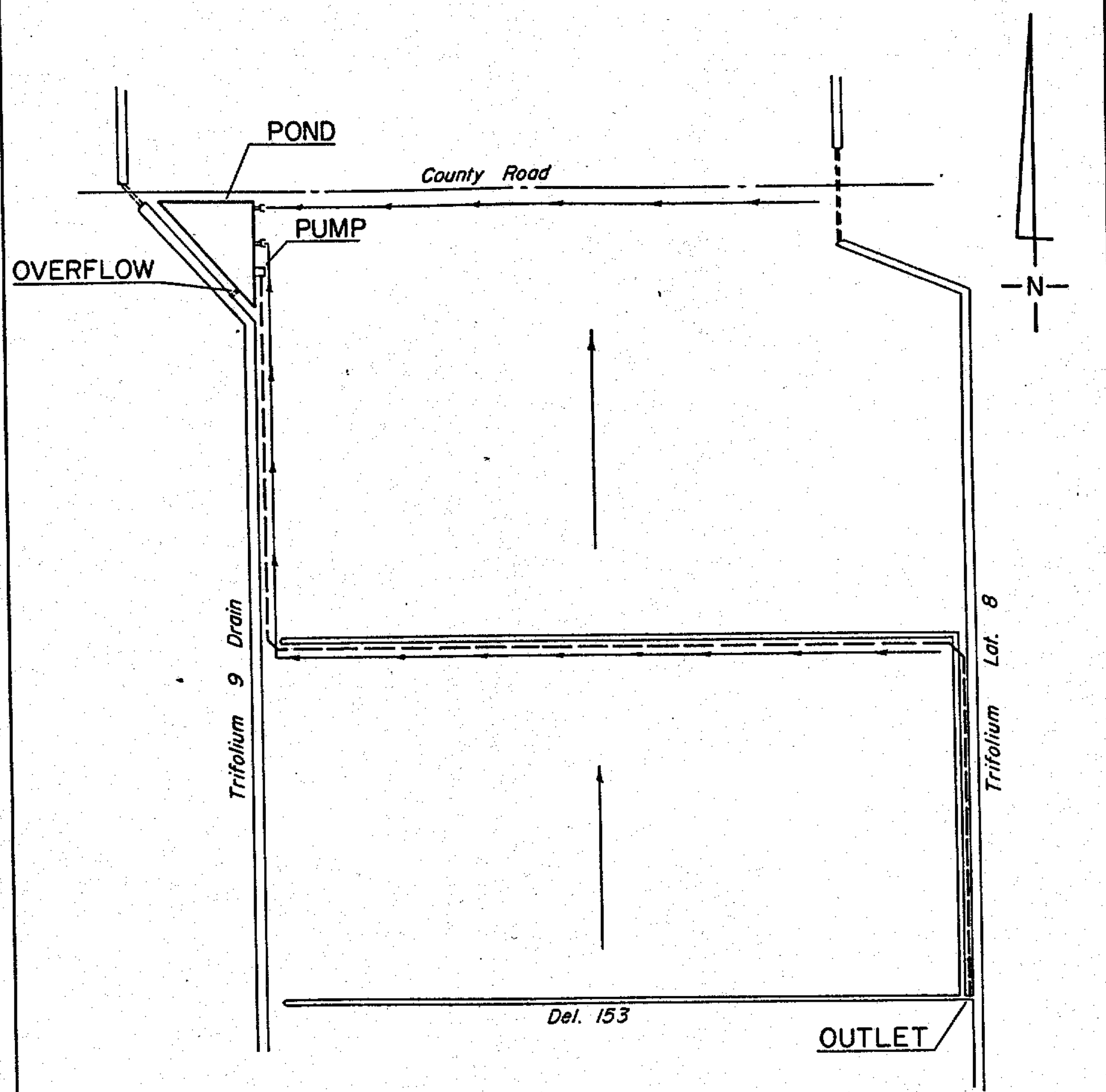
Refer Dwg. 12F-6923

J. R. SMITH PUMPBACK

NE$\frac{1}{4}$ SEC. 16 and W$\frac{1}{2}$ W$\frac{1}{2}$ NW$\frac{1}{4}$ SEC. 15

T. 11 S. – R. 14 E.

Dwg. L-2882



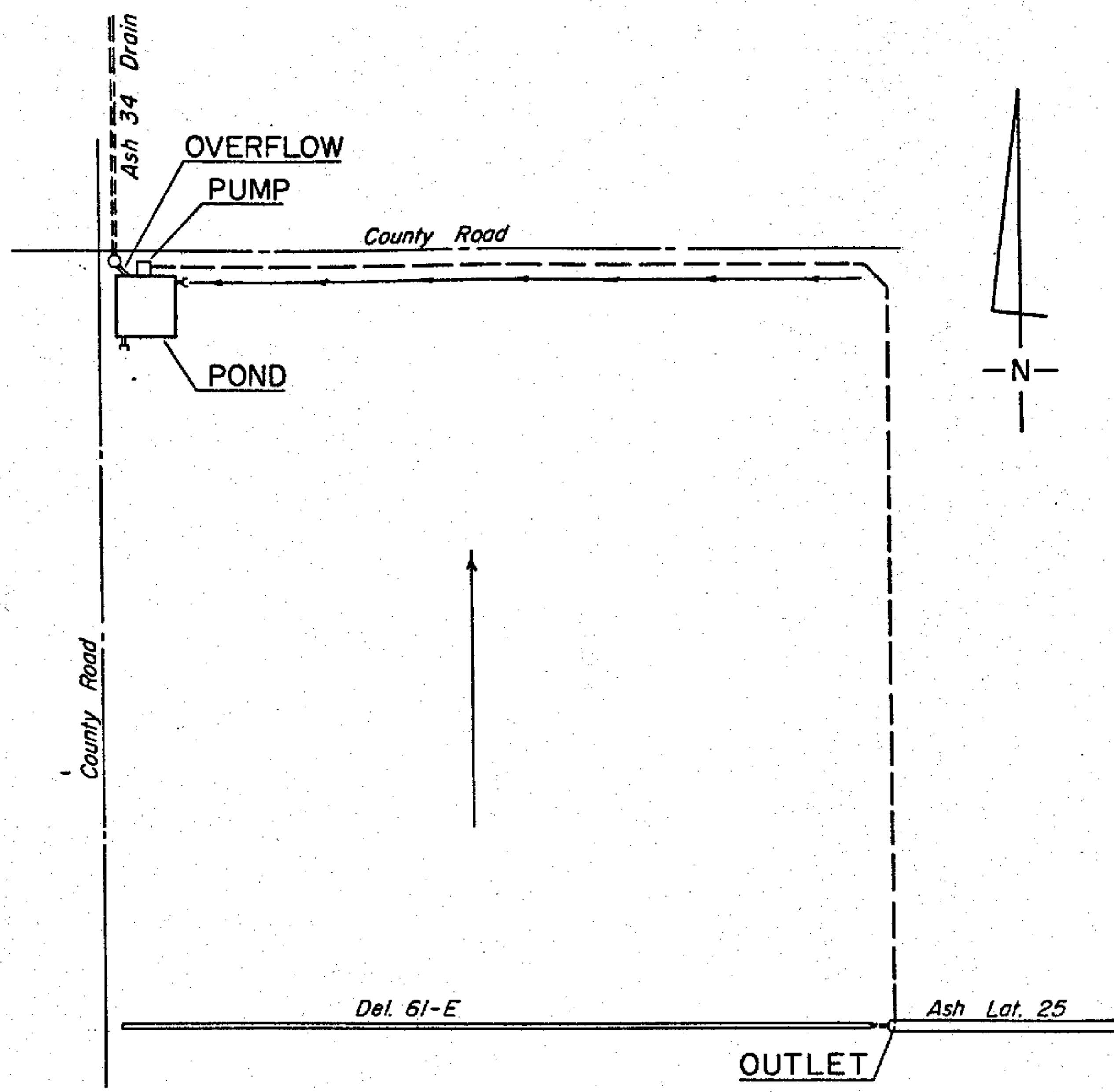
Refer Dwg. 12F-6924

MALLORY PUMPBACK

N½ TRACT 128

T. 13 S. - R. 13 E.

Dwg. L-2883



Refer Dwg. 12F-6926

NILSON PUMPBACK

LOTS 1, 2, 4, and 5 SEC. 16
T. 16 S. - R. 15 E.

Dwg. L-2884

Tailwater salinity appears to be directly related to the salinity of the soil in the field. In general, if the field has a low soil salinity, tailwater from that field will also be low in salinity. If the field has a high soil salinity, the salinity of the tailwater from that field will be high. As the water travels across the field it picks up salts from the soil. In addition, during the summer the salt in the water is concentrated by evaporation as the water travels across the field. The water temperature also increases. Tailwater temperatures on alfalfa fields have been measured as high as 110°F during the summer. The effects of these higher temperatures have not yet been evaluated.

Over 2,000 soil samples have been gathered from the fields involved in the demonstration tailwater recovery program. These samples are currently being analyzed. Temperature and salinity analyses collected during the year on fields included in the irrigation scheduling programs are listed in Table 5.19. Table 5.20 shows the results of tailwater salinity and temperatures for the demonstration tailwater systems.

Data is available from the first tailwater system installed on two fields (320 acres) belonging to John C. Veysey (see Table 5.21). During the period November 10, 1985, to March 27, 1986, 77.5 acre-feet (AF) were recycled by the system. Exhibit 5-6 is a printout from the electronic recorder data for one irrigation on Mr. Veysey's sugar beets served by Delivery 30 (January 3 and 4, 1986) on Newside Lateral 3-A. All of the tailwater (TW) flowing into the pond was pumped back to the field; there was no flow to the drain. For comparison, an average sugar beet field in the Imperial Valley might have 24 percent tailwater (90 AF) for the same time period. If projected for the entire year this would amount to a savings of approximately 1 AF/acre.

A field day, sponsored by the District, was held at the Veysey Ranch on April 10, 1986. A copy of the public notice is shown in Exhibit 5-7.

Table 5.19

Page No. 1
04/09/86

TAILWATER SALINITY ANALYSIS

DATE	CROP	DEL/TW/POND	TIME	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
09/30/85	ALFALFA	TAILWATER	08:38	72.0	78.0	1.08
09/30/85	ALFALFA	TAILWATER	01:45	90.0	88.0	1.06
09/30/85	ALFALFA	TAILWATER	09:06	78.0	80.0	1.38
09/30/85	ALFALFA	TAILWATER	01:38	92.0	90.0	1.56
09/30/85	ALFALFA	TAILWATER	09:37	77.0	78.0	1.39
10/05/85	ONIONS	DELIVERY	11:20	70.0	82.0	0.94
10/15/85	ALFALFA	DELIVERY	10:30	66.0	72.0	0.95
10/15/85	ALFALFA	TAILWATER	10:04	66.0	74.0	1.38
10/15/85	ALFALFA	DELIVERY	08:53	65.0	70.0	0.97
10/15/85	ALFALFA	DELIVERY	10:45	70.0	74.0	0.89
10/15/85	ALFALFA	TAILWATER	12:30	76.0	80.0	1.17
10/15/85	ALFALFA	TAILWATER	08:45	60.0	70.0	1.32
10/21/85	ALFALFA	DELIVERY	11:45	73.0	80.0	1.05
10/22/85	ALFALFA	DELIVERY	12:43	72.0	81.0	0.93
10/22/85	ALFALFA	TAILWATER	12:30	83.0	80.0	1.11
10/22/85	ALFALFA	DELIVERY	12:35	71.0	80.0	0.95
10/22/85	ALFALFA	TAILWATER	11:45	80.0	79.0	1.98
10/22/85	ALFALFA	TAILWATER	10:30	68.0	74.0	1.03
10/22/85	ALFALFA	DELIVERY	10:36	69.0	74.0	0.91
10/22/85	ALFALFA	TAILWATER	13:30	76.0	82.0	1.11
10/22/85	ALFALFA	DELIVERY	13:43	72.0	83.0	0.91
10/22/85	ROW ALFALFA	DELIVERY	14:00	58.0	72.0	1.68
10/23/85	ALFALFA	TAILWATER	10:45	74.0	74.0	1.43
10/23/85	ALFALFA	TAILWATER	13:39	82.0	62.0	0.98
10/23/85	ROW ALFALFA	TAILWATER	08:45	58.0	72.0	1.68

1 of 5

TAILWATER SALINITY ANALYSIS

DATE	CROP	DEL/TW/POND	TIME	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
10/28/85	ALFALFA	TAILWATER	09:40	74.0	78.0	1.17
10/28/85	ALFALFA	DELIVERY	11:45	73.0	86.0	0.93
10/28/85	ALFALFA	DELIVERY	09:30	72.0	78.0	0.93
10/28/85	ALFALFA	DELIVERY	11:00	70.0	84.0	0.92
10/28/85	ALFALFA	DELIVERY	08:36	69.0	76.0	0.94
10/28/85	ALFALFA	TAILWATER	08:40	69.0	77.0	1.25
10/28/85	ALFALFA	TAILWATER	08:30	68.0	76.0	1.24
10/28/85	ALFALFA	DELIVERY	11:30	74.0	84.0	0.93
10/29/85	ALFALFA	DELIVERY	12:50	72.0	90.0	0.89
10/29/85	ALFALFA	DELIVERY	01:00	72.0	90.0	0.92
10/29/85	ALFALFA	DELIVERY	10:43	73.0	83.0	0.90
10/29/85	ALFALFA	TAILWATER	10:37	80.0	81.0	1.06
10/29/85	ALFALFA	DELIVERY	11:20	72.0	84.0	0.90
10/29/85	ALFALFA	DELIVERY	12:08	72.0	88.0	0.92
10/29/85	ALFALFA	TAILWATER	11:50	84.0	88.0	1.34
10/29/85	ALFALFA	DELIVERY	10:55	72.0	86.0	0.90
10/29/85	ALFALFA	TAILWATER	09:15	69.0	72.0	1.10
10/29/85	ALFALFA	DELIVERY	11:13	72.0	84.0	0.90
10/29/85	ALFALFA	TAILWATER	10:23	70.0	80.0	1.03
10/30/85	ALFALFA	DELIVERY	11:45	72.0	86.0	0.89
10/30/85	ALFALFA	TAILWATER	11:15	78.0	86.0	0.95
10/30/85	ALFALFA	DELIVERY	02:30	72.0	90.0	0.87
10/30/85	ALFALFA	DELIVERY	02:30	0.0	0.0	0.00
10/30/85	BEETS	DELIVERY	09:11	68.0	79.0	0.87
10/30/85	BEETS	TAILWATER	08:53	65.0	78.0	0.91

TAILWATER SALINITY ANALYSIS

DATE	CROP	DEL/TW/POND	TIME	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
10/30/85	BEETS	DELIVERY	09:47	71.0	80.0	0.95
11/04/85	ALFALFA	DELIVERY	13:00	74.0	83.0	1.54
11/04/85	ALFALFA	DELIVERY	09:23	64.0	76.0	0.97
11/04/85	ONIONS	DELIVERY	09:40	66.0	72.0	0.96
11/04/85	WHEAT	DELIVERY	12:30	66.0	82.0	0.95
11/05/85	ALFALFA	DELIVERY	10:34	68.0	80.0	0.96
11/05/85	ALFALFA	TAILWATER	10:43	70.0	80.0	1.13
11/05/85	ALFALFA	DELIVERY	14:30	70.0	80.0	0.97
11/05/85	WHEAT	DELIVERY	10:00	64.0	76.0	0.99
11/06/85	BERMUDA GRASS	TAILWATER	14:25	82.0	62.0	1.46
11/06/85	BERMUDA GRASS	TAILWATER	14:30	82.0	62.0	1.72
11/06/85	ROW ALFALFA	TAILWATER	10:39	58.0	52.0	1.14
11/12/85	ALFALFA	TAILWATER	10:57	58.0	50.0	1.75
11/12/85	ALFALFA	TAILWATER	12:57	66.0	54.0	1.18
11/12/85	ALFALFA GERM.	DELIVERY	13:24	62.0	65.0	0.93
11/12/85	ALFALFA GERM.	TAILWATER	13:19	68.0	73.0	1.31
11/12/85	ONIONS	TAILWATER	13:02	64.0	52.0	1.20
11/12/85	RAPE	TAILWATER	14:38	58.0	52.0	1.28
11/12/85	ROW ALFALFA	TAILWATER	12:31	62.0	51.0	1.38
11/12/85	ROW ALFALFA	DELIVERY	13:40	61.0	64.0	0.89
11/12/85	SUGAR BEETS	TAILWATER	13:31	65.0	67.0	1.81
11/12/85	SUGAR BEETS	DELIVERY	13:35	56.0	66.0	1.33
11/13/85	ALFALFA	TAILWATER	13:10	64.0	68.0	0.99
11/13/85	ALFALFA	DELIVERY	13:18	68.0	68.0	0.87
11/13/85	ALFALFA	TAILWATER	13:10	64.0	68.0	0.99

TAILWATER SALINITY ANALYSIS

DATE	CROP	DEL/TW/POND	TIME	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
11/13/85	ALFALFA	DELIVERY	13:18	68.0	68.0	0.87
11/18/85	ALFALFA	DELIVERY	13:00	60.0	70.0	0.95
11/18/85	ALFALFA	DELIVERY	10:40	58.0	70.0	0.97
11/18/85	ALFALFA	DELIVERY	10:45	58.0	70.0	1.01
11/18/85	MULCH H20 WHEAT	DELIVERY	13:35	60.0	70.0	0.88
11/21/85	ALFALFA	TAILWATER	12:35	58.0	72.0	0.88
11/21/85	SUGAR BEETS	DELIVERY	12:10	59.0	72.0	0.91
12/31/85	ALFALFA	DELIVERY	12:00	56.0	68.0	0.93
01/01/86	BEETS	TAILWATER	12:30	61.0	78.0	1.65
01/03/86	ALFALFA	DELIVERY	12:45	61.0	78.0	1.06
01/03/86	ALFALFA	TAILWATER	12:36	72.0	78.0	1.27
01/04/86	ALFALFA	DELIVERY	08:35	57.2	62.6	0.90
01/04/86	ALFALFA	TAILWATER	08:09	53.2	57.2	0.97
01/04/86	ALFALFA	POND	08:24	53.0	59.0	1.13
01/04/86	BEETS	TAILWATER	09:54	58.0	68.0	1.57
01/04/86	BEETS	DELIVERY	10:05	58.0	64.4	0.87
01/04/86	BEETS	POND	10:17	58.0	69.0	1.62
02/05/86	ROW ALFALFA	TAILWATER	08:25	48.0	58.0	0.93
02/05/86	ROW ALFALFA	DELIVERY	08:30	53.0	58.0	0.99
03/07/86	ALFALFA	TAILWATER	09:48	65.0	78.0	1.22
03/07/86	ALFALFA	POND	10:00	65.0	64.0	0.94
03/07/86	ALFALFA	DELIVERY	09:35	68.0	78.0	1.02
03/14/86	SUGAR BEETS	TAILWATER	15:45	62.0	78.0	0.00
03/28/86	SUGAR BEETS	POND	09:15	66.0	75.0	1.66
03/28/86	SUGAR BEETS	TAILWATER	09:05	68.0	75.0	1.85

TAILWATER SALINITY ANALYSIS

DATE	CROP	DEL/TW/POND	TIME	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
03/28/86	SUGAR BEETS	DELIVERY	08:58	67.0	75.0	0.87
04/03/86	WHEAT	DELIVERY	10:20	68.0	73.4	0.88
04/03/86	WHEAT	TAILWATER	14:33	77.0	80.1	1.09
04/03/86	WHEAT	POND	14:37	78.0	80.1	1.24
04/08/86	AWHEAT	DELIVERY	08:19	64.0	71.0	0.86
04/08/86	WHEAT	DELIVERY	13:05	62.0	78.0	0.96
04/08/86	WHEAT	TAILWATER	09:00	63.0	66.0	0.94
04/08/86	WHEAT	TAILWATER	09:08	64.0	67.0	0.96
04/09/86	ALFALFA	TAILWATER	13:10	66.0	84.0	0.92
04/09/86	ALFALFA	DELIVERY	13:13	66.0	84.0	0.90
04/09/86	ALFALFA	TAILWATER	13:00	66.0	84.0	0.94
04/09/86	ALFALFA	TAILWATER	10:13	63.0	86.0	1.02
11/05/86	ALFALFA	TAILWATER	12:25	78.0	84.0	1.11
12/31/86 5		TAILWATER	12:50	58.0	69.0	1.11
12/31/86 5		DELIVERY	12:40	56.0	69.0	0.96

Table 5.20

TAILWATER RETURN SYSTEMS

TAILWATER SALINITY ANALYSIS

DATE	LOCATION	DEL/TW/POND	TIME	CROP	WATER TEMP	AIR TEMP	ELECTRICAL CONDUCTIVITY
04/03/86	CENTRAL MAIN 15	DELIVERY	10:20	WHEAT	68.0	73.4	0.88
04/03/86	CENTRAL MAIN 15	POND	14:37	WHEAT	78.0	80.1	1.24
04/03/86	CENTRAL MAIN 15	TAILWATER	14:33	WHEAT	77.0	80.1	1.09
12/31/86	CENTRAL MAIN 15	DELIVERY	12:40		56.0	69.0	0.96
12/31/86	CENTRAL MAIN 15	TAILWATER	12:50		58.0	69.0	1.11
01/04/86	NEWSIDE 30-A	DELIVERY	10:05	SUGAR BEETS	58.0	64.4	0.87
01/04/86	NEWSIDE 30-A	POND	10:17	SUGAR BEETS	58.0	69.0	1.62
01/04/86	NEWSIDE 30-A	TAILWATER	09:54	SUGAR BEETS	58.0	68.0	1.57
03/28/86	NEWSIDE 30-A	DELIVERY	08:58	SUGAR BEETS	67.0	75.0	0.87
03/28/86	NEWSIDE 30-A	POND	09:15	SUGAR BEETS	66.0	75.0	1.66
03/28/86	NEWSIDE 30-A	TAILWATER	09:05	SUGAR BEETS	68.0	75.0	1.85
11/12/85	NEWSIDE 33	DELIVERY	13:35	SUGAR BEETS	56.0	66.0	1.33
11/12/85	NEWSIDE 33	TAILWATER	13:31	SUGAR BEETS	65.0	67.0	1.81
01/01/86	NEWSIDE 33	TAILWATER	12:30	SUGAR BEETS	61.0	78.0	1.65
03/14/86	NEWSIDE 33	TAILWATER	15:45	SUGAR BEETS	62.0	78.0	1.42
01/04/86	Q-15	DELIVERY	08:35	ALFALFA	57.2	62.6	0.90
01/04/86	Q-15	POND	08:24	ALFALFA	53.0	59.0	1.13
01/04/86	Q-15	TAILWATER	08:09	ALFALFA	53.2	57.2	0.97
03/07/86	Q-15	DELIVERY	09:35	ALFALFA	68.0	78.0	1.02
03/07/86	Q-15	POND	10:00	ALFALFA	65.0	64.0	0.94
03/07/86	Q-15	TAILWATER	09:48	ALFALFA	65.0	78.0	1.22
01/09/86	TRIFOLIUM 8 - 153	DELIVERY	10:10	ALFALFA	56.0	68.0	0.91
01/09/86	TRIFOLIUM 8 - 153	TAILWATER	10:20	ALFALFA	53.0	68.0	0.95

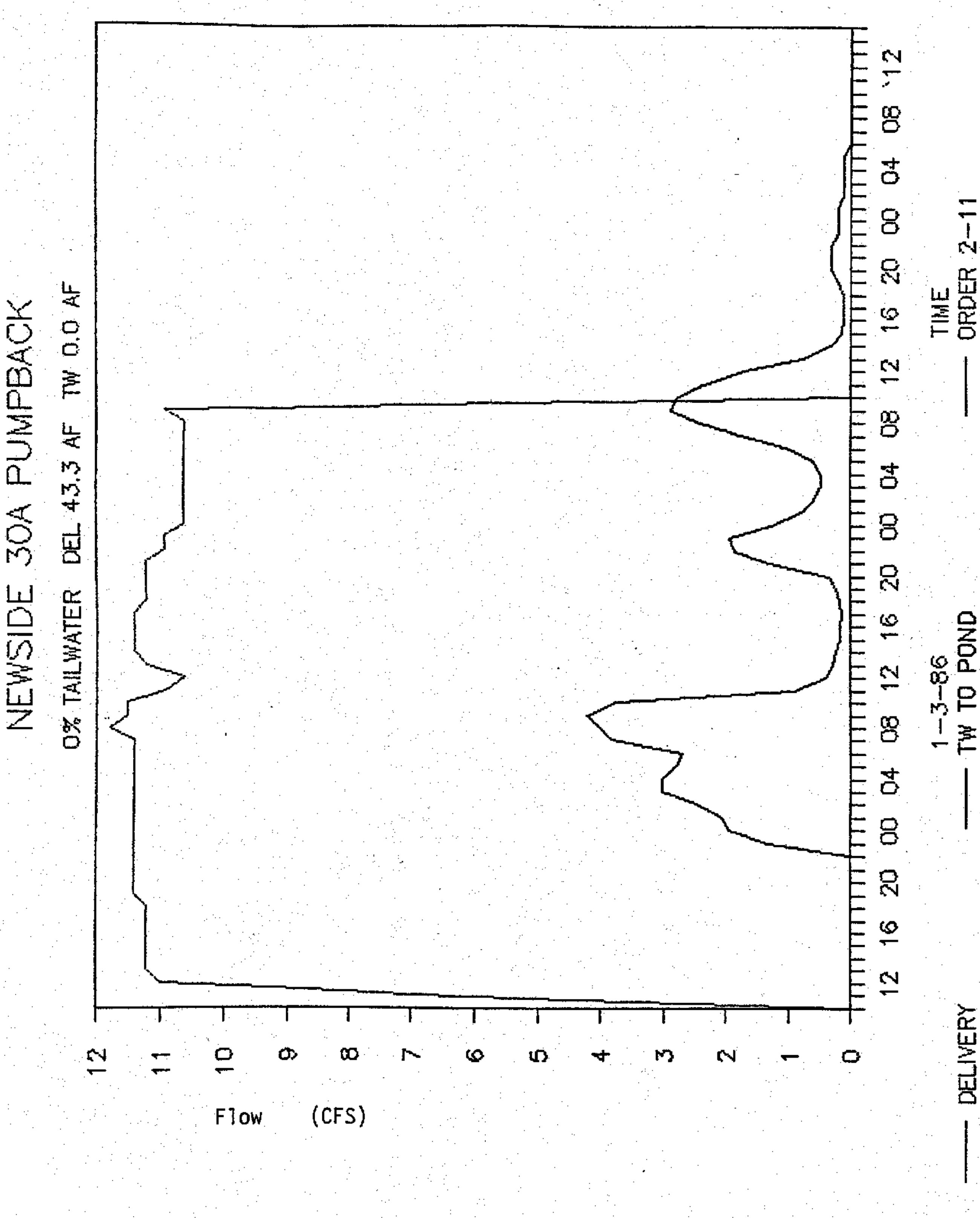
Table 5.21

VEYSEY TAILWATER RECOVERY SYSTEM

DATE	DELIVERY AC FT	TAILWATER AC FT	RECYCLED AC FT	TAILWATER PERCENT
11-10-85	42.9	1.3	5.0	3.0
01-03-86	43.3	0.0	4.6	0.0
01-07-86	5.2	0.0	2.0	0.0
01-10-86	42.4	0.0	13.0	0.0
02-03-86	60.2	0.2	13.0	0.3
02-26-86	55.4	0.0	13.3	0.0
03-12-86	57.0	0.9	13.5	1.6
03-27-86	72.5	0.0	13.1	0.0
TOTAL-AVG	378.9	2.4	77.5	0.1

4960 KW X .0484 = $240.06

$240.06 / 77.5 AC-FT = $3.10 PER AC-FT PUMPED BACK


NEWSIDE 30A PUMPBACK
0% TAILWATER DEL 43.3 AF TW 0.0 AF
Flow (CFS)
0
1
2
3
4
5
6
7
8
9
10
11
12
12
16
20
00
04
08
12
16
20
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08
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16
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04
08
'12
1-3-86
TIME
— DELIVERY
— TW TO POND
— ORDER 2-11

EXHIBIT 5-6

IMPERIAL VALLEY PRESS - APRIL 8, 1986

IMPERIAL IRRIGATION DISTRICT

PUMPBACK FIELD DAY

Thursday, April 10, 1986

11:00 a.m.

Location: 1/2 mile south of Keystone Road on Highway 86, across from Holly Sugar

Discussion will include: Cost and operation of system, temperature and salinity analysis, and amount of irrigation water conserved.

IMPERIAL IRRIGATION DISTRICT

"Facing The Future . . . Proud of Our Past"

Irrigation Scheduling Program

The Irrigation Scheduling Program was increased to 15,000 acres in 1985, after termination of its three-year cooperative agreement with the U.S. Bureau of Reclamation (USBR).

Many of the growers that had been in the program since its start were dropped from the program and new "high tailwater" growers were added. The tailwater assessment records were reviewed, and growers with three or more tailwater assessments on an individual field were contacted as potential cooperators in the programs.

Irrigation scheduling with the neutron probe has proven to be a simple but accurate method for monitoring soil moisture and scheduling irrigations. A majority of the farmers participating in the program have reduced their tailwater. On wheat fields where previously 10 to 12 irrigations were being applied in a season, 5 to 7 irrigations are now being applied.

On the average, two irrigations can be eliminated on wheat fields, which is a $2.80 per acre labor savings. Approximately 0.13 acre-feet less water will be applied to the field, resulting in a savings of $1.13 per acre. The total savings would be $3.93 per acre. The estimated cost for the scheduling service is $5.00 per acre.

In 1985, tailwater on cotton and sugar beets was reduced by 26 percent and 16 percent respectively, on fields added to the program in 1984. Tailwater on the flat crops remained the same. Irrigation scheduling has a more immediate impact on tailwater flows from row crops due to the nature of the irrigation method.

Tailwater has been reduced yearly on Alfalfa Field Number 01-148, starting in 1982 from 25 percent; 1983, 19 percent; 1984, 12 percent; and in 1985, 10 percent. One grower that was added to the program in 1984 has reduced tailwater on bermuda grass from 28 percent to 10 percent, a 73 percent reduction in tailwater.

Theoretically, irrigation scheduling in combination with proper irrigation application techniques could conserve up to 100,000 acre-feet of water per year. However, as the program to date has proven, complete acceptance by all of the water users, of the advice by District personnel, has not occurred.

Many of the farmers are not convinced that they will apply sufficient water and continue to order greater amounts than advised. The District normally delivers water for a period of 24 hours and attempts to deliver within 10 percent of the farmer's order. Using the neutron probe to schedule irrigations we can usually determine the fields moisture requirements within 5 to 10 percent. As the District's delivery system is further improved, more delivery flexibility will be possible and farmers should be able to irrigate more efficiently.

The average unit irrigation efficiency for all fields monitored in 1985 was 85 percent.

Table 5.22
Irrigation Scheduling Efficiency
Summary

	1982		1983		1984		1985	
	Applied Water "/AC	Unit Eff. (%)	Applied Water "/AC	Unit Eff. (%)	Applied Water "/AC	Unit Eff. (%)	Applied Water "/AC	Unit Eff. (%)
Alfalfa	77	88	68	88	66	87	69	86
Row Alfalfa	-	-	-	-	-	-	72	82
Cotton	60	84	64	83	54	83	57	82
Wheat	*	89	25	88	34	87	30	86
Sugar Beets	*	76	50	78	56	76	43	80
Asparagus	*	77	*	77	-	-	-	-
Melons	*	74	*	84	-	-	*	96
Carrots	-	-	*	88	-	-	*	72
Tomatoes	-	-	-	-	*	70	-	-
Bermuda	-	-	-	-	*	90	48	79
Onions	-	-	-	-	53	78	-	-

* Entire crop season not monitored.

Broad-Crested Weirs

Farmers in the Imperial Valley have been encouraged to improve their water management practices. Good irrigation water management requires accurate water application measurements. The Imperial Irrigation District measures delivery water to the farms through an orifice structure (delivery gate). The amount of water being delivered is normally measured twice, on the Zanjero's afternoon and morning run, during an irrigation day. These measurements, although sufficient for billing purposes, are not accurate enough to use for detailed analysis of irrigation efficiency.

Recently the Agricultural Research Service has developed the modified broad-crested weir to measure water in open channels or ditches. The new style weir eliminates most of the problems connected with other weirs and flumes. If properly constructed, the discharge rate can be mathematically determined using as-built dimensions within allowable tolerances. Very low head losses are required. The low cost modified broad-crested weir is easy to construct, usually taking only a few hours to install and costing less than one hundred dollars.

The broad-crested weir has been used extensively in the District's Irrigation Scheduling Program to measure delivery. In conjunction with the weir, a water-level recorder has been used to record the totalized discharge.

Although the broad-crested weir is an excellent tool for measuring delivery ($\pm$ 2 percent accuracy), it is not practical for use in measuring all deliveries in the District. This is because some head loss is required for proper measurements and in some cases the head is not available. Research is ongoing to develop other applicable methods for measuring deliveries in very low head loss conditions.

Computerized Water Management Study

The District has received a grant of $25,000 per year for three years, from the California Department of Water Resources (DWR) to develop an irrigation scheduling program utilizing the California Irrigation Management Information Service (CIMIS) program. The overall program involves scheduling on a field-by-field basis and canal system scheduling.

The Agreement between the DWR and the IID executed April 17, 1986, provides that the District perform the following work:

1. The IID will install equipment to measure and monitor water flow quantities and qualities. In addition, computer scheduling programs will be developed/purchased.

2. The IID will develop data collected from CIMIS and field evaluations, into usable reports for water users participating in the program. The project will initially include a demonstration area of approximately 10,000 acres. Eventually, this information will be available for use by other water users in its service area.

3. The IID will implement education and information programs to promote use of the irrigation scheduling service and CIMIS data.

4. The IID will submit a progress report to the DWR at the end of funding years one and two, and a final report at the end of year three. These reports will include the following information at a minimum:

   a. project goals and objectives;
   b. how project was implemented;
   c. description of education and information programs;
   d. response of growers to program;
   e. estimated benefits from the project (current and future); and
   f. continuation of project.

5. The IID is aware of the Irrigation Evaluation Short Course, sponsored by the DWR, and available at California Polytechnic State University, San Luis Obispo, and agrees to send appropriate staff to the course as schedules permit.

The goal of the three-year program will be to have a practical computer program in place to make the CIMIS and related data available for use by all District water users. The products will be regularly printed information, plus reasonable access to computer programs by telephone connections.

During the first year of the proposed three-year study, equipment will be installed to measure and monitor water-flow quantities, and the computer software programs will be developed.

In the second and third years, the data will be developed into usable reports for District water users cooperating in the program, and subsequently for use by all other consumers.

Active education and information programs will be implemented to promote use of the irrigation scheduling service and the CIMIS data.

Based on experience during the past four years, water users who have volunteered for irrigation scheduling services from the District have gradually increased their acceptance of advice from the District staff.

Since the District will continue to offer these services at no cost to individual users for an indefinite time, use rate can be expected to increase. Development of information demonstrating increased efficiencies, and more importantly, reduced costs, should result in an increasing use rate of the scheduling service.

Exhibit 5-8 is a copy of the May 1986 newsletter entitled "Cimis Update" describing current activities relating to the program.

George Deukmejian, Governor
State of California

Gordon K. Van Vleck, Secretary for Resources
The Resources Agency

David N. Kennedy, Director
Department of Water Resources

May 1986

No. 5

CIMIS Update

Mobile Irrigation Management Laboratory (Mobile Lab)

This issue of CIMIS Update describes the Department of Water Resources (DWR) Mobile Irrigation Management Laboratory Program, an important part of the California Irrigation Management Information System (CIMIS) project.

The CIMIS weather station network and computer system provides reference evapotranspiration (ETo) and precipitation values to growers. These values help a grower to determine the optimal timing for an irrigation and how much water is required to refill the crop root zone. But, the efficiency of the irrigation system will ultimately determine how much water should be applied to the field to refill the crop root zone. For example, if the irrigation system has an application efficiency of only 50 percent and the crop's water requirement is four inches, then six inches of water will have to be applied to fill the crop's root zone. Mobile Labs measure irrigation efficiency and how uniformly irrigation water is distributed over a field.

How well does your irrigation system work? The Mobile Lab Program can help you determine this. The Mobile Labs show growers ways to operate and manage their irrigation systems more efficiently. To receive an evaluation, all growers have to do is contact one of the resource conservation districts (RCD's) in their service area to set up an appointment. The lab will come to the grower's farm and collect the data needed to calculate distribution uniformity, application rates, and make practical recommendations to improve irrigation management. The Mobile Labs operate as an education program and not as an on-farm service. Lab units are limited to one evaluation per irrigation method per year. If you wish more extensive work, contact a private consultant or get training in how to evaluate irrigation systems at Cal Poly, San Luis Obispo.

Mobile Lab Locations

The CIMIS project has five Mobile Labs in full operation. Each is a cooperative effort by the Department of Water Resources (DWR), the local RCD, and the U.S. Soil Conservation Service (SCS).

Below is a list of Mobile Lab locations, and contact persons. However, special requests can be made to perform evaluations outside of these areas. Currently, there is no charge to the grower for an evaluation if the grower uses the labs that are under contract with DWR.

Kings River-Excelsior Resource Conservation District operates a Mobile Lab in Kings, Fresno and Tulare Counties. The contact person for this lab is John Parrish at (209) 584-9209.

CIMIS Update
Office of Water Conservation
Department of Water Resources
P. O. Box 942836
Sacramento, CA 94236-0001
800-925-5530

Water conservation information can also be obtained from any of the following Department of Water Resources' District Offices:

Central District
P. O. Box 160088
Sacramento, CA 95816
(916) 323-4891

Northern District
P. O. Box 607
Red Bluff, CA 96080
(916) 527-6530
Extension 262

San Joaquin District
3374 E. Shields Ave
Fresno, CA 93726
(209) 445-5262

Southern District
P. O. Box 6598
Los Angeles, CA 90055
(213) 620-4194

Coachella Valley Resource Conservation District operates a Mobile Lab in Riverside County. The contact person is Sam Aslan or Don Ackley at (619) 347-7658.

Ventura County Resource Conservation District operates a Mobile Lab in Ventura County. The contact person is Mohammad Farzan at (805) 482-4206.

Kern County Resource Conservation District operates a Mobile Lab in Kern County. The contact person is Arturo Carvajal at (805) 861-4129.

Mission Resource Conservation District operates a Mobile Lab in San Diego County. The contact person is Robert Miller at (619) 728-1332.

CIMIS Grant Funds Help Start System Evaluation Programs

Rancho California Water District was awarded a CIMIS grant last year and these funds are helping growers in their service area with evaluations of irrigation systems. Other districts receiving CIMIS grants are also using these funds to start or upgrade their irrigation system evaluation programs. These districts include Central Modoc Resource Conservation District, East Valley Resource Conservation District, Imperial Irrigation District and Broadview Water District. For more information on these grant programs, contact Patti Seastrom, DWR, at (916) 322-3071.

Evaluation Course

To ensure that quality, standardized training on evaluating irrigation systems is available for Mobile Lab teams, as well as local water agencies' staff, irrigation consultants, and farming companies, DWR offers an Irrigation System Evaluation Short Course through California Polytechnic State University, San Luis Obispo. This course is 2-1/2 days, and costs $75.00. Because of the demand for this course, those interested are encouraged to register early. The course is offered twice a year; the next class will be held on September 10, 11 and 12, 1986. For more information on this course or the Mobile Lab Program, contact Keith Watkins at (916) 322-4326.

News Bits

There is a new weather station on line -- San Luis Obispo (Station No. 52). Data will be available from this station by May 1. New stations coming on line in the near future will be Greenfield (near Salinas) and Blackwells Corner (near Lost Hills).

Modified Demand

This program is described briefly in the 1985 Plan (page VI.24). It was suggested by the Water Conservation Advisory Board as a means of providing more flexibility for the water user. The trial was run during mid-1985 for a limited time on a selected zanjero run. The records for this trial have been entered into a computer for further analysis.

Leaching Requirement Study

As described on page VI.15 of the 1985 Plan, this program has two elements. The first is to quantify total flow from tile lines. Table 5.16 shows estimated tile drain discharge for 1984.

The second element is to quantify deep percolation. During the summer of 1985, approximately 2,400 samples were collected from fields, primarily those involved in the pumpback project. These samples have been analyzed and the results of about 1,500 tests entered into a computer data base for later interpretation. This program is being coordinated with the several other ongoing studies.

Public Meetings

Several public meetings relating to water conservation were held during 1985 and early 1986. Exhibit 5-9, consists of nine pages showing ads inserted in the Imperial Valley Press (IVP) between July 12, 1985, and March 27, 1986. The first was a full-page, complete copy of the July 8, 1985, Draft Memorandum of Understanding (MOU) between IID and Metropolitan Water District (MWD), which appeared in the newspaper on July 12, 1985. Secondly, a notice was published on September 3, 1985, announcing six public meetings regarding the proposed "water swap." These meetings were held as scheduled with attendance varying from 2 - 3 to over 50.

A Notice of Public Hearing by the Board of Directors on the Draft MOU was published three times in late September. The September 30, 1985, hearing was attended by over 100 people.

A public hearing was held by the Board on October 29, 1985. Notice of this meeting was published in the IVP on October 10, 1985.

IID 531 (R5 2-85)

Paid 8-23-85 JJ $1087.47

IMPERIAL IRRIGATION DISTRICT

ADVERTISING INSERTION ORDER

DATE July 10, 1985

NAME OF PUBLICATION Imperial Valley Press/Brawley News

ADDRESS P.O. Box 250 El Centro, CA 92244

ATTENTION: Nick Alvarado

PLEASE INSERT THE ATTACHED ADVERTISEMENT. PROOF is REQUIRED

PRIOR TO PUBLICATION, SUBMIT PROOFS TO PUBLIC INFORMATION AND COMMUNITY SERVICES, 333 EAST BARIONI BOULEVARD, P. O. BOX 937, IMPERIAL, CALIFORNIA 92251.

TYPE OF AD: DISPLAY XX CLASSIFIED

NUMBER OF INSERTIONS Once (1)

INSERTION DATES Friday, July 12, 1985

HEADLINE Draft Water Memorandum Dated July 8, 1985

PRODUCTION DATA:

SIZE Full Page

POSITION PREFERRED ROP

PHOTOENGRAVINGS SUPPLIED ART WORK

PASTE-UPS OFFSET PROOFS

PHOTOGRAPHS MATS

SPECIAL INSTRUCTIONS:

Ad copy is attatched. If you have any further questions, please contact Ron Hull at 339-9416. Thanks

ART WORK, PHOTOENGRAVINGS, AND/OR MATS ARE THE PROPERTY OF IMPERIAL IRRIGATION DISTRICT AND SHOULD BE RETURNED FOLLOWING PUBLICATION.

Linda L. Sanchez

PUBLIC INFORMATION & COMMUNITY SERVICES

BILLING INSTRUCTIONS

AFTER PUBLICATION SUBMIT STATEMENT IN DUPLICATE WITH PROOF OF PUBLICATION TO PUBLIC INFORMATION AND COMMUNITY SERVICES, IMPERIAL IRRIGATION DISTRICT, P. O. BOX 937, IMPERIAL, CALIFORNIA 92251.

FOR OFFICE USE ONLY

TYPE OF RATE COST OF AD $1,087.47

ORIGINATING DEPARTMENT Public Information/Community Services GENERAL LEDGER NO.

EXHIBIT 5-9

DRAFT (IID)
July 8, 1985

MEMORANDUM OF UNDERSTANDING BETWEEN THE IMPERIAL IRRIGATION DISTRICT AND THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

THIS MEMORANDUM OF UNDERSTANDING (Memorandum), made this ______ day of ____________, 1985, is intended to set forth in summary form the concept of an agreement (Agreement) to be entered into between the Imperial Irrigation District (Imperial) and The Metropolitan Water District of Southern California (Metropolitan). It is further the intention and understanding of the parties hereto that they will continue to negotiate in good faith to conclude at the earliest practicable date such an Agreement containing this concept:

RECITALS

1. Metropolitan and Imperial, along with Palo Verde Irrigation District (Palo Verde) and Coachella Valley Water District (Coachella), are each contractors with the United States for delivery of Colorado River water, as authorized by the Boulder Canyon Project Act.

2. Pursuant to the contracts, Palo Verde, the Yuma Project (California Division), Imperial and Coachella (collectively "the agricultural agencies") have the first three priorities to Colorado River water and are collectively entitled to 3.85 maf each year. The fourth and fifth priorities totaling

1,212,000 af per year are held by Metropolitan. The sixth priority of 300,000 af per year is held by Imperial, Coachella and Palo Verde. The seventh priority of all remaining water available for use within California is reserved for agricultural use in the Colorado River Basin within California, which includes the land within Imperial.

3. Imperial has present perfected rights, with a priority date of 1901, as defined in the Arizona v. California decrees.

4. After the Central Arizona Project commences operations, California may be limited to its basic apportionment of 4.4 maf a year by the Secretary of Interior. At that time, under the priority system, Metropolitan's dependable supply of Colorado River water will be reduced from 1,212,000 acre-feet per year to 550,000 acre-feet per year, less appropriate Indian Reservation and miscellaneous rights.

5. Imperial has undertaken water conservation improvements and measures and intends to undertake additional improvements and measures to its water delivery system, its operations, and the operations and systems of the members of its agricultural community. These improvements and measures can, pursuant to applicable law, make water available for diversion to Metropolitan.

6. Imperial contends that, as a result of applicable law, contracts and court decrees, Imperial can sell, lease, exchange or otherwise transfer water conserved by it to others outside of Imperial, including Metropolitan.

Metropolitan contends that, as a result of applicable law, contracts and court decrees, Imperial cannot sell, lease, exchange or otherwise transfer Colorado River water to users outside of Imperial's boundaries, and that such water is only available to California's other Colorado River contracting agencies including Coachella and Metropolitan in the order of their respective contract priorities.

7. Despite Imperial's and Metropolitan's divergent contentions, Imperial is desirous of assisting Metropolitan to meet the water needs of its member agencies on the Coastal Plain of Southern California, and Metropolitan is desirous of assisting Imperial in making better use of California's share of Colorado River water through funds provided by Metropolitan, and of obtaining a firm right to use a quantity of water which can be made available for Metropolitan's use as a result of Imperial's conservation efforts.

8. Without Imperial or Metropolitan waiving their respective contentions, the parties believe it to be in their mutual best interests to enter into an agreement containing the Agreement concept set forth herein.

AGREEMENT CONCEPT

1. The Agreement will contain the elements of this Memorandum. In addition, the Agreement will provide that Imperial and Metropolitan will negotiate in good faith toward the goal of concluding an additional agreement or agreements whereby Imperial may make additional quantities of water

available to Metropolitan as a result of Imperial's conservation program.

2. Imperial has created a Water Conservation Fund (Fund), all monies and interest of which shall be expended only for conservation improvements and measures such as studies, planning, development, design, construction, operation, repair and maintenance of water conservation improvements and measures and salinity control measures to mitigate any impact from the water conservation measures under the Agreement. At the request of Metropolitan, Imperial will submit to Metropolitan budgeting information and other documentation concerning the status and use of the Fund so that Metropolitan can examine and verify that all monies, and interest thereon, are expended for such conservation improvements and measures. However, Imperial shall maintain the sole discretion to determine what specific conservation improvements and measures will be established and financed by monies in the Fund.

3. Commencing January 1, 1988, Imperial shall make available for Metropolitan's use 100,000 acre-feet per calendar year of Colorado River water by its water conservation improvements and measures for a term set forth in Agreement Concept 6. However, during any year there is Colorado River water available for use in addition to Metropolitan's fourth and fifth priorities under its contract with the United States, the amount of such additional water shall be credited to Imperial's obligation to make 100,000 acre-feet

per year available for Metropolitan's use and deemed restored to the third priority for that year.

4. Except as otherwise provided in Agreement Concept 6, Metropolitan will make equal annual payments to Imperial's Fund on the dates and in the following amounts:

January 1, 1986	$10,000,000.00
January 1, 1987	$10,000,000.00
January 1, 1988	$10,000,000.00
January 1, 1989 and each January 1st thereafter until termination	$10,000,000.00 subject to an adjustment determined as follows: At such time that an additional Agreement is reached between Imperial and Metropolitan (Agreement Concept 1), a calculation will be made by dividing the annual contribution by Metropolitan to Imperial's Conservation Fund under such additional agreement by the quantity of water to be made available annually under such additional agreement. The resulting dollar per acre foot amount shall be multiplied by the 100,000 acre-feet per year made available under this Agreement to obtain an adjusted annual payment beginning on January 1 of the year following the effective date of the additional agreement. However, the adjusted annual payment shall not be less than $10,000,000.00.

Said payments thereon shall be used by Imperial only for water conservation improvements and measures as described in Agreement Concept 2. Such payments will assure Metropolitan 100,000 acre-feet of Colorado River water each year as provided herein and will be subject to proportionate reduction in accordance with the termination provisions of Agreement Concept 6. For an example, see Exhibit A.

5. Any additional water to be made available to Metropolitan from additional conservation measures and any changes in annual payments by Metropolitan shall be the subject of supplements or amendments to the Agreement or of an additional agreement or agreements. It is the objective of the parties that such supplements, amendments or agreements will provide that water will be made available for Metropolitan's use in addition to the initial 100,000 acre-feet provided for in Agreement Concept 3. However, neither party shall be obligated to enter into any such supplements, amendments or agreements.

6. Year one of the Agreement shall be 1988. The Agreement shall be for a minimum term of 35 years, and shall continue thereafter until the right to divert all the water made available to Metropolitan pursuant to the Agreement is terminated. Imperial may terminate all or any part of Metropolitan's right to divert and use the conserved water by giving a 15-year notice on or after the end of year 20 of the Agreement. Upon receipt of any such 15-year notice, Metropolitan will no longer be obligated to make the annual payments associated with that quantity of water during the last seven years of such notice. For an example, see Exhibit A.

Metropolitan shall have the right to terminate all or any part of the Agreement by giving a 15-year notice on or after the end of year 20 of the Agreement.

7. Metropolitan shall not own any of Imperial's water or Imperial's water rights but shall have the right,

subject to the provisions of the Agreement, to use a specific quantity of water that has been conserved by Imperial. Metropolitan shall have no ownership or contract rights in any water conservation facilities or projects installed or operated pursuant to the Agreement.

8. This Memorandum and the Agreement shall not be binding upon Imperial or Metropolitan unless Palo Verde, Coachella and the Secretary of Interior give their written approval of these documents. Such approval shall specifically include a reduction of the 3.85 maf per calendar year maximum diversion rights of the agricultural agencies to 3.75 maf per calendar year, subject to the termination provisions set forth in Agreement Concept 6 and further subject to the additional water provisions of Agreement Concept 3. Metropolitan shall have the responsibility, with Imperial's cooperation, for obtaining the approval. Unless such approval is first obtained, Imperial shall not be obligated to make water available for Metropolitan's use and Metropolitan shall not be obligated to make the payments provided for herein.

9. Nothing contained in this Memorandum or the Agreement is intended or shall be construed to affect, alter, or in any way limit or restrict the rights held by either party by contract or law to divert or use Colorado River water except as will be specifically set forth in the Agreement.

10. This Memorandum and the Agreement shall be binding upon and inure to the benefit of the parties hereto

and their successors and assigns. No party may assign or transfer its rights or obligations under this Memorandum and/or the Agreement without the prior written consent of the other party hereto; however, Imperial may assign its rights under this Memorandum and/or the Agreement as security for any water conservation financing Imperial might obtain in carrying out this Memorandum and the Agreement.

THIS MEMORANDUM OF UNDERSTANDING was approved by the Board of Directors of the Imperial Irrigation District on ________________, 1985 and by the Board of Directors of The Metropolitan Water District of Southern California on ________________, 1985.

IMPERIAL IRRIGATION DISTRICT

By________________________
President

APPROVED AS TO FORM:

____
J. PENN CARTER
Chief Counsel

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

By________________________
President

APPROVED AS TO FORM:

____
WARREN J. ABBOTT
General Counsel

EXHIBIT A

Agreement Concept No. 4

*Example: Assume second agreement for an additional 150,000 acre-feet per year for annual payment of $16,500,000 for related water conservation purposes. Adjusted annual payment for the 100,000 acre-feet of the first agreement equals:

$$\frac{\$16,500,000}{150,000} \times 100,000 = \$11,000,000 \text{ per year.}$$

Total annual payment would then become $27,500,000 for 250,000 acre-feet per year.

Agreement Concept No. 6

**Example: Assume that Imperial has given proper notice that it wants to recover 60,000 acre-feet a year in year 2025, and that the annual payment under the first agreement to the Water Conservation Fund for all related water conservation purposes has escalated to $12,000,000/yr. The revised annual payment equals:

$$\$12,000,000 \times \frac{40,000}{100,000} = \$4,800,000\text{/yr.}$$

IMPERIAL VALLEY PRESS, SEPTEMBER 3, 1985

PUBLIC MEETINGS

DURING THE LAST FOUR WEEKS THE IMPERIAL IRRIGATION DISTRICT HAS BEEN BROADCASTING SEVERAL KEY QUESTIONS ABOUT THE PROPOSED "WATER SWAP" BETWEEN IMPERIAL IRRIGATION DISTRICT AND THE METROPOLITAN WATER DISTRICT, BECAUSE WE WANT YOU TO HAVE THE FACTS.

NOW IT IS TIME FOR YOU TO EXPRESS YOUR OPINIONS, SUGGESTIONS OR CRITICISMS OF THE PROPOSAL. PUBLIC MEETINGS WILL BE HELD IN YOUR COMMUNITY IN SEPTEMBER AS FOLLOWS?

DATE	TIME	LOCATION
September 5, 1985	5:30 p.m.	The Gold Room De Anza Hotel 233 Fourth Street Calexico, CA
September 9, 1985	7:30 p.m.	The Farm Bureau 1000 Broadway Avenue El Centro, CA
September 10, 1985	5:30 p.m.	La Reata Cafe 119 E. Main Street Calipatria, CA
September 12. 1985	5:30 p.m.	Imperial Lions Club 609 South "F" Street Imperial, CA
September 18, 1985	5:30 p.m.	Brawley Stockman's Club 275 South Marjorie Avenue Brawley, CA
September 23, 1985	5:30 p.m.	J & M Cafe 540 East 5th Street Holtville, CA

DISTRICT WATER POWER

IMPERIAL IRRIGATION DISTRICT

Imperial Irrigation District

Ad copy to run:

SEPTEMBER 23, 26, and 28, 1985

NOTICE OF PUBLIC HEARING

THE BOARD OF DIRECTORS OF IMPERIAL IRRIGATION DISTRICT WILL CONDUCT A PUBLIC HEARING CONCERNING THE DRAFT MEMORANDUM OF UNDERSTANDING BETWEEN IMPERIAL IRRIGATION DISTRICT AND THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA.

THE HEARING IS SCHEDULED FOR:

7:00 P.M., MONDAY

SEPTEMBER 30, 1985

IMPERIAL IRRIGATION DISTRICT AUDITORIUM

1285 BROADWAY AVENUE

EL CENTRO, CALIFORNIA

IMPERIAL IRRIGATION DISTRICT

NOTICE OF PUBLIC HEARING

El Centro, California
October 29, 1985
9:00 a.m.

IVP 10/10/85

Imperial Irrigation District proposes to enter a Water Transfer Memorandum of Understanding between the Imperial Irrigation District (Imperial) and Metropolitan Water District (Metropolitan). Imperial has undertaken water conservation improvements and measures and intends to undertake additional improvements and measures to its water delivery system, its operations, and the operations and systems of the members of its agricultural community. These improvements and measures can, pursuant to applicable law, make water available for diversion to Metropolitan.

Imperial has created a Water Conservation Fund, all monies and interest of which shall be expended only for conservation improvements and measures, such as studies, planning, development, design, construction, operation, repair and maintenance of water conservation improvements and measures and salinity control measures to mitigate any impact from the water conservation measures under the proposed Memorandum of Understanding. Commencing January 1, 1988, Imperial shall make available for Metropolitan's use 100,000 acre-feet (af) per calendar year of Colorado River water by its water conservation improvements and measures for a term specified in the proposed Memorandum of Understanding.

Except as otherwise provided in the proposed Memorandum of Understanding, Metropolitan will make equal payments to Imperial's Fund in the amount of $10,000,000 annually. These payments shall be used by Imperial only for water conservation improvements and measures. Such payments will assure Metropolitan 100,000 af of Colorado River water each year as provided in the proposed Memorandum of Understanding and will be subject to proportionate reduction in accordance with the termination provisions. The proposed Memorandum of Understanding shall be for a minimum term of 35 years and shall continue thereafter until the right to divert all the water made available to Metropolitan is terminated. Any additional water to be made available to Metropolitan from additional conservation measures and any changes in annual payments by Metropolitan shall be the subject of supplements or amendments to an agreement to be entered into by the parties.

The project will have no significant effect on the environment.

This is notice that a Negative Declaration under Local Guidelines implementing the California Environmental Quality Act will be considered for approval at the October 29, 1985 regular meeting of the Board of Directors.

The environmental documents have been filed with the Secretary to the Board of Directors and are posted and available for public review at the executive offices of Imperial Irrigation District at 1284 Main

IMPERIAL IRRIGATION DISTRICT
ENVIRONMENTAL IMPACT REPORT ADVERTISMENT

AD SIZE: APPROXIMATLY 2 col. x 5 inches Imperial Valley Press

AD COPY TO RUN: ~~January 30, 1986~~ January 25, 30th & February 4, 1986

NOTICE OF PUBLIC MEETING

IMPERIAL IRRIGATION DISTRICT PUBLIC MEETING

ON THE ENVIRONMENTAL IMPACT REPORT

PREPARATION FOR WATER CONSERVATION

AND TRANSFER PROGRAM

7:00 p.m.

WEDNESDAY, FEBRUARY 5, 1986

Imperial Irrigation District Auditorium
1285 Broadway Avenue
El Centro, California

PURPOSE: To provide and receive information about the preparation of the Environmental Impact Report on the Imperial Irrigation District's water conservation plan and transfer program and to receive public comments, and concerns, which should be addressed in the environmental study.

IMPERIAL IRRIGATION DISTRICT

NOTICE OF PUBLIC MEETING

IMPERIAL IRRIGATION DISTRICT AUDITORIUM

1285 BROADWAY AVENUE

EL CENTRO, CALIFORNIA

MARCH 27, 1986

7:30 P.M.

A PUBLIC MEETING HAS BEEN SCHEDULED FOR A PRESENTATION BY BOB DAVIDSON AND MEL BROWN OF THE PARSONS WATER RESOURCES, INC., CONCERNING AN OVERVIEW OF THE PARSONS CORPORATION AND ACCOMPLISHMENTS FOR IMPERIAL IRRIGATION DISTRICT.

IMPERIAL IRRIGATION DISTRICT

"Facing The Future . . . Proud of Our Past"

IV Press 3/25/86
Also in I.V. Weekly and Holtville Tribune

During early 1986, two public meetings were held, the first being on February 5, 1986, to receive input on preparation of the Environmental Impact Report (EIR) on the District's water conservation plan and transfer program. The second meeting, held on March 27, 1986, was for presentation by Parsons Water Resources concerning that company's accomplishments on behalf of the District. Notices of these meetings were published in Imperial Valley newspapers.

The Board has made every effort to inform District constituents of its water conservation plan and related programs. As a result, the Board has responded to public concerns and has put aside the MOU, although negotiations with MWD for a new agreement have continued. Public involvement will continue as the EIR moves toward final adoption. This Update is a further effort by the District to keep interested persons advised of the District's ongoing water conservation program.

Incentives

Since the 1985 Plan was accepted by the Board, and during several of the public meetings, the suggestion was made that the District should share the benefits of any possible outside funding directly with water users. The District has offered the irrigation scheduling program for several years as a free service to a limited number of water users.

The Water Conservation Advisory Board, on March 6, 1986, appointed a committee to develop a workable and practical incentive program which water users will use to conserve water.

The committee was to work with representatives of the District and Parsons Water Resources in this task to identify all possible incentive alternatives and select the most logical and practical. The incentives can be either direct payments or in the form of reduced water rates to eligible water users.

The committee met regularly during March and April to develop a list of incentives, and to evaluate each of them for fairness, effectiveness, costs, and other parameters. The goal of the committee is to prepare recommendations for submittal to the Advisory Board in July 1986.

SECTION 6

Summary

This Update presents a listing and description of the several components of the District's continuing water conservation programs, being undertaken in accordance with the 1985 Water Conservation Plan. In fact, during 1985, the largest conservation program carried out to date was accomplished. Even then several planned programs were only started, and others had to be deferred, such as construction of the Trifolium Reservoir, due to problems such as acquiring rights-of-way, completing environmental documentation, and concern about available funds. This deferment was partially offset by expanding the concrete lining program, however.

The several important programs relating to improving and expanding water measurements are well underway. One of the important elements of these programs has been the purchase and installation of electronic water-level recorders. It is anticipated that this type of equipment, from which data can be processed through computers, will replace the chart-type recorders used for many decades as the standard instrument for obtaining continuous records so necessary for accurate determination of flows, deliveries and losses. The goal of water conservation is to reduce losses, therefore, losses both before and after conservation measures are implemented must be determined with greater accuracy than that offered by historical records.

Until outside funding is available, it is recommended that the current level of effort in water conservation continue with emphasis on expanding and improving the data base, planning, and construction of physical works such as concrete lining as limited funds allow.