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State of California
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DEPARTMENT OF WATER RESOURCES
Southern District

PRELIMINARY EVALUATION OF POTENTIAL FOR AGRICULTURAL WATER CONSERVATION IN IMPERIAL IRRIGATION DISTRICT'S CONVEYANCE AND DISTRIBUTION SYSTEM

by

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This Technical Information Record describes the results of Imperial Irrigation District's water conservation efforts, presents information on additional savings anticipated from their program, and identifies areas where additional off-farm savings may be realized. Effects of conservation are described and some constraints inhibiting conservation are mentioned.

The findings of this TIR have not been fully reconciled with all technical aspects of the total investigation, which will be fully reviewed when all phases of the investigation have been completed. Hence, this TIR is only for internal office use and should be considered as preliminary and subject to revision.

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I. INTRODUCTION

Objectives

The objectives of this investigation were: to determine methods used by Imperial Irrigation District (IID) to achieve agricultural water conservation in its conveyance and distribution system (the off-farm system only) and amounts of water saved; to determine additional ways of conserving water and, if possible, estimate amounts to be saved; and to describe beneficial and detrimental effects of implementing agricultural water conservation in IID.

Scope

The study area is the water service area of IID (Figure 1).

Only the component of agricultural water conservation that can be achieved in the off-farm portion of the IID system is considered. The off-farm portion of the system includes the All-American Canal, the southeast part of the Coachella Canal, and other main canals and lateral canals operated by IID to deliver water at farmers' headgates and the IID drain system.

The information presented is based principally on data from IID and Department of Water Resources files and is supplemented by information obtained in meetings with IID staff and water users and experts involved in agricultural research in Imperial Valley. Some review of literature has been made and any specific information therefrom is referenced.

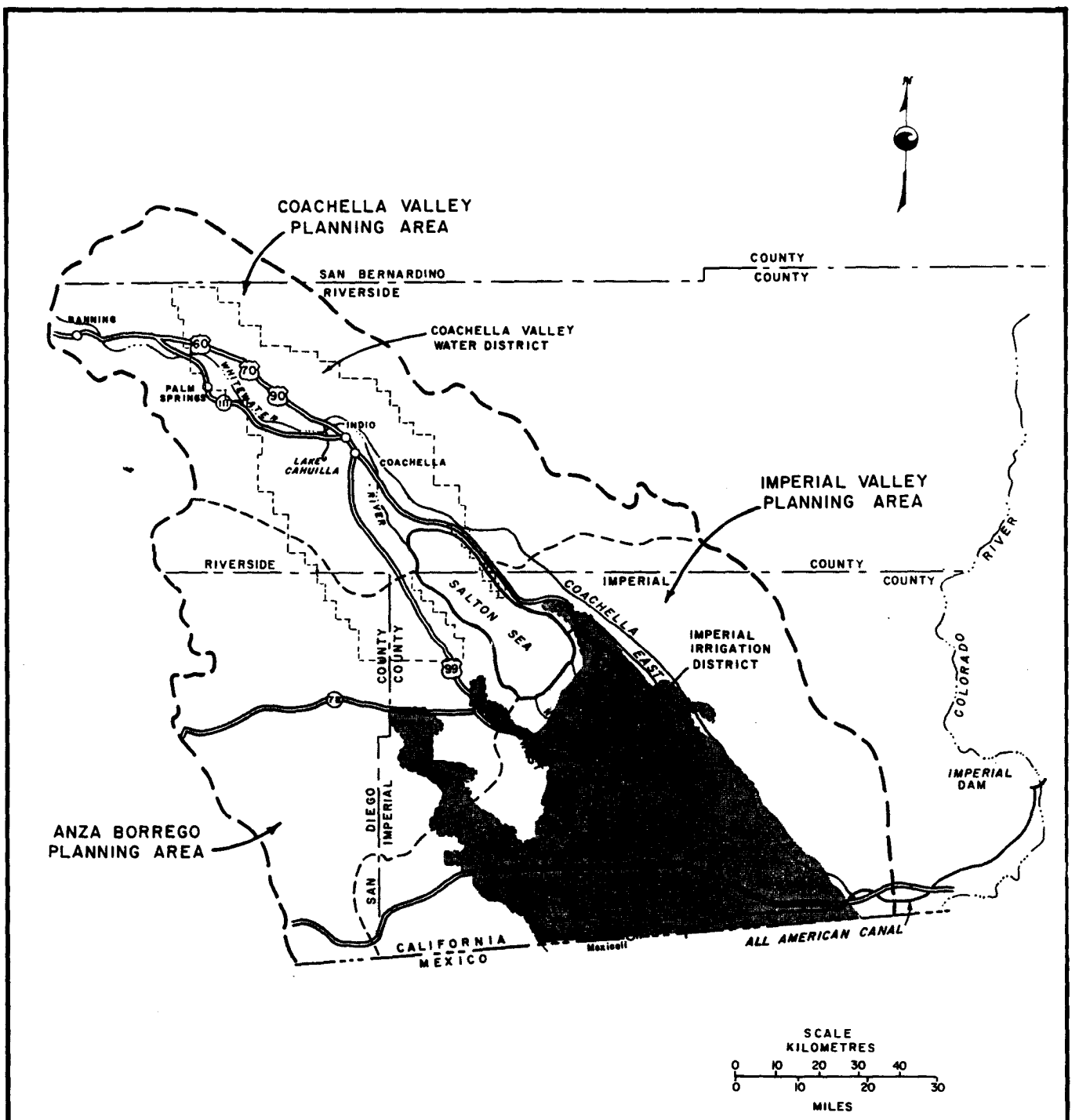

Figure 1 – LOCATION OF THE IMPERIAL IRRIGATION DISTRICT IN RELATION TO THE COACHELLA AND IMPERIAL VALLEYS

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1981

II. FACILITIES AND OPERATION

Historical Development (7, 9)*

The California Development Company (C. D. Company) was formed in 1896 to reclaim Imperial Valley with Colorado River water, using as its basis water filings made by some individuals in the 1890s which had been assigned to the C. D. Company.

Excavation of a canal to convey Colorado River water to the Valley began in August 1900. The point of diversion from the Colorado River was constructed near Pilot Knob, a short distance north of the United States-Mexico border. From the diversion point, construction of the canal continued southward, paralleling the river into Mexico for a distance of 6 to 8 kilometres (4 to 5 miles). At that point, the canal swung westward for a distance of 5 kilometres (3 miles) where it connected with the Alamo River channel. This natural channel was then modified and used as a canal. For the next 64 kilometres (40 miles), the canal passed through Mexico, then reentered the United States where the Alamo River turned northward to the Salton Sea. Imperial Valley received its first water through the canal in June 1901.

In 1911, IID was formed under the California Irrigation District Act to acquire the properties and rights of the C. D. Company, and in 1916, IID acquired the C. D. Company's properties from the Southern Pacific Company, which had bought the insolvent company earlier that year.

The need for an "All-American" canal north of the border was apparent, since Imperial Valley had little security in its water supply and little protection from floods, with its main canal and levees in Mexico.

IID negotiated an agreement with the Bureau of Reclamation in which the Bureau agreed to investigate the need for an All-American Canal. The

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* Numbers in parentheses refer to references in Appendix A.

Bureau reported that such a canal would be impractical without a dam to control flooding and in 1919 issued a report recommending an All-American Canal and government construction of a storage reservoir on the Colorado River.

The result was passage of the Boulder Canyon Project Act in December 1928, which authorized construction of Boulder Dam (now Hoover Dam), Imperial Dam, and the All-American Canal. Construction of the main All-American Canal commenced in August 1934, work on Imperial Dam was begun in 1936 and completed in 1938. Work on the Coachella Canal, a branch of the All-American Canal, was initiated in 1938. Construction of the Coachella Canal was stopped in 1942, but work was resumed in 1944, and it was completed on June 26, 1948. Partial service through the All-American Canal had started on October 12, 1940, and full service began on February 10, 1942.

The Bureau built the All-American Canal at a cost to the IID of more than $25 million. Since 1942 this canal has been the major source of water for agricultural use in Imperial Valley and has also provided large amounts of water for agricultural use in Coachella Valley.

All-American Canal System

The All-American Canal system located in the southeastern corner of California is a gravity-flow system which consists of the Imperial Dam, some 32 kilometres (20 miles) north of Yuma, Arizona, the All-American Canal headworks and desilting basins, the All-American Canal, Coachella Canal, and appurtenant structures.

The IID has constructed four major hydroelectric power plants, one each at Pilot Knob Check and at Drop Nos. 2, 3, and 4 on the All-American Canal, and two smaller ones on the distribution system.

The desilting works were installed below the headworks at the west end of the Imperial Dam to remove silt that would reduce the capacity of conveyance facilities, interfere with operations, and clog sprinkler irrigation systems. These works consist of: (1) six settling basins arranged in pairs and equipped with 12 rotating scraper mechanisms to collect and remove silt that settles out of the water and (2) pumps which return the silt and water to the river channel.

Since the completion of Hoover Dam and other river control structures, sediment loads arriving at Imperial Dam have been substantially reduced. The silt still arriving at Imperial Dam is the result of rains below Parker Dam and the scouring of the riverbed and banks.

In 1978, desilting operations resulted in the removal of 474 000 tonnes (523,000 tons) of sediment from the water prior to diversion into the All-American Canal. The silt and about 210 000 cubic dekametres (170,000 acre-feet) of water used in desilting operations were returned to the Colorado River.

The All-American Canal system conveys Colorado River water to facilities of the IID; Coachella Valley Water District (CVWD), formerly Coachella Valley County Water District; and the Yuma Project (Reservation Division) for distribution.

The dam, headworks, and desilting works can supply 430 cubic metres (15,200 cubic feet) per second of water to the All-American Canal on the California side of the Colorado River and 62 cubic metres (2,190 cubic feet) per second to the Gila Gravity Main Canal on the Arizona side of the Colorado River.

In 1978, the system diverted water from the Colorado River to irrigate 229 000 hectares (567,000 acres) of crops (including duplicate crops)

in the Imperial Valley and 24 600 hectares (60,800 acres) in the Coachella Valley plus land in the Yuma Project. Table 1 shows the total amounts conveyed below Pilot Knob in 1979 for IID and CVWD (Appendix B gives more details).

As of 1978, IID operated and maintained 2 830 kilometres (1,760 miles) of conveyance and distribution facilities to carry water westward and northward from the Colorado River to the Imperial and Coachella Valleys. The main facilities include the 129-kilometres (80-mile) long All-American Canal, which terminates west of Calexico, its branches (listed from east to west) which carry water north, the East Highline Canal, the Central Main Canal, and the Westside Main Canal. IID operates the southern 79 kilometres (49 miles) of the 198-kilometres (123-mile) long Coachella Canal.

IID also operates and maintains 2 339 kilometres (1,454 miles) of drains to collect irrigation return flow. Table 2 lists IID's conveyance and collection facilities (Appendix C has more details).

IID's gross order delivery at Station 60, about 1.6 kilometres (1 mile) downstream from Imperial Dam, includes requirements for the Yuma Project and Imperial and Coachella Valleys and, at times, Treaty (18) water for Mexico. The treaty water is carried in the All-American Canal and returned to the river through Pilot Knob Hydroelectric Plant.

IID operational data for 1955 through 1979 are listed in Table 3.

TABLE 1
DIVERSIONS BELOW PILOT KNOB FOR
IID AND CVWD, 1979

	In cubic dekametres	In acre-feet
Imperial Irrigation District	3 507 700	2 843 700
Imperial Irrigation District Pilot Knob Powerplant	689 700	559 100
Coachella Valley Water Dstrict (formerly Coachella Valley County Water District)	645 600	523 400
Total	4 843 000	3 926 200

TABLE 2
IID'S IRRIGATION WATER CONVEYANCE
AND COLLECTION FACILITIES

	In kilometres	In miles
Canals		
All-American Canal[5]	129	80
New Briar Canal[5]	5	3
Coachella Canal (IID portion)[15]	79	49
East Highline Canal[2][9]	80	50
Central Main Canal[2][9]	43	27
Westside Main Canal[2][9]	72	45
Other canals and laterals	2 422	1,505
	2 830	1,759
Drains*		
All-American Canal drains[5]	83	52
Other main drains and lateral drains[5]	2 256	1,402
	2 339	1,454

*The drains collect water farmers cannot utilize, tailwater, and drainage from 39 700 kilometres (24,700 miles) of on-farm subsurface tile drains.

TABLE 3

IMPERIAL IRRIGATION DISTRICT OPERATIONAL DATA, 1955-79

Year	Imperial Dam to Pilot Knob Total water	Total loss**	Pilot Knob to Drop No. 1*** CVWD diversion	CVWD loss	IID loss	Water received by IID at Drop 1	Total deliveries to users	Operational losses	Conveyance system efficiency (%)
				in thousand acre-feet*					
1955	3,582	186	572	82		2,927	1,961	966	67.0
1956	3,563	161	548	109		2,907	2,012	895	69.2
1957	3,377	167	498	97		2,782	1,949	833	70.1
1958	3,288	155	492	65		2,731	1,941	790	71.1
1959	3,401	102	493	68		2,840	2,045	795	72.0
1960	3,566	102	493	88		2,984	2,178	806	73.0
1961	3,558	124	508	92		2,957	2,196	762	74.2
1962	3,571	136	554	10	55	2,951	2,224	727	75.4
1963	3,600	166	525	12	71	2,991	2,285	707	76.4
1964	3,319	101	503	8	37	2,770	2,399	372	86.6
1965	3,203	60	502	13	64	2,624	2,312	312	88.1
1966	3,366	58	468	12	68	2,818	2,470	348	87.7
1967	3,226	77	447	9	50	2,720	2,365	354	87.0
1968	3,338	70	463	10	58	2,806	2,476	330	88.2
1969	3,200	76	479	7	39	2,676	2,352	324	87.9
1970	3,251	55	434	9	53	2,755	2,418	336	87.8
1971	3,405	50	457	9	55	2,884	2,535	349	87.9
1972	3,405	54	491	10	57	2,847	2,531	315	88.9
1973	3,520	67	503	9	53	2,956	2,670	286	90.3
1974	3,685	78	540	11	61	3,072	2,777	295	90.4
1975	3,613	81	557	9	46	3,001	2,704	298	90.1
1976	3,348	95	506	10	48	2,784	2,515	268	90.4
1977	3,216	103	494	5	24	2,693	2,455	238	91.1
1978	3,216	75	493	9	43	2,672	2,441	231	91.3
1979	3,367	84	515	8	41	2,803	2,571	232	91.7

*Rounded to the nearest 1,000. One acre-foot = 1.2335 cubic dekametres; conveyance system efficiency = operational losses ÷ total deliveries to users.

**Colorado River System Reservoir loss

***1955-1961 CVWD and IID water losses are not available separately

SOURCE: Imperial Irrigation District. Annual Summary, Water Diversion, Transportation, Distribution and Drainage, United States and Mexico 1955-1979.

Imperial Irrigation District's Operational Procedures[1/]

IID orders water from the U. S. Bureau of Reclamation (USBR) for the approximately 5,500 farm headgates which it serves. IID must place its order 6 to 11 days before the water is needed.[2/]

IID's activities with USBR are closely related with the irrigation needs of the farmers within their service area. IID's policy has been to require the farmers to notify them at least 24 hours in advance as to the amount of water needed for their irrigation operations. Delivery of the water can be expected between 24 and 72 hours after this request.[3/]

The Water Control Section of the IID, under the supervision of the Watermaster, is responsible for distribution of water into the main and lateral canal systems.

IID's hydrographers are in charge of the releases of water to the main laterals. The hydrographers may release more than is ordered to ensure that all the farmers needing water will have enough.[4/]

Zanjeros (canal headgate tenders) employed by IID are in charge of the lateral canal releases. They start releases early in the morning and return to the field in the afternoon to make adjustments. Although IID's policy is to deliver water in 24-hour increments only, it has established provisions to allow deviations.[5/]

1/ Information in this section, which was derived in discussions at various meetings, is confirmed by depositions on file in the offices of the law firm of Sutherland and Gerber in El Centro. Among those making these depositions were one or more persons in each of the following categories: IID management, IID zanjero director, IID zanjeros, and farmers who are IID customers

2/ Robert F. Carter, General Manager of IID. Proceedings of the Agricultural Water Conservation Conference. June 23-24, 1976. Davis, California.

3/ Lee Hermsmeier, U. S. Department of Agriculture, Agricultural Research Service. Personal interview. August 18, 1979.

4/ Doug Welch and Gary Doshier, U. S. Department of Agriculture, Soil Conservation Service. Personal interview. August 24, 1979.

5/ IID Water Conservation Advisory Board. Personal interview. August 9, 1979

IID has limited capability to take back excess water when a grower orders too much or is unable to use his full allocation. The capability depends on the type of delivery operation, location of the field, and requests by other growers who may want to take the water. Often the system is unable to absorb this excess, and the water is lost at the end of the canal or field, consequently flowing into drains which ultimately convey most of it into the Salton Sea, although some drain water is pumped back to canals.

The problem of canal spillovers (excess water at the end of a canal or lateral) is prevalent on the east side of the valley between the Alamo River and the East Highline Canal, where laterals parallel one another in an east-west direction. In the southeastern portion of IID, the canals and laterals are designed so that excess water from one will spill over into another. The drains and canals are generally 0.8 kilometre (0.5 mile) apart.

Canals are emptied once a month[6/] or once in 2 months[7/] for maintenance, repair, cleaning, and weed control purposes. These "cutouts" are generally for a three- to five-day period. Water users are notified by mail 10 to 11 days prior to the date of each canal cutout. Growers may take delivery of the water destined to be drained from the canal free of charge. Some growers rely on this water on a regular basis to conduct "finish irrigations".[8/] District personnel and growers believe draining these canals on a periodic basis is essential to keep the water distribution system clear of algae and debris.

6/ U. S. District Court, Southern District of California. Salton Bay Marina, Inc., a California Corporation, et al., Plaintiffs, vs. Imperial Irrigation District, a Public Irrigation District, et al., Defendants. Deposition of James C. Luker. No. 76-1095-T, October 12, 1979. pp. 38-39.

7/ Imperial Irrigation District: Water Conservation Advisory Board. 21-Point Water Conservation Program for the Imperial Irrigation District. Community and Special Services, El Centro. October 1, 1980.

8/ Charles Westmoreland, Imperial Valley Grower, Imperial. Statement made at El Centro Farm Bureau Meeting. November 26, 1980.

III. DIVERSIONS AND LOSSES

Water losses within the IID system can be attributed to several factors: (1) evaporation and seepage losses in the conveyance and distribution system, (2) unaccounted for losses, (3) water dumped because the farmers do not take it, (4) water allowed to run off the irrigated farmland, and (5) seepage and evaporation losses in farm ditches.

The first three categories involve off-farm losses, the last two involve on-farm losses and are discussed in another TIR.

Conveyance Losses

Seepage and evaporation losses from canals are usually considered together under the term conveyance losses. The conveyance losses usually vary directly with the area of the wetted surface of the canal.

Seepage will vary depending upon the capacity, length, and condition of the canals, laterals, and on-farm ditches. (Seepage in farm facilities and irrigation runoff are considered elsewhere, as is stated above.) Seepage losses from pipe and lined canals or laterals are significantly less than losses from unlined facilities. Such losses can be partially recovered by pumping or drainage collection. Part of the unrecovered portion of the seepage loss supports phreatophyte vegetation for wildlife habitat, while some returns to the Colorado River.

Evaporation losses cannot be recovered, but they can be reduced by removing vegetation from canal banks. Evaporation losses in the All-American and Coachella Canals have been estimated to be about three percent of seepage losses (16).

Table 4 shows total amounts conveyed in the All-American Canal, diversions from it to the main canals, and losses assigned to it for 1979.

TABLE 4
WATER DIVERSIONS AND ALL-AMERICAN CANAL LOSSES IN 1978
In acre-feet[a/]

	Diversions	Losses	Remainder in All-American Canal
All-American Canal Diversion at Imperial Dam			5,185,600
Yuma Project	421,100[b/]		
Above Pilot Knob			4,764,500
Imperial Dam to Pilot Knob		83,700[c/]	
			4,680,800
Pilot Knob Powerplant	1,313,700		
Below Pilot Knob Powerplant			3,367,100
Coachella Branch for CVWD	515,300		
			2,851,800
Pilot Knob to Drop No. 1			
CVWD		8,100[d/]	2,843,700
IID		40,600[e/]	
Below Drop No. 1 (for IID only)			2,803,100
To IID above East Highline Check	1,209.900		
			1,593,200
Drop No. 1 to East Highline Check		7,800[e/]	
Below East Highline Check			1,585,400
To IID, East Highline Check to Westside Main Canal	1,573,200		
			12,200
East Highline Check to Westside Main Canal		12,200[e/]	
Below Westside Main Canal			0
Total	5,033,200	152,400	

a/ Multiply by 1.2335 to obtain cubic dekametres; numbers are rounded to 100.
b/ In addition, the Yuma Project is charged for 930 800 cubic dekametres (754,600 acre-feet) that flows through the Pilot Knob Powerplant and an unknown portion of the 103 200 cubic dekametres (83,700 acre-feet) of losses between Imperial Dam and Pilot Knob.
c/ Charged to Colorado River System Reservoir
d/ Charged to CVWD
e/ Charged to IID

In addition to the IID losses in the All-American Canal shown in the table, other losses within its system include those: (1) from the main canals, 9 100 cubic dekametres (7,400 acre-feet) of operational losses and 98 000 cubic dekametres (79,400 acre-feet) of unaccounted for losses and (2) from the lateral canals, 144 700 cubic dekametres (117,300 acre-feet) of conveyance losses and 10 000 cubic dekametres (8,100)acre-feet) of operational losses. Some portions of these losses were recovered, as previously mentioned.

As shown in Table 4, total diversions at Imperial Dam in 1979 amount to 6 396 400 cubic dekametres (5,185,600 acre-feet). Included in this amount are diversions for the Yuma Project. Allocations for this project are as follows: 519 300 cubic dekametres (421,000 acre-feet) for the project itself and 930 800 cubic dekametres (754,600 acre-feet) charged to the project for the Pilot Knob Hydroelectric Powerplant. Conveyance loss from Imperial Dam to Pilot Knob Powerplant plus water diverted through the Pilot Knob Hydroelectric Plant totaled 1 723 700 cubic dekametres (1,397,400 acre-feet) for 1979.

Net diversions to IID and CVWD are measured at Pilot Knob, not at Imperial Dam. Below Pilot Knob on the All-American Canal, the total water available for diversion in 1979 was 4 153 300 cubic dekametres (3,367,100 acre-feet).

Of the total water available for diversion below Pilot Knob Check, 635 600 cubic dekametres (515,300 acre-feet) was diverted from Drop No. 1 structure to Coachella Canal for CVWD. Between the reach of Pilot Knob Check to Drop No. 1 structure, the seepage losses were about 60 100 cubic dekametres (48,700 acre-feet); of these, 10 000 cubic dekametres (8,100 acre-feet) were assigned to CVWD, making a total of 645 600 cubic dekametres (523,400 acre-feet) conveyed for CVWD, plus an unspecified share

of the 105 300 cubic dekametres (83,700 acre-feet) of water identified as Colorado River System Reservoir losses (the amount lost between Imperial Dam and Pilot Knob).

All water diverted below the Drop No. 1 structure on the All-American Canal is for use by IID. In 1979, total diversion and losses below Drop No. 1 were 3 457 600 cubic dekametres (2,803,100 acre-feet), an increase of 161 600 cubic dekametres (131,000 acre-feet) from 1978.

This amount included: (1) 1 492 400 cubic dekametres (1,209,900 acre-feet) diverted to the East Highline Canal plus 9 600 cubic dekametres (7,800 acre-feet) of seepage losses from Drop No. 1 to the East Highline Canal turnout, and (2) 1 940 500 cubic dekametres (1,573,200 acre-feet) diverted to the Westside Main Canal plus 15 000 cubic dekametres (12,200 acre-feet) of seepage losses from the East Highline Canal to the Westside Main Canal turnout.

IID estimates that 90 percent of the total volume of water diverted to the District is delivered to users; the other 10 percent of the diversion represents losses. In 1979, IID delivered 3 171 200 cubic dekametres (2,570,900 acre-feet) to users.

Irrigation Efficiency

Irrigation efficiency for IID can be determined by using the following equation:

$$\frac{\text{Total water delivered to farms for irrigation less total drainage to Salton Sea (ET)}}{\text{Total water delivered to farms for irrigation (applied water)}} \times 100.$$

Using average values for the 1975-79 period, irrigation efficiency for IID is calculated as follows:

Total flow to the Salton Sea less water from Mexico = 1 324 000 dam^3 (1,073,000 acre-feet).

Total water delivered to farms for irrigation = 3 129 000 dam^3 (2,537,000 acre-feet).

$$\text{Irrigation Efficiency} = \frac{3\ 129\ 000\ dam^3 - 1\ 324\ 000\ dam^3}{3\ 129\ 000\ dam^3} \times 100,$$

$$= 58 \text{ percent.}$$

Allowing 2 percent for storm runoff and seepage losses to drains, the irrigation efficiency for IID would then be 60 percent. This figure closely approximates that obtained by calculating irrigation efficiency from ET estimates provided by Kaddah and Rhoades. 9/

Langley, using U. S. Bureau of Reclamation (USBR) ET estimates, concluded that irrigation efficiency for IID ranged from 65 to 73 percent for the 1975-79 period. 10/ His calculations were based on estimated ET values rather than actual ET.

The difference in reported irrigation efficiencies can be traced to the ET values used in the computations. The lack of accurate field-tested ET values for all the crops grown in the District results in different estimates of irrigation efficiency.

The on-going "Water Conservation Opportunities Study, Imperial Irrigation District" by the USBR should try to resolve the problem of questionable crop ET values, as well as measuring tailwater flows and identifying proper leaching requirements for Valley crops. Solutions to each of these problems would permit a more accurate determination of irrigation efficiency for the District.

9/ Kaddah, M. T. and Rhoades, J. D. "Salt Balance in Imperial Valley, California". Soil Science Society of America Journal. Vol. 40. 1976.

10/ "Affidavit of Maurice N. Langley..." in Civil Action No. 76-10957 in the U. S. District Court. (No date).

Unaccounted for Losses

Another kind of loss, although negligible, is the water siphoned by the local farmers living along the All-American Canal on the Mexican side of the border. These farmers use regular garden hose with diameters ranging from 1-1/4 to 2-1/2 centimetres (1/2 to 1 inch). During a field survey on November 20, 1979, Department personnel saw several different locations on the Mexican side of the All-American Canal where water was being siphoned.

IV. WATER CONSERVATION EFFORTS

IID has conserved water by: (1) initiating a concrete-lining program to provide better service to water users and to reduce water losses; (2) equipping unlined main canals that are not scheduled to be lined with parallel water recovery lines and pumping stations for salvaging water lost by seepage; (3) constructing water-regulating reservoirs to hold water ordered but not used by farmers; and (4) equipping its water control structures with telemetry facilities, which are activated by the water control section at IID's Imperial headquarters. Instantaneous control of major check and diversion structures has reduced operational spills, thereby conserving water. The Colorado River Board (CRB), based on 1975 data, estimated that IID in 1976, with its conservation program, had reduced annual water losses in its facilities from the 1950's totals of 610 600 cubic dekametres (495,000 acre-feet) to 366 300 cubic dekametres (297,000 acre-feet); a savings of 244 200 cubic dekametres (198,000 acre-feet).[11/]

In July 1976, IID supplemented its water conservation efforts with a 13-point water conservation program, which, in turn, was supplemented by a 21-point program (8) in 1980. The 21-point program was one of the first tasks of the Water Conservation Advisory Board following its organization in 1979. The Board, consisting of farmers within the IID service area, was organized to formulate an expanded water conservation program involving irrigation efficiency in system operation and farming practices and to make recommendations to IID's Board of Directors and the Imperial Valley farming community.

IID has also revised its water rate schedules, raising the rates at various times, to cover rising costs and to encourage conservation. See

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11/ Colorado River Board of California. Based on 1975 data. Myron B. Holburt memorandum to Gerald H. Meral. April 7, 1977.

Appendix D for the latest water rate schedule.

IID's water conservation efforts have increased conveyance system efficiency substantially since 1955 (see Table 3).

Concrete-Lining Program

IID began concrete-lining canals in 1954 and accelerated the program during the early 1960's. Table 5 provides an annual compilation of miles of canal lined through 1979 and the estimated amounts of water saved by the project. In 1979, IID estimates that more than 170 000 cubic dekametres (138,000 acre-feet) of water was saved as a result of 1 178 kilometres (732 miles) of canal lining (9). IID plans to line an additional 833 kilometres (518 miles) of lateral earthen canals and estimates it will save an additional 123 400 cubic dekametres (100,000 acre-feet) per year above the 1979 amount by completing the lining program. To encourage concrete lining of canals in the IID, the Board of Directors adopted regulations permitting IID participation with landowners. Prior to adoption of the regulations, the concrete-lining regulation applied only to lateral canal termini, which after lining would be maintained by private landowners. About 3 700 kilometres (2,300 miles) of farm canals have been lined under this program.

Parallel Water Recovery Lines and Pumping System

The rest of the system, consisting of the main canals that are not scheduled to be lined, is being equipped with parallel water recovery lines and pumping stations for salvaging any water lost by seepage. In 1978, about 22 000 cubic dekametres (18,000 acre-feet) of water was salvaged by use of this system. No estimate is available of the potential for additional water savings in this category.

TABLE 5

ESTIMATED AMOUNT OF WATER CONSERVED BY CONCRETE-LINING PROGRAM (9)

Year	Cumulative amount of canals concrete lined		Total estimated annual water conserved[a]	
	In kilometres	In miles	In cubic dekametres	In acre-feet
1954	1.29	0.80		150
1955	2.10	1.30	301	244
1956	4.76	2.96	686	556
1957	9.83	6.11	1 400	1,100
1958	14.84	9.22	2 100	1,700
1959	21.39	13.29	3 100	2,500
1960	27.21	16.91	3 900	3,200
1961	43.47	27.01	6 290	5,100
1962	71.90	44.68	10 400	8,400
1963	116.22	72.22	16 800	13,600
1964	197.53	122.74	28 500	23,100
1965	282.54	175.57	40 700	33,000
1966	390.75	242.81	56 200	45,600
1967	487.70	303.05	70 300	57,000
1968	563.61	350.22	81 200	65,800
1969	652.28	405.32	94 000	76,200
1970	714.63	444.06	103 100	83,500
1971	770.97	479.07	111 100	90,100
1972	829.22	515.27	119 500	96,900
1973	877.41	545.21	126 400	102,500
1974	927.57	576.38	133 700	108,400
1975	989.35	614.77	142 600	115,600
1976	1 046.05	650.00	150 700	122,200
1977	--	--	--	
1978[b]	--	--	--	
1979	1 178.00	732.00	169 700	137,600

a/ Based on an annual average water savings of 288 cubic dekametres per kilometre (376 acre-feet per mile) and on the assumption that 50 percent of lined sections are below natural ground surface with a negligible seepage rate.

b/ In 1978, IID lined 30.1 kilometres (18.7 miles) of canals and farmers installed 53.8 kilometres (33.4 miles) of concrete headworks. By the end of 1978, the cumulative total for all categories of canal lining, including on-farm, was 4 796.7 kilometres (2,980.6 miles).

Water-Regulating Reservoirs

As a major conservation effort, IID has constructed two of several planned water-regulating reservoirs intended primarily to store water for release as needed by farmers, thereby saving water which otherwise would spill from the system. The reservoirs have provided a secondary benefit: improved service downstream from the reservoirs when increased deliveries are required.

IID put into operation in February 1976 the Kakoo Singh (Nectarine) Reservoir a year before initiating its 13-point water conservation program. This reservoir, the first of its kind in the Valley, is located near the Nectarine lateral on the East Highline Canal and has a capacity of 390 cubic dekametres (320 acre-feet).

The second and larger reservoir, the J. M. Sheldon Reservoir, was provided for as Point 1 of the 13-point program. This reservoir, which is located near the No. 8 heading structure on the Westside Main Canal and has a capacity of 740 cubic dekametres (600 acre-feet), was put into operation in March 1977.

During 1978, the J. M. Sheldon Reservoir saved about 20 900 cubic dekametres (16,900 acre-feet) of water and the Kakoo Singh Reservoir saved about 20 200 cubic dekametres (16,400 acre-feet). Both reservoirs are expected to save 49 000 cubic dekametres (40,000 acre-feet) annually.

The ability of these reservoirs to save this amount depends in part on whether IID can control growth of the water plant, Hydrilla verticillata, which forms impenetrable mats on the water surface, clogging channels and reservoirs, possibly slowing water deliveries and decreasing reservoir storage capacity. IID is aggressively pursuing methods to control this plant, which was first observed in June 1977 and by the next year had

become a problem.

IID had land in escrow in December 1980 on which it plans to construct another regulating reservoir, with a capacity of 432 cubic dekametres (350 acre-feet), on Central Main Canal about 3.2 kilometres (2 miles) south of Brawley. IID is also considering several other sites as locations for additional regulating reservoirs.

Telemetry Facilities and Remote Control Operation

In March 1957, IID's first telemetering unit was installed at the Nectarine (Vail) check on the East Highline Canal. This unit permitted operation of diversions on the Vail Canal to be controlled from the Watermaster's office at Imperial, a distance of approximately 34 kilometres (21 miles).

Since then, telemetry units have been installed at key checks and turnouts on the All-American Canal. The system controlling the transportation of water to the Coachella and Imperial Valleys is fully automated and can be operated from IID's headquarters in Imperial. This operation has proved highly successful and economical, making possible a reduction in working hours by the hydrographers and in water losses.

Installation of radios in field vehicles has improved the overall maintenance and operation of the river delivery system. Potential problems at the headgates, canals, and drains can now be communicated to headquarters to prevent unnecessary water losses from occurring.

13-Point Water Conservation Program

Recognizing the seriousness of the water shortage in the northern part of the State, IID in July 1976 supplemented its water conservation efforts with a stringent 13-point program. Included in the program are:

1. Construction of a water-regulating reservoir on the Westside Main Canal.

2. Reconstruction of farm outlet boxes, as required.
3. Employment of an adequate number of water-regulating personnel to effect more efficient deliveries, as the system will permit.
4. Daily inventory of surface field discharge, charging users who needlessly waste water an assessment for that day equal to three times the scheduled water rate.
5. Development of surface water evaporation ponds.
6. Preliminary studies for a regulating reservoir on the Central Main Canal.
7. Studying the feasibility of installing additional water recovery lines paralleling the main canals to increase salvage of seepage water now entering the drainage system and the Salton Sea.
8. Providing free drainage water to persons willing to pump and use it.
9. Continuing the concrete-lining program.
10. Initiating a record of accrued water use per acre per parcel per annum through computerized billing.
11. Installation of radio equipment in all water conservation-related vehicles to afford immediate communication with supervision.
12. Initiation of an irrigation management services program.
13. Delivery of water off-schedule when and wherever possible.

Some progress has been made in conservation during the implementation of this program by IID with cooperation from its water users. Adaptation of this program has not been without problems particularly in the increased costs passed on to IID's customers.

In addition to constructing the reservoir in accordance with Point 1 of the 13-point program, IID has also constructed an evaporation pond (Point 5); had land in escrow in December 1980 for another regulating reservoir (Point 6); has installed water recovery lines (Point 7); has provided drainage water free to users (Point 8); is continuing the concrete-lining program (Point 9); has initiated the recording of accrued water use per acre parcel per annum (Point 10); has installed radio equipment in water conservation-related vehicles (Point 11); and is continuing to implement Points 12 and 13.

IID is reconstructing waste boxes in the corners of fields to record the runoff from irrigation and currently employs waste checkers to work on a 24-hour schedule checking waste discharge and citing violators of IID regulations. The waste recorders measure the amount of water passing through a weir or flume.

21-Point Water Conservation Program

Following their appointment in 1979, members of the Water Conservation Advisory Board developed a 21-point water conservation program to supplement the existing 13-point program. The program was adopted by the IID Board of Directors to be effective July 1, 1980, and was revised, effective October 1, 1980. The program incorporates additional provisions for operational methods to reduce losses, including penalties for unauthorized adjustments made on farm headgates. The items included in 21 points are now presented:

1. IID shall establish a penalty of $100 for an unauthorized adjustment of delivery gates which would result 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 equipment, the operator-user shall be permitted to discontinue his water delivery for a period of not more than three 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 three 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 are to be installed on structures accommodating gates which are owned, operated, and maintained, as well as regulated, under the jurisdiction of the IID 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 five 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 1 of the 2 consecutive measurements showing 15 percent or more runoff is made between 12 noon and 6 p.m.

4. In the event a water user is receiving more than his confirmed order, the 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 percent or more of his running order irrespective of the quantity of water the user is receiving.
6. Any surface runoff measurement made within four hours after IID 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 IID personnel whose duties include checking of surface runoff will initial any waste assessment sheets issued.
11. Changes can be made for the last day of a run by notifying IID not later than 3 p.m. of the preceding day.
12. When a water user requests an adjustment in the quantity of water delivered not to exceed two feet, IID shall be obliged to honor the request if it is within the ability of IID's system to accommodate such request and the water user notifies

the zanjero in advance of beginning his daily run. The zanjero of the run shall obtain approval to make the 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, providing that IID is notified in advance but not later than 3 p.m. preceding the time the order is changed. No penalty shall be charged for the reduction as long as it does not exceed 50 percent or 5 feet of the order as confirmed, whichever is less. Water returned with notice after 3 p.m. or which exceeds the quantity that this rule authorizes shall be subject to an assessment equal to two times the regular water rate.

14. By notifying IID before 3 p.m. orders can be adjusted for the last 12 hours of the run, up to 50 percent of the confirmed order or five feet, whichever is less.

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

16. By notifying IID 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 IID 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. IID shall secure whatever additional radio equipment is necessary to improve communications between the farmers and Water Department personnel.

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

20. IID shall prepare a monthly water information bulletin for distribution which shall include information submitted to IID by a committee to be appointed by the Water Conservation Advisory Board, and from other sources as required for the purpose of assisting the water user in using all water beneficially.

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

IID's Fall 1980 publication on the 21-point program includes the following table as an example of how monetary penalties are assessed.

Examples of Penalties Now Being Levied Under Rule 13
(Figures in second-feet)

Phone call to IID	Before 3 p.m.	Before 3 p.m.	Before 3 p.m.	After 3 p.m.	No call
Water to be returned for	12 Hrs.	12 Hrs.	More than 12 hrs.	12 hrs.	Any no. of hrs.
Feet of order	12	12	12	12	12
Feet returned	5	8	12	4	4
No. of feet penalty Applies to (2 X normal charge)	0	3	12	4	4
Additional penalty (for adjusting gate)	0	0	0	0	$100
Total feet of water paid for	12	18	36	20	20
Dollar amount (order + penalty)	$156	$234	$468	$260	$260 + 100 = $360

Water Rate Revisions

IID revised its water rate schedules in 1980. A copy of the revised schedules is included in Appendix E. The Schedule 7 revision was effective January 1, 1980, and Schedules 1 through 6 revisions were effective July 1, 1980.

Under Schedule 1, the basic agricultural rate is $5.27 per cubic dekametre ($6.50 per acre-foot) for the first 1.8 cubic metres per square metre (6 acre-feet per acre) irrigated per year. 12/

The other rate schedules are used for irrigating on mesalands and for other uses.

12/ Effective June 1, 1981, water rates increased to $6.08 per cubic dekametre ($7.50 per acre-foot).

V. ADDITIONAL OPPORTUNITIES FOR WATER CONSERVATION

Large amounts of water lost by seepage from the All-American and Coachella Canals could be prevented by lining their unlined portions.

The All-American Canal is an earth-lined channel with a 102-millimetre (4-inch) compacted clay base and 152-millimetre (6-inch) loose clay sides, side slopes of 1.75:1, a base width of 49 metres (160 feet), and a water depth of 6.3 metres (20.6 feet). Design flow for the first 22 kilometres (13.7 miles) is 429 cubic metres (15,155 cubic feet) per second, gradually decreasing to 74 cubic metres (2,600 cubic feet) per second at the terminus.

Until recently, the Coachella Canal was an earth-lined channel for the first 138 kilometres (86 miles), with side slopes of 2:1, base width of 18 metres (60 feet), a water depth of 3.1 metres (10.3 feet), and a design flow of 71 cubic metres (2,500 cubic feet) per second. In November 1980, IID put into operation a concrete-lined section that had been constructed to replace the first 79 kilometres (49 miles). The last 58 kilometres (36 miles) is also concrete lined, with slopes 1.5:1, base width of 3.7 metres (12 feet), water depth of 3.3 metres (10.8 feet), and a 89-millimetre (3.5-inch) lining.

IID has estimated the seepage losses in the All-American and Coachella Canals (Table 6). Saving water by lining these canals could have local, intrastate, interstate, and international ramifications.

Table 6
Estimated Seepage Losses in the All-American and Coachella Canals, 1975-1979
In Cubic Dekametres
(In acre-feet)

All-American Canal	Length kilometres (miles)	1975	1976	1977	1978	1979
Imperial Dam to Pilot Knob*	43 (27)	99 600 (80,752)	116 800 (94,695)	127 300 (103,240)	92 900 (75,319)	103 300 (83,717)
Pilot Knob to Drop No. 1	25 (15)	67 200 (54,514)	71 800 (58,224)	36 000 (29,163)	64 000 (51,867)	60 000 (48,654)
Drop No. 1 to East Highline Canal	35 (22)	72 200 (58,555)	40 100 (32,543)	27 500 (22,293)	30 100 (24,407)	9 700 (7,835)
East Highline Canal to Westside Main Canal	35 (22)	10 500 (8,546)	24 100 (19,505)	22 200 (17,983)	27 800 (22,560)	15 100 (12,252)
Total	138 (86)	249 500 (212,367)	252 800 (204,967)	213 000 (172,679)	214 800 (174,153)	188 100 (152,458)
Coachella Canal						
Drop No. 1 to 6A Check**	79 (49)	158 200 (128,271)	159 900 (129,639)	139 500 (113,029)	152 800 (123,900)	165 700 (134,300)
6A Check to Milepost 90.6	67 (42)	66 300 (53,710)	41 000 (33,240)	Data Not Available		
Total	146 (91)	224 500 (181,981)	200 900 (162,879)			

* Losses from this reach are considered Colorado River System Reservoir losses. Most of the seepage loss in this reach is assumed to reach the Colorado River through the ground water as return flow. If this reach is lined, an amount equal to salvage would have to be released to satisfy downstream obligations which would have been fulfilled by this return flow. Net diversions to IID and CVWD are measured at Pilot Knob, not at Imperial Dam.

** Concrete lined in November 1980.

Source: Imperial Irrigation District, Annual Report, 1977.
Imperial Irrigation District, Annual Report, 1979.
U. S. Bureau of Reclamation, Miscellaneous Data.

In a January 1978 report (13), the U. S. Bureau of Reclamation presented the values shown in Table 7 for probable amounts of seepage from the All-American Canal that could be salvaged. The study lists water salvage potential in various reaches of the All-American Canal. The January 1978 Status Report extracted data from an attachment to a letter from the Area Engineer (San Bernardino) to the Regional Director (Boulder City) on the subject: Report on Findings of General Investigation (Feasibility), Boulder Canyon Project, All-American Canal System Water Salvage, Imperial Division, California, April 17, 1970.

The "Report on the Water Conservation Opportunities Study", September 1978, by the U. S. Bureau of Reclamation and Bureau of Indian Affairs states that diversions could be reduced by 432 000 cubic dekametres (350,000 acre-feet) per year at a cost of $238.3 million if conservation measures were fully implemented. This would not include recovery of a present amount of "water lost to further use" estimated to be 116 000 cubic dekametres (93,800 acre-feet) per year, which is underflow to Mexico.

The reduction in diversions includes 184 000 cubic dekametres (149,000 acre-feet) per year as a result of seepage reductions in the conveyance system, at an estimated cost of $169 million. Another 248 000 cubic dekametres (201,000 acre-feet) per year could be saved by on-farm practices costing $69.3 million (Table 8).

One current proposal is to line the portion of the All-American Canal from Pilot Knob to Drop No. 1 to save 58 000 to 59 200 cubic dekametres (47,000 to 48,000 acre-feet) per year to replace the Yuma Desalting Plant Reject Stream to meet the United States' obligations for water deliveries to Mexico enunciated in the Water Treaty of 1944 (17) and in other agreements of the International Boundary and Water Commission, United

Table 7

USBR ESTIMATES OF WATER THAT COULD BE SAVED BY LINING THE ALL-AMERICAN CANAL*

In cubic dekametres
(In acre-feet)

All-American Canal	Probable loss from unlined canal	Theoretical loss from lined canal[a/]	Estimated savings with lined canal
Station 60 to Pilot Knob	74 000[b/] (60,000)	17 300[c/] (14,000)	Undetermined[d/]
Pilot Knob to Drop 1	70 300[e/] (57,000)	11 100 (9,000)	59 200 (48,000)
Drop 1 to East Highline Canal	49 300[f/] (40,000)	12 300 (10,000)	37 000 (30,000)
East Highline Canal to Central Main Canal	4 100[g/] (3,300)	4 100 (3,300)	0
Central Main Canal to Westside Main Canal	5 200[g/] (4,200)	5 200 (4,200)	0

a/ Losses from lined canals include 0.33 metre per square metre (0.10 foot per square foot) per day seepage loss, plus estimated evaporation loss, plus losses from siphons, except for the last two reaches where the theoretical loss from a lined canal was limited by the probable loss from the unlined canal.

b/ Based on IID recorded losses for 1965 and 1966, rounded.

c/ Includes 617 cubic dekametre (500 acre-foot) loss from siphons.

d/ Because an unknown quantity of the present seepage losses returns to the river, the quantity that could be saved by canal lining has not been estimated.

e/ Based on January 1967 ponding test loss, plus evaporation, extended to one year.

f/ 10-year average, IID provisional records, rounded.

g/ Based on January 1966 ponding test loss, plus evaporation and loss from siphons, extended to 1 year.

*See reference No. 13.

Table 8

CONSERVATION AND ECONOMIC DATA[14]

Conveyance system	Annual reduction in acre-feet*	Capital cost	Annual cost in acre-feet*	Benefits in acre-feet*	Study cost
Seepage reduction	148,800	$169 million	$76**		
On-farm					
Seepage reduction	152,300				
Level orient fields	24,400				
Irrigation scheduling	24,500				
Subtotal	201,200	$69.3 million	$65**		
Combined	350,000	$238.3 million	$70**	$51	$800,000

*Acre-feet x 1.2335 = cubic dekametres. Dollars per acre-foot divided by 1.2335 = dollars per cubic dekametre

**Includes interest at 6-3/8 percent and annual operation, maintenance, and replacement costs

States and Mexico (9), (10), and (11).

The Colorado River Basin Salinity Control Project Act (Public Law 93-320) authorized the replacement of the first 79-kilometre (49-mile) unlined portion of the Coachella Canal with a concrete-lined section to eliminate some of the 174 000 cubic dekametres (141,000 acre-feet) of Colorado River water now being lost annually through canal seepage.

Contracts were awarded for both reaches of the 79-kilometre (49-mile) Coachella Canal relocation (1-A and 1-B), with construction initiated in July 1979 on Reach 1-A and in August 1979 on Reach 1-B. The canal was put into operation in November of 1980.

The amount that can be salvaged with the new concrete-lined section of the canal is estimated to be 163 000 cubic dekametres (132,000 acre-feet)[13/] to 143 000 cubic dekametres (116,000 acre-feet)[14/] per year.

The salvaged water will be credited to the United States for delivery to Mexico as a replacement for the bypass of Wellton-Mohawk Irrigation District drain water. This will be on an interim basis, until such time as the Secretary of the Interior does not meet all the water delivery requests of the California agencies holding Colorado River water rights up to 5.4 million cubic dekametres (4.4 million acre-feet) per year.

13/ Eugene Hinds, Regional Director of the Lower Colorado Region, Water and Power Resources Service. Excerpt from Status Report on Features of the Colorado River Salinity Control Program. Presentation of California Water Resources Association meeting, Coronado, California, August 7 and 8, 1980.

14/ Colorado River Board of California. Myron B. Holburt letter to Roy D. Gear, Assistant Regional Director, U. S. Bureau of Reclamation, on "Relation Between Proposed Developments of Water Resources and Seepage from the All-American Canal, Eastern Imperial Valley, California". U. S. Geological Survey Open-File Report No. 79-744. May 1979. Letter dated July 16, 1979.

Other areas of potential savings not yet discussed in the report include:

- o Use of additional waste checkers, with expanding shifts and more frequent checks for waste;
- o Development of an irrigation management program, that would be taught at the community colleges and special workshops to inform and educate farmers and technicians about efficient irrigation practices;
- o Making other improvements in the conveyance and distribution system, i.e., in facilities, equipment, and operation, and in IID's flexibility to facilitate water delivery on demand (perhaps including use of a 12-hour delivery schedule);
- o Improvement of coordination among farmers in ordering water;
- o Improvement of operational control by IID and reduction in dumping of water when farmers are unable to take water or IID takes canals out of service;
- o Provision of financial incentives for conservation, such as cost pricing of water, establishing an off-peak agricultural electric rate, and use of other kinds of penalties besides triple charge for excessive tailwater and fines for unauthorized headgate closing;
- o Minimization of canal cutouts;
- o Construction of a drainage line running along the Alamo River between the Palmetto and Vail Canals to collect lateral spillovers and waste (this to be provided in conjunction with cross ditches here and elsewhere to connect laterals for transferring water across the valley floor to areas where it is needed);
- o Provision of additional monitoring devices to measure diversions and spills, tailwater, etc.;

- Substituting crops that have higher salt tolerances for those which possess low tolerance;
- Elimination of delivery site siphons and other means to make unauthorized uses of water;
- Use of gated pipe and pumpback devices;
- Construction of wells to intercept and recover seepage.

VI. EFFECTS OF CONSERVATION

Additional water could be made available for use in the Imperial Valley or elsewhese if that which is lost by evaporation and seepage or spills is salvaged. This practice could have both beneficial and detrimental effects.

Beneficial Effects of Conservation

Beneficial effects include:

- Making more water available for leaching, for more multiple cropping on presently irrigated lands, for irrigation of more land in Imperial Valley, or for other uses, such as for geothermal power plant cooling;
- Making water available for use outside Imperial Valley in California or elsewhere;
- Helping to stabilize the level of the Salton Sea; and
- Reduction in cost to farmers of fertilizer and other chemicals that are lost in excessive water application.

Other Effects

A major reduction in diversions to and seepage from the All-American Canal and other canals would have one or more of the following effects:

- Decrease local water recharge and affect ground water conditions;
- Reduce seepage component of return flow between Imperial Dam and Pilot Knob to the Colorado River which contributes to the United States' Treaty obligations for delivery of water to Mexico;
- Decrease wildlife habitat;
- Decrease flow to the Salton Sea, which would help stabilize the level of the sea and also decrease dilution water, which would result in increasing salinity, which is detrimental to Salton Sea fishery and

other recreational values;

- o Less water to generate power and a possible loss in power and revenues;
- o Reduce agricultural drain water available for potential geothermal power plant cooling; and
- o Have a financial impact on IID and its customers resulting from the cost of additional facilities, land, and labor.

Factors Hindering Implementation of Conservation Program

Factors which may inhibit implementation of water conservation measures are:

- o Reluctance by water users within the irrigation service area to relinquish any rights to water;
- o The lack of procedures whereby beneficiaries outside the irrigation service area share in the reimbursable costs of the conservation measures;
- o Lack of an extensive and accurate data base; additional water measurement facilities are needed to obtain this in the future;
- o Repayment contracts are not structured to encourage conservation of water supplies; the cost of water is a relatively minor production cost under current Federal pricing policies on Federal projects;
- o Economics of conservation: the cost of preventing seepage and excess deliveries and spills and recovering spills and tailwater appears to be higher than the cost of obtaining fresh water from the Colorado River; and
- o Reducing the amount or changing the quality of return flows above Pilot Knob might affect the quantity and quality of water Mexico receives and may impair the United States' ability to meet its obligations to Mexico under the 1944 Water Treaty and other agreements.

The Southern District's preliminary report entitled "Investigation of John J. Elmore Allegations of Misuse of Water by Imperial Irrigation District Under California Water Code Section 275" was released for review April 13, 1981, to individuals, agencies, and public interest groups. Revisions have been made in the text, where applicable, in response to the comments received. Completion and release of the revised publication is expected in July 1981.

APPENDIX A

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BIBLIOGRAPHY

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APPENDIX B

ANNUAL SUMMARY OF WATER DIVERSION, TRANSPORTATION DISTRIBUTION AND DRAINAGE

IMPERIAL IRRIGATION DISTRICT

ANNUAL SUMMARY
WATER DIVERSION, TRANSPORTATION, DISTRIBUTION AND DRAINAGE
UNITED STATES AND MEXICO

YEARS OF 1979 AND 1978

WATER DIVERSION

COLORADO RIVER:	1979		1978		
Grand Canyon:					
Discharge - Year	8 672 300		9 332 800		A.F.
Hoover Dam:					
Reservoir Elevation - Dec. 31	1197.97		1193.31		Feet
Maximum Reservoir Elevation	1202.80		1193.31	(12-31)	Feet
Available Storage - Dec. 31	22 623 000		21 960 000		A.F.
Maximum Available Storage	23 324 000		21 960 000		A.F.
Loss in Storage - Year	(G) 663 000		(G) 1 710 000		A.F.
Daily Discharge - Maximum	25 900	(5-22)	22 300	(5-4)	C.F.S
- Minimum	587	(4-15)	1 180	(12-24)	C.F.S
- Mean	10 666		10 327		C.F.S
Discharge - Year	7 721 700		7 476 580		A.F.
Davis Dam:					
Storage - Dec. 31	1 634 000		1 682 000		A.F.
Loss in Storage - Year	48 000	(G)	40 000		A.F.
Daily Discharge - Maximum	21 700	(7-2)	19 600	(4-19)	C.F.S
- Minimum	1 880	(1-22 to 27)	1 950	(12-26)	C.F.S
- Mean	11 150		10 723		C.F.S
Discharge - Year	8 072 700		7 763 100		A.F.
Parker Dam:					
Storage - Dec. 31	551 700		549 400		A.F.
Loss in Storage	(G) 2 300		300		A.F.
Daily Discharge - Maximum	17 900	(7-14)	16 400	(7-23)	C.F.S
- Minimum	1 690	(12-22)	920	(1-11)	C.F.S.
- Mean	9 951		9 210		C.F.S.
Discharge - Year	7 204 200		6 667 500		A.F.
Imperial Dam:					
Diversions - All-American Canal	5 185 604		4 502 118		A.F.
- Gila Main	673 660		796 820		A.F.
Passing Imperial Dam	264 850		391 350		A.F.
Discharge - Year	6 124 114		5 690 288		A.F.
Yuma - Below Yuma Main Spill:					
Daily Discharge - Maximum	3 210	(4-27)	3 060	(3-2)	C.F.S.
- Minimum	510	(1-1)	459	(2-27)	C.F.S.
- Mean	2 337		866		C.F.S.
Discharge - Year	1 691 610		626 890		A.F.
Morelos Dam:					
Diversions to Alamo Canal	2 044 289		1 367 822		A.F.

(G)Gain

WATER TRANSPORTATION

	1979		1978		
All-American Canal:					
*Received at Head	5 185 604		4 502 118		A.F.
*Diversions above Siphon Drop	68 469		62 194		A.F.
*Diversions at Siphon Drop	352 602		401 946		A.F.
Pilot Knob Power Plant:					
*Y.C.W.U.A. Transfer	754 557		479 286		A.F.
*Imperial Irrigation District	559 072		266 967		A.F.
*Total Diversions to Power Plant	1 313 701		746 277		A.F.
*Diversions to Pilot Knob Spillway	72		24		A.F.
Discharge Below Pilot Knob:					
For C.V.C.W.D.	523 385		501 394		A.F.
For Imperial Irrigation District	2 843 730		2 714 988		A.F.
Total	3 367 115		3 216 382		A.F.
Loss - Imperial Dam to Pilot Knob	83 717		75 319		A.F.
Loss - Pilot Knob to Drop No. 1:					
For C.V.C.W.D.	8 090		8 677		A.F.
For Imperial Irrigation District	40 564		43 190		A.F.
Total	48 654		51 867		A.F.
Diversion to Coachella Canal	515 295		492 717		A.F.
Discharge below Drop No. 1	2 803 166		2 671 798		A.F.
Daily Discharge Below Drop No. 1					
- Maximum	6 225	(4-27)	6 050	(4-20)	C.F.S
- Minimum	450	(1-18)	300	(1-12)	C.F.S
- Mean	3 872		3 690		C.F.S
Diversions above E.H.L. Check	1 209 924		1 139 552		A.F.
Discharge below E.H.L. Check	1 585 407		1 507 839		A.F.
Loss - Drop No. 1 to E.H.L. Check	7 835		24 407		A.F.
Diversions E.H.L. to W.S.M. Check	1 573 155		1 485 279		A.F.
Loss - E.H.L. to W.S.M. Check	12 252		22 560		A.F.
Loss - Pilot Knob to W.S.M. Check	60 651		90 157		A.F.
Coachella Canal:					
Received at Head	515 295		492 717		A.F.
Diversion above 6-A Check	6 673		4 252		A.F.
Discharge below 6-A Check	374 323		364 604		A.F.
Loss - Drop No. 1 to 6-A Check	134 299		123 861		A.F.

*Daily report from All-American Canal, River Division

WATER DISTRIBUTION

UNITED STATES:

1. Main All-American Canal:

Division	ACRE FEET Net Received 1979	Net Received 1978	Operational Loss 1979	Operational Loss 1978	Deliveries To Users 1979	Deliveries To Users 1978	Canal Loss and Unaccounted for 1979	Canal Loss and Unaccounted for 1978
	A		B		C		D	
East Mesa	8 488	8 737			8 474	8 695	14	42
Holtville	548 304	535 672	20	46	522 418	506 755	25 866	28 871
Calexico & El Centro	464 780	427 242	54	116	453 532	418 626	11 194	8 500
Imperial	427 554	401 874	2 773	2 512	399 553	374 251	25 228	25 111
Brawley	430 920	417 808			399 201	385 806	31 719	32 002
Westmorland	406 335	395 329	5 351	3 629	386 539	365 223	14 445	26 477
Calipatria	409 948	389 653		5	401 139	381 345	8 809	8 303
Total	2 696 329	2 576 315	8 198	6 308	2 570 856	2 440 701	117 275	129 306
% of Net Received	100.00	100.00	0.30	0.24	95.35	94.74	4.35	5.02

2 Main Canal Operational Loss:

	1979	1978	
All-American Canal - Alamo Spillway			A.F.
- New River Spillway	90	306	A.F.
Dahlia Spillway	316	284	A.F.
No. 4 Spillway	1 950	1 940	A.F.
Dixie Spillway	106	137	A.F.
Vail Spillway - New River	101	205	A.F.
Vail Supply to Alamo - Above North End Dam	789	800	A.F.
Rositas - at Rose Heading	673	747	A.F.
East Highline at "Z" Spillway	3 380	3 194	A.F.
Total	7 405	7 613	A.F.

3. Operational Loss Recovered:

A. From Main Canals			A.F.
B. From Divisions - Rositas	3 754	3 043	A.F.
C. From Divisions - Vail	776	679	A.F.

WATER DISTRIBUTION

	1979		1978	
	Acre-Feet	% Colo. at Imp. Dam	Acre-Feet	% Colo. at Imp. Dam
Discharge below Pilot Knob (I.I.D.)	2 843 730	46.43	2 714 988	47.71
		% Disch. Below Pilot Knob		% Disch. Below Pilot Knob
5. Net Operational Loss from Divisions (Item 1B minus 3A and 3B)	3 668	0.13	2 586	0.09
6. Net Operational Loss from Main Canals (Item 2)	7 405	0.26	7 613	0.28
7. Net Deliveries from Main Canals Item 1A minus 3A and 3B)	2 691 799	94.66	2 572 593	94.76
8. Total Diversions from Main Canals (Item 6 plus 7)	2 699 204	94.92	2 580 206	95.04
9. Total Canal Loss and Unaccounted for - Main Canals (Item 4 minus 8)	144 526	5.08	134 782	4.96
10. Total Canal Loss and Unaccounted for - Entire System (Item 1D plus 9)	261 801	9.21	264 088	9.73
11. Total Deliveries to Users (Item 1C)	2 570 856	90.40+	2 440 701	89.90
12. Delivered to I.I.D. Users - Coachella Canal	6 673	0.24-	4 252	0.15
13. Grand Total Delivered to Users (Item 11 plus 12)	2 577 529	90.64	2 444 953	90.05

Note: "Unaccounted for" represents, in part, water delivered through approximately 1750 service pipes which are unmeasured.

INFLOW TO SALTON SEA

		1979		1978	
Alamo Channel:					
*Crossing Line from Mexico		1 416		1 296	A.F.
Main Canal Operational Loss		1 462		1 547	A.F.
Division Operational Loss	(G)	3 891	(G)	3 183	A.F.
Drainage		636 139		603 413	A.F.
Metered at Outlet		635 126		603 073	A.F.
New River Channel:					
*Crossing Line from Mexico		144 905		98 408	A.F.
Main Canal Operational Loss		2 563		2 872	A.F.
Division Operational Loss		2 208		2 140	A.F.
Drainage		308 044		289 625	A.F.
Metered at Outlet		457 720		393 045	A.F.
Direct to Sea:					
Main Canal Operational Loss		3 380		3 194	A.F.
Division Operational Loss		5 351		3 629	A.F.
Drainage		101 396		92 437	A.F.
Total		110 127		99 260	A.F.
Summary:					
*Crossing Line from Mexico		146 321		99 704	A.F.
Main Canal Operational Loss		7 405		7 613	A.F.
Division Operational Loss		3 668		2 586	A.F.
Drainage		1 045 579		985 475	A.F.
Total to Sea		1 202 973		1 095 378	A.F.

ELEVATION OF THE SALTON SEA:

December 31, 1979	January 1, 1979
-227.75	-228.20

(G)Gain
*Computed from Meter Stations at the Boundary.

APPENDIX C

LATERAL CANAL MILEAGE

LATERAL CANAL MILEAGE AS OF DECEMBER 31, 1979
BY DIVISIONS

Divisions	Total Miles	Miles Earth Section	% Earth Section	Miles Concrete Lined	% Concrete Lined	Miles Pipelined	% Pipelined
Holtville	295.18	83.24	28.20	211.58	71.68	0.36	0.12
El Centro-Calexico	229.64	128.22	55.84	100.92	43.94	0.50	0.22
Imperial	203.68	98.93	48.57	104.25	51.18	0.50	0.25
Brawley	243.90	135.73	55.65	102.23	41.91	5.94	2.44
Westmorland	199.74	77.87	38.99	121.87	61.01	0.00	0.00
Calipatria	301.21	209.07	69.41	91.19	30.27	0.95	0.32
Totals	1 473.35	733.06	49.75	732.04	49.69	8.25	0.56

1979 Annual P. 19 says 737.52

APPENDIX D

BY-LAWS OF THE IMPERIAL IRRIGATION DISTRICT WATER CONSERVATION ADVISORY BOARD

BY-LAWS OF THE IMPERIAL IRRIGATION DISTRICT

WATER CONSERVATION ADVISORY BOARD

ARTICLE 1. PURPOSE

Section 1.01. The purpose for which this board is organized is to recommend to the board of directors of the Imperial Irrigation District and the Imperial Valley farming community an expaned program of irrigation efficiency in system operation and farming practices.

ARTICLE 2. MEMBERSHIP

Section 2.01. The committee shall consist of ten (10) regular members, all of whom shall have voting privileges.

Section 2.02. Two regular members and one alternate shall be appointed by each member of the Imperial Irrigation District board of directors from their respective water operating divisions. Regular members and alternates shall be engaged in farming.

Section 2.03. Alternates shall be subject to the same requirements for attendance at meetings as regular members, and shall have voting privileges in the absence of a regular member from the alternate's division and shall be the first choice for appointment to succeed a regular member from his division, whose term has expired.

Section 2.04. Two members of the Imperial Irrigation District board of directors and three District management representatives shall be appointed by the District board and shall serve as advisors to the regular advisory board members.

Section 2.05. Regular members shall serve for only one (1) term, such term to be two (2) years, except that, by a vote of seven (7) regular board members, the terms of not more than three (3) regular members may be extended for an additional one (1) year. Alternates shall serve until their successors are appointed by the Imperial Irrigation District board of directors, but in no event less than two (2) years. Advisors to the regular board members shall serve at the will and pleasure of the Imperial Irrigation District board of directors.

Section 2.06. By vote of not less than seven (7) regular members, a regular member may be removed from the board for any reason. Further, if any regular member fails to attend three (3) consecutive board meetings or five (5) meetings in any year during his term of office, his position may be declared vacant by a majority of the remaining regular members of the board.

Section 2.07. Alternates shall fill any vacancy on the advisory board, and shall serve for the remainder of the term during which the vacancy occurred.

ARTICLE 3. MEETINGS

Section 3.01. Meetings of the advisory board shall be held in the board room, located in the Executive Offices of the Imperial Irrigation District, 1284 Main Street, El Centro, California.

Section 3.02. The first meeting of the advisory board shall be held on July 12, 1979, at 1:30 P.M., for the purpose of selecting

officers and transacting such other business as may come before the meeting. Each year thereafter, at its regular meeting in July, the board shall select officers and reorganize itself as required by these By-Laws.

Section 3.03. Regular meetings shall be held on the second Thursday of each month, beginning with the month of August, 1979, at 1:30 P.M., unless such day falls on a legal holiday, in which event the regular meeting for that month shall be held at the same hour and place on the next succeeding day.

Section 3.04. Special meetings of the board may be called by the chairman, or, in his absence, the vice-chairman, or by a majority of the regular members of the board. Special meetings shall be held at the board's regular meeting place.

Section 3.05. Notices of regular and special meetings of the board shall be in postcard form, sent to each member, alternate, and advisor, by United States mail, and shall be given by the secretary or other person designated by the chairman. Notice of each regular meeting shall be mailed on the Friday preceding such meeting. Notice of special meetings shall be mailed at least 72 hours prior to the time of any such meeting.

Section 3.06. All meetings shall be held in compliance with the requirements of the Ralph M. Brown Act (Chapter 9, Division 2, Title 5 of the Government Code), and shall be open and public unless

otherwise authorized by law.

Section 3.07. A quorum shall consist of a majority of the regular members holding office. In the absence of a quorum, a meeting of the board may be adjourned from time to time by vote of a majority of the regular members present, but no other business shall be transacted.

Section 3.08. Each regular member is entitled to one (1) vote on each matter submitted to the meeting. Voting shall be by voice vote, unless a regular member demands a roll call vote, in which event the secretary shall call the roll and duly record the votes of each board member. There shall be no voting by mail or proxy voting.

Section 3.09. Meetings of the board shall be presided over the chairman, or, in his absence, the vice-chairman, or, in the absence of both, by a chairman chosen by a majority of the regular members present. The secretary shall act as secretary of all meetings. Meetings shall be governed by Roberts Rules of Order, as such Rules may be revised from time to time, insofar as such Rules are not inconsistent with or in conflict with these By-Laws.

ARTICLE 4. OFFICERS

Section 4.01. The officers of the advisory board shall be a chairman, a vice-chairman and a secretary.

Section 4.02. The chairman and vice-chairman shall be elected annually by the board from among its regular members, and may be removed either with or without cause, by a majority of the board, at any time.

Section 4.03. The chairman shall preside at all meetings of the board, and shall, as required, serve ex officio as a member of all standing committees of the board.

Section 4.04. In the absence of the chairman, or in the event of his inability or refusal to act, the vice-chairman, shall perform all duties of the chairman, and when so acting shall have all powers of and be subject to all restrictions on the chairman.

Section 4.05. The secretary of the board of directors of the Imperial Irrigation District shall serve, ex officio, as the secretary of the advisory board. He shall not be a member of the said board, and shall have no voting privileges. He shall be responsible for certifying and keeping the original of these By-Laws, as amended or otherwise altered, and shall maintain the same at the Executive Offices of the Imperial Irrigation District, together with the book of minutes of all meetings of the board, recording therein the time and place of holding, whether regular or special, and the proceedings conducted at said meetings. He shall be responsible for giving all notices in accordance with the provisions of these By-Laws or as required by law.

ARTICLE 5. MISCELLANEOUS PROVISIONS

Section 5.01. Committees. The advisory board may designate two or more of its regular members to act as a committee, to investigate and report on such matters as the board deems appropriate. No act of any such committee shall be valid unless approved by vote of the board

itself.

Section 5.02. Fiscal Year. For purposes of these By-Laws, the business of the board shall be conducted on a fiscal year basis commencing July 1st of each year. All terms of office shall be deemed to begin on July 1st and end on June 30th.

Section 5.03. No Compensation or Expense Reimbursement. Regular members shall receive no compensation, salary, or other remuneration for their service as regular members. Expenses incurred by board members, if any, in connection with their service, shall not be reimbursed.

Section 5.04. Effective Date of By-Laws and Amendments. By-Laws shall become effective upon their adoption by the advisory board, and approval by the District board of directors. Amendments may be adopted by a majority vote of the advisory board, subject to approval by the District board of directors.

Section 5.05. Construction. As used in these By-Laws the masculine gender includes the femine and neuter, singular number includes the plural, and the word "shall" is mandatory and the word "may" is permissive.

IN WITNESS WHEREOF, the undersigned secretary of the Water Conservation Advisory Board of the Imperial Irrigation District has executed these By-Laws this _____ day of _____, 1979.

_____
SECRETARY, WATER CONSERVATION
ADVISORY BOARD

The undersigned, Secretary to the Board of Directors of the Imperial Irrigation District, hereby certify that the foregoing By-Laws for the Water Conservation Advisory Board of the Imperial Irrigation District, dated _____, 1979, were approved by the Board of Directors of the Imperial Irrigation District at a _____ meeting held on _____, 1979.

Dated: _____, 1979.

_____

SECRETARY OF BOARD OF DIRECTORS
OF IMPERIAL IRRIGATION DISTRICT

Water Conservation Advisory Board

P. O. BOX 1809
EL CENTRO, CALIFORNIA 92244

ATTENTION: IMPERIAL VALLEY FARMERS

Enclosed are copies of the newly revised 21-POINT WATER CONSERVATION PROGRAM which became effective October 1, 1980.

Please note the change in No. 13 which provides for some limited options for users to adjust an order when all of the amount ordered is not needed. The IID must be notified early to adjust the order if the water is to be made available for another user. To prevent order changes from disrupting other water deliveries only one adjustment time can be offered; the midpoint of the last day of an order.

Some other options are also being offered on a trial basis in the hope that ways can be found to reduce the need for finish orders and also reduce the frequency of finishing early.

WHY THIS RULE CHANGE IS NECESSARY

Many governmental agencies today have plans for maintaining or increasing their use of Colorado River water. The City of Los Angeles will need more water when Arizona begins taking their share of Colorado River water. States in the northern Colorado River basin plan to use more water in converting shale to oil, and for other mining and industrial uses. Never in our history have there been so many demands on Colorado River water.

Imperial Irrigation District has the legal right to divert the water it now uses. But the law states that we have a right to this water only as long as we use it beneficially.

Wasting water is not a beneficial use. Only a small minority of water users waste water, and that minority does not waste a great deal of water. But if we are to be assured of a continuing supply of Colorado River water, as we have had in the past and as we have today -- we must constantly strive to use our water prudently as well as beneficially, and put up safeguards to make sure we don't waste a drop.

That is why the Water Conservation Advisory Board proposed the 21-POINT WATER CONSERVATION PROGRAM and the Board of Directors of Imperial Irrigation District voted unanimously to adopt it.

Your cooperation and suggestions will be appreciated.

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 which 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 five percent (5%) 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 fifteen percent (15%) 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 fifteen percent (15%) or more of his running order irrespective of the quantity of water the user is receiving.

6. Any surface runoff measurement made within four (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 sheets 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 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.

13. A reduction in the water order shall be made to apply to the last twelve (12) hours water is run, providing that the District is notified in advance but not later than 3:00 p.m. preceding the time the order is changed. No penalty shall be charged for said reduction as long as the same does not exceed fifty percent (50%) or five (5) feet of the order as confirmed, whichever is less. Water returned with notice after 3:00 p.m. or which 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 twelve (12) hours of the run, up to fifty percent (50%) of the confirmed order or five (5) 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 fifty percent (50%), 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 eighteen (18) hours after the beginning of the day's water delivery.

18. The District shall secure whatever additional radio equipment that is necessary to improve communications

APPENDIX E

WATER RATES

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 1

General Agricultural and Municipal Service

Applicable to:

(a) Service where water is taken from the canals of the District for general irrigation use by lands or properties located within the boundaries of the District.

(b) Service where water is taken from the canals of the District for use by cities, incorporated or unincorporated, towns, private water companies, mutual water companies, and water utility districts for lands or properties within the boundaries of the District.

Water Rate

For all water delivered Schedule (a)	$6.50 per acre-foot
For all water delivered Schedule (b)	$6.50 per acre-foot

Minimum Charge

The minimum charge for a delivery of water of "stock run" shall be $3.35 per day.

Board Resolution
July 8, 1980

Date Effective
July 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 1-A

Mesa Agricultural Service

Applicable to service for irrigation on mesa lands within the boundaries of the District. By "mesa lands" is meant all lands located above the 1030 contour line.

Water Rate

For the first 6 acre-feet per acre irrigated per year	$ 6.50 per acre-foot
For all over 6 acre-feet per acre irrigated per year up to and including 8 acre-feet per year	$13.00 per acre-foot
For all over 8 acre-feet per acre irrigated per year	$26.00 per acre-foot

Minimum Charge

The minimum charge for a delivery of water of "stock run" shall be $3.35 per day.

Special Conditions

(a) All lands receiving water service under this schedule shall comply in all respects with Regulation No. 19 of the "Rules and Regulations Governing Distribution and Use of Water" approved June 6, 1967.

(b) Where water service is furnished to mesa lands which are outside the boundaries of the District, the water rates shall be double those shown in this schedule. The minimum charge shall be $13.00 per day.

Board Resolution
July 8, 1980

Date Effective
July 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 2

Pump Service

Applicable to service to private pumping plants where water is taken from the canals of the District to be used for general irrigation for lands or properties within the boundaries of the District.

Annual Water Rate

Per acre irrigated (3 AF x $6.50) $19.50 per year

Special Conditions

All power costs associated with the delivery of water for irrigation purposes covered by Schedule No. 2 shall be borne by the water user.

Board Resolution
July 8, 1980

Date Effective
July 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 3

Pipe and Small Parcel Service

Applicable to service from any pipes which are installed to take water by gravity flow only from the canals of the District for general use, or for any service to small parcels from an open ditch.

Annual Charge

(a) For pipes with a diameter of 2 inches or less, or for service to small parcels from an open ditch — $45.00 per year

(b) For pipes with a diameter of over 2 inches and not exceeding 6 inches, per acre served — $30.00 per year

Annual Minimum Charge - Schedule 3(b):

For pipes with a diameter of over 2 inches and not exceeding 6 inches, the minimum charge for each and every service connected shall be — $60.00 per year

Special Conditions

(a) Service to Governmental Agencies Located Outside the Boundaries of the District. When a governmental agency has an installation located outside the boundaries of the District that receives water service by a service pipe, the annual and minimum charge shall be double those shown above.

(b) In the event any of the above pipes serve more than one water user, each additional water user shall be subject to the annual charges provided for in this schedule.

(c) Pump accounts used for water service to cattle and/or feed yards shall be charged on the basis of Schedule 3(b) whether water delivery is made by pipe and/or otherwise.

(d) Water service to small acreages, not otherwise provided for in Schedule No. 5, shall be charged on the basis of Schedule 3(b) or on the minimum charge basis, whichever is applicable.

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 4

Wholesale Service

Applicable to water service to water users' associations, only, for commercial and industrial purposes.

Water Rate

For all water delivered	$ 6.50 per acre-foot

Special Conditions

Annual Rate Based on Gross Acreage. In those cases, where due to conditions existing in the customer's facilities for handling water, it is impractical for the District to install water measuring equipment, water service applicable to this schedule shall be furnished on an annual charge per acre as follows:

Water Charge

For gross acreage of area served, per acre	$52.50 per year

Annual Minimum Charge

Annual minimum charge to any water user's association shall be	$105.00 per year

Board Resolution
July 8, 1980

Date Effective
July 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 5

Miscellaneous Service

Applicable to water service to schools, churches, cemeteries, experimental farms, golf courses, and recreational activities directly connected with such agencies.

Rate

(a) For school grounds, church yards, cemeteries, hospitals, agricultural experimental farms operated by public agencies, and other similar uses by public agencies, none of which are in excess of 40 gross acres, water shall be delivered without charge except as provided in Schedule 6 or 7.

(b) For service to cemeteries and agricultural experimental farms in excess of 40 gross acres, all water delivered shall be charged for at the rates stipulated under Schedule No. 1, "General Agricultural Service."

(c) Water service to golf clubs and for similar organized recreational activities shall be furnished at a rate of $13.00 per year for each acre irrigated.

Special Conditions

(a) Restriction of Use. Water delivered under this schedule shall be used exclusively for purposes directly connected with the functions of the user. Where water so delivered is used for any other purposes, the regular charges under the applicable schedule shall apply.

(b) Water Service - Small Acreages. Except as provided for herein, any water user receiving water directly or indirectly, from the District, and said water user not otherwise subject to a water rate for such water schedule shall be charged as provided for in Schedule No. 3, "Pipe and Small Parcel Service."

Board Resolution
July 8, 1980

Date Effective
July 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 6

Stand-by Service (Water Availability Charge)

Applicable to lands within the service area of the District which are entitled to water service in accordance with the District's Rules and Regulations.

Annual Stand-by Charge

For each gross acre, or fraction thereof, whether water is actually used or not	$ 2.00
Less allowance for any and all right-of-way considerations	5%
Net per acre charge	$ 1.90

Special Conditions

(a) Semi-Annual Billing. Billing for stand-by service will occur semi-annually in advance of January 1 and July 1. The date of delinquency is established as being February 15 and August 15 for the respective 6-month period.

(b) Minimum Charge. No semi-annual billing shall be for an amount less than $1.00.

(c) Private Water Agencies. Charges for acreages within the Imperial Irrigation District which are directly served by private water systems, mutual water companies, or other private agencies providing water services shall be collected from said agencies.

Board Resolution
June 12, 1979

Date Effective
January 1, 1980

Imperial Irrigation District
Imperial, California

WATER RATES

SCHEDULE NO. 7

Water Service Charge

Applicable to lands within the service area of the District which are entitled to water service in accordance with the District's Rules and Regulations and which are not subject to assessment.

Annual Rate

For each gross acre, or fraction thereof, whether water is actually used or not	$ 2.00
Less allowance for any and all right-of-way considerations	5%
Net per acre charge	$ 1.90

Special Conditions

(a) Semi-Annual Billing. Billing for stand-by service will occur semi-annually in advance of January 1 and July 1. The date of delinquency is established as being February 15 and August 15 for the respective 6-month period.

(b) Minimum Charge. No semi-annual billing shall be for an amount less than $1.00.

(c) Public Water Agencies. Charges for acreages within the Imperial Irrigation District which are directly served by public water systems, water utility districts or other public agencies providing water services shall be collected from said agencies.

Board Resolution
June 12, 1979

Date Effective
January 1, 1980