WATER MANAGEMENT PLAN

FOR THE

MODESTO IRRIGATION DISTRICT

July 13, 1999

Prepared In Accordance with
MEMORANDUM OF UNDERSTANDING
November 13, 1996

Regarding

AGRICULTURAL WATER SUPPLIERS
EFFICIENT WATER MANAGEMENT PRACTICES
ACT of 1990 AB 3616

Water Management Plan

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INTRODUCTION

The Modesto Irrigation District (MID) Agricultural Water Management Plan (WMP) has been prepared in accordance with Exhibit B of the Memorandum of Understanding (MOU) regarding Efficient Water Management Practices by Agricultural Water Suppliers in California (November 13, 1996). MID realizes that the AB 3616 process and the negotiated MOU's intent is to encourage agricultural water suppliers to assess current efficient water management practices and to evaluate additional practices the may conserve water and be cost effective. MID also understands that the AB3616 process and the MOU present an opportunity for water suppliers to demonstrate to the public existing accomplishments in water efficiency projects and management.

Section 2 of the MOU states the following purposes:

1. Create a constructive working relationship between agricultural water suppliers, environmental interest groups, and other interested parties
2. Establish a dynamic list of Efficient Water Management Practices (EWMPs)
3. Establish a criteria to evaluate the appropriateness of the EWMPs
4. Implement appropriate EWMPs while avoiding unnecessary or unreasonable planning, paperwork, or expense for water suppliers, thereby voluntarily achieving more efficient water management than currently exists or may be required by law

Section 4 of the MOU states that each signatory water supplier will develop a WMP for EWMPs and take reasonable steps to implement such WMP. Included in this WMP is an analysis with discussion regarding each of the EWMPs presented in Exhibit A of the MOU. The EWMPs are grouped into the following categories:

- List A – Generally Applicable Efficient Water Management Practices

    1. Prepare and adopt a Water Management Plan using the guidelines in Exhibit B of this MOU for agricultural water suppliers
    2. Designate a Water Conservation Coordinator
    3. Support the availability of water management services to water users
    4. Where appropriate, improve communication and cooperation among water suppliers, water users, and other agencies
    5. Evaluate the need, if any, for changes in policies of the institution to which the water supplier is subject
    6. Evaluate and improve efficiencies of water suppliers pumps

- List B – Conditionally Applicable Efficient Water Management Practices

1. Facilitate alternate land use
2. Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to crops or soils
3. Facilitate the financing of capital improvements for on-farm irrigation systems
4. Facilitate voluntary water transfers that do not unreasonably affect the water user, water supplier, the environment, or third parties
5. Line or pipe ditches and canals
6. Increase flexibility in water ordering by, and delivery to, the water users within operational limits
7. Construct and operate water suppliers spill and tailwater recovery systems
8. Optimize conjunctive use of surface and groundwater
9. Automate canal structures

- List C – Other Efficient Water Management Practices

1. Water measurement and water use report
2. Pricing and other incentives

Development of the Plan and the assessing of current practices revealed brought to light the extent to which MID has implemented many of the practices listed in the MOU. The list below includes some of the important practices and other actions already in place at MID:

- Financial contributions to a mobile irrigation lab to provide evaluation of on-farm irrigation systems performance and efficiency. (MID contributes up to 75% of the cost of the evaluations.)
- Financial contributions to water users for the replacement of water supply ditches, pipelines, canal sidegates, lift pumps and debris screens trough the Conveyance Upgrade Program. (MID contributes up to 50% of the cost of these projects)
- Financial loans to water users for the replacement of water supply ditches, pipelines, canal sidegates, lift pumps and debris screens. (MID finances the other 50% of the cost of these projects. The water user may have the total project cost paid and financed by MID)
- An in-lieu groundwater recharge program by providing up to 34,000 acre-feet per year of treated river water to the City of Modesto. Prior to 1995 the City of Modesto relied on groundwater for 100% of its M&I needs.
- A Water Conservation Program from 1989 through 1996 that contributed several million dollars for District and private projects. Some of the projects included concrete lining of canals and replacement of several miles of ditches and pipelines. (Approximately 80% of District canal are concrete lined.)
- The installations of automatic SCADA controls at most of the District's water distribution diversion points and spills. The automation of water diversion pints increases the flexibility for on-farm water deliveries.
- Provides CIMIS information through the telephone and MID's web page. CIMIS information helps water users in calculating crop water needs.

- Acquisition and dissemination of groundwater information for the Modesto Groundwater Basin. MID was the lead agency in the formation of the Basin in accordance with AB 3030 and is the leading management coordinator.
- A co-purchaser and operator (with TID) of a hydrologic model that determines current and future watershed runoff potential. This model will optimize MID's ability to manage its watershed runoff and water storage.

The MID WMP was prepared in accordance with the MOU and consistent with the guidelines in Exhibit B Development and Contents of Water Management Plans and the California Department of Water Resources criteria for the preparation of the WMP Steps 1-9.

Step 1: Coordinate with Other Agencies and the Public

The Plan was prepared in cooperation with public entities including the Turlock Irrigation District and other agricultural water suppliers. MID solicited public input by inviting oral and written comments prior to and during the MID Board of Directors public hearing on July 13, 1999. Table 1. shows some of the local interested parties notified of MID's intent to adopt a Plan.

Table 1.
Solicitation and Participation Efforts

	Helped write plan	Provided assistance	Was sent a copy of the draft	Com-mented on the draft	Attended public meetings	Notified of intention to adopt
Local government agency	☐	☐	☐	☐	☐	X
Special districts	☐	☐	☐	☐	☐	X
Regional agency	☐	☐	☐	☐	☐	X
Environmental citizen group	☐	☐	☐	☐	☐	X
Land Use Agencies	☐	☐	☐	☐	☐	X
Business group	☐	☐	☐	☐	☐	X
Social citizen group	☐	☐	☐	☐	☐	X
State government agency	☐	☐	☐	☐	☐	X
Federal government agency	☐	☐	☐	☐	☐	X
Irrigation Districts	X	X	☐	X	☐	X

Step 2: Describe the Water Supplier

The Modesto Irrigation District is a public utility that supplies surface water, groundwater, and electrical service to agricultural and municipal customers. MID obtains its surface water supply from the Tuolumne River. The 1,880 square mile Tuolumne River watershed extends to the high Sierra. Most of the water in the river comes from snow melt of winter storms. Peak flows occur during the months of April through July, during which time over 60 percent of the annual flow occurs. The Tuolumne River annual flow averages over 1,800,000 acre-feet, varying between a low of 383,000 acre-feet in 1977 to a high of 4,430,000 acre-feet in 1983. Figure 1 is a chart showing historical Tuolumne River computed natural flows at La Grange Dam based on monthly averages.

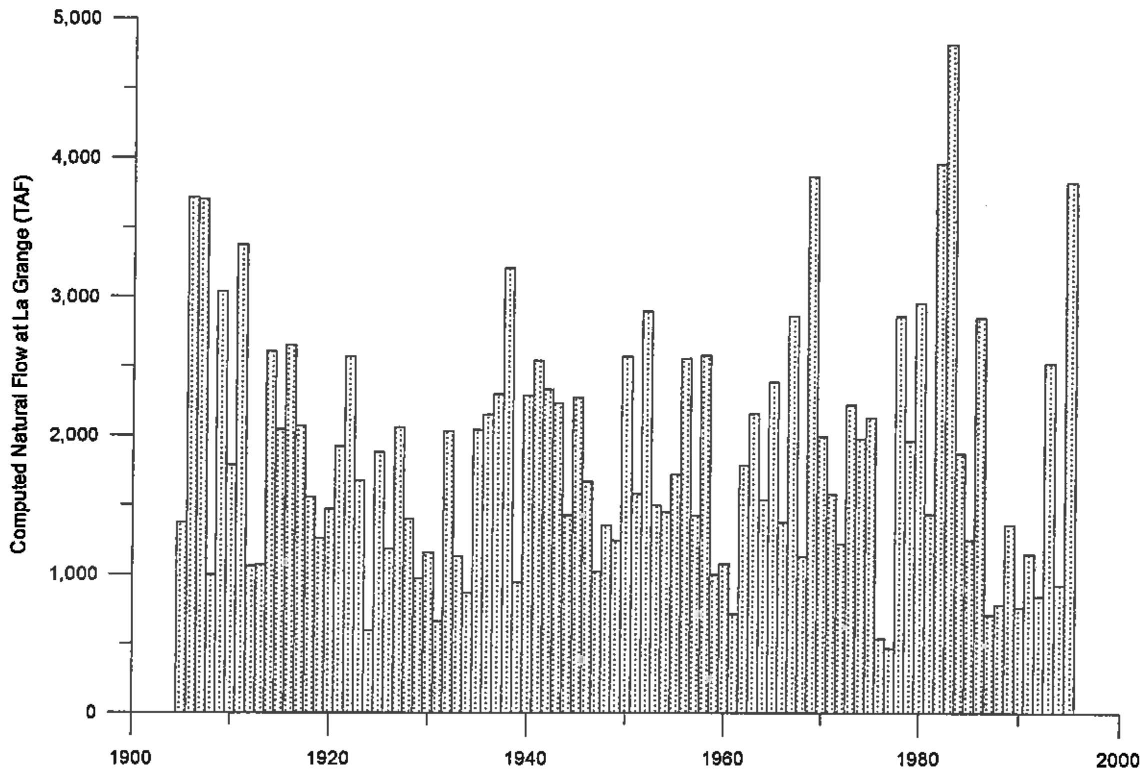

Figure 1: Computed Natural Flow Below Don Pedro Reservoir (1905-1995)

2A: History and Size

MID was formed on July 9, 1887 as the second irrigation district in California formed under the California Irrigation Districts Act (Wright Act). During its early years, MID acquired numerous water rights and developed facilities to irrigate agricultural lands and to generate electricity. Since its beginning, MID has provided low cost water and power to its customers. Water from the Tuolumne River is diverted to MID's water conveyance facilities to the 108,000 acres of land within the District service area. As shown in table 2., MID currently delivers water to 71,000 acres of irrigated land.

Table 2. Water Supplier History and Size	
Requested Provision	**Explanation**
Date of Formation	1887
Source of Water At Time of Formation	Tuolumne River
Gross Acreage at Time of Formation	108,000
Present Irrigated Acreage	71,000

2B: Location and Facilities

The MID is located in eastern Stanislaus County, which is part of the northeastern San Joaquin Valley. The San Joaquin Valley makes up the southern two-thirds of the Great Central Valley of the State of California. The MID is bounded on the north by the Stanislaus River, on the south by the Tuolumne River, on the west by the San Joaquin River, and on the east by the Sierra Nevada Foothills. The terrain of the District is relatively flat and is composed primarily of alluvial fans sloping from east to west from the foothills to the San Joaquin River. Elevations range from over 200 feet on the east to less than 40 feet on the west. Figure 2.is a map of California showing MID's location in eastern Stanislaus County. The fold out map shows MID's boundary, irrigation canals, Modesto and Don Pedro Reservoirs.

Plan

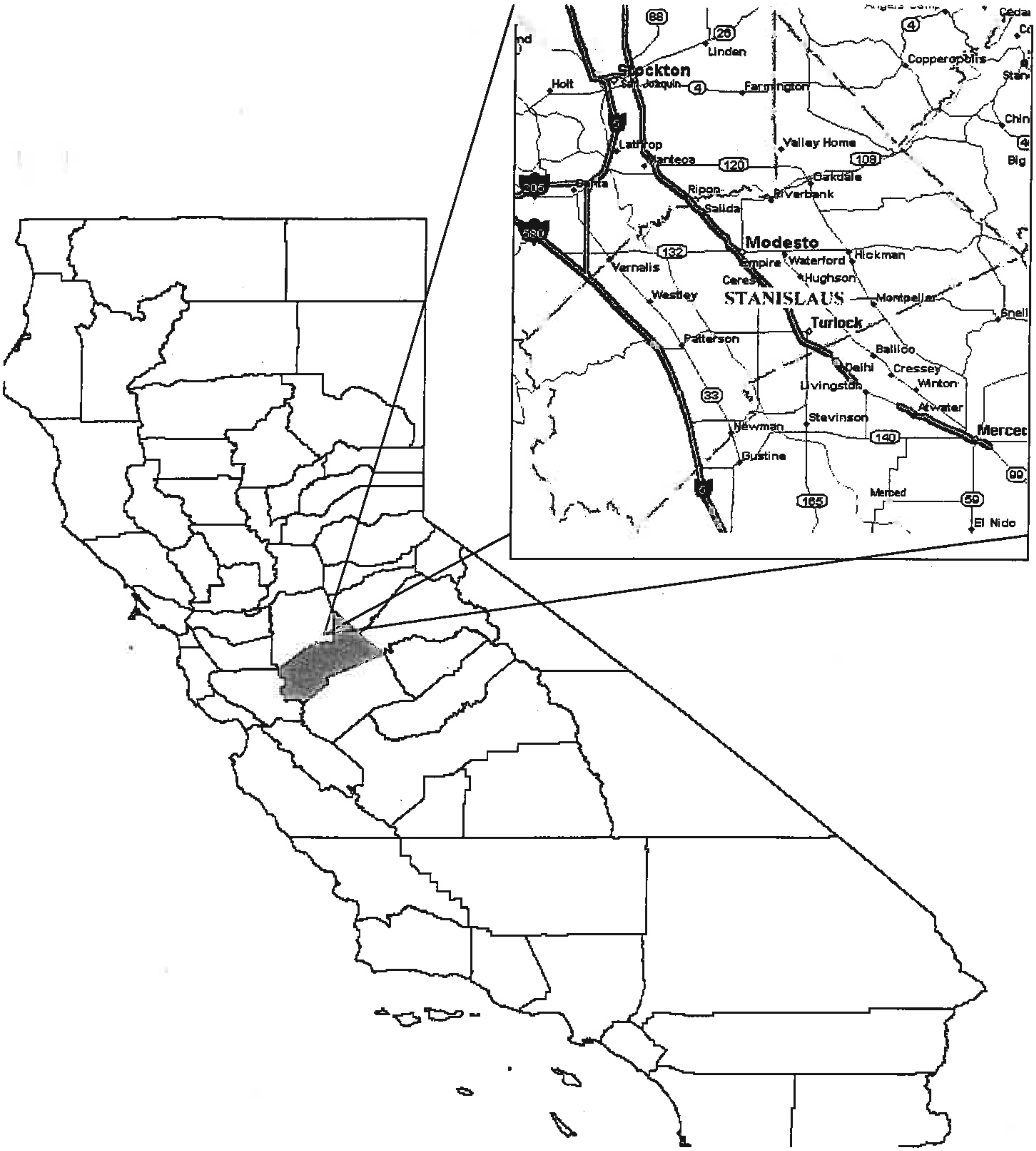

Figure 2: Map showing location of MID

MID distributes a combination of Tuolumne River water and groundwater via a network of storage facilities, canals, pipelines, pumps, drainage facilities and control structures. MID's first project as a public entity was the construction of La Grange Dam completed on December 13, 1893 in conjunction with the TID. This dam is still used as the facility to divert water into MID's main irrigation canal from the Tuolumne River as it leaves the Sierra Nevada foothills. On June 27, 1903 farmers along the newly completed main canal began receiving water. By September of that year water was moving through some of the laterals. Table 3. provides a summary of existing irrigation facilities in MID.

Table 3. Water Conveyance and Delivery System	
System Used	**Number of Miles**
Unlined Canals	25
Lined Canals	95
Pipelines	105
Drains	10

Storage and regulation of main canal deliveries began in 1911 with the completion of the 28,000 acre-foot Dallas-Warner Reservoir, now known as Modesto Reservoir. Carryover storage of water from year to year to protect permanent crops from extended drought periods was not available until the completion of the Old Don Pedro reservoir in 1923. Old Don Pedro reservoir allowed MID and TID to store a maximum of 325,000 acre-feet of water each year and to begin generating electricity from hydrogeneration facilities developed to help pay for the cost of the irrigation system. In 1970, MID again added to its storage and power generation facilities with the completion of New Don Pedro Dam and Reservoir with a maximum storage capacity of 2,030,000 acre-feet. MID has the capability to store up to 255,789 acre-feet of water annually in Don Pedro Reservoir. As Table 4 indicates, MID has a total annual carryover storage capacity of 283,789 acre-feet of water.

Table 4. Supplier Reservoirs	
Reservoir	**Volume (ac-ft)**
Modesto Reservoir	28,000
Don Pedro Reservoir	255,789
Total Storage	283,789

The MID water conveyance and delivery system was designed for gravity flow. The water flows by gravity from Don Pedro on the east to the San Joaquin River on the west. Gravity water conveyance systems are energy efficient but will create unavoidable operational spills to the downstream rivers and creeks. The end of the system operational spill water is of relatively high quality but is lost to MID. MID does not have operational spill water return facilities to capture and return it upstream for reuse by the water users.

On-farm surface drainage is minimal. The majority of the land within the District's service area retains irrigation tailwater within the parcel boundary. Table 5 summarizes the tailwater/spill recovery system.

Table 5. Tailwater/Spill Recovery System	
System	Yes/No
District Operated Tailwater/Spill Recovery	No
Grower Operated Tailwater/Spill Recovery	Yes

As described above, the MID on-farm water delivery system was designed to deliver irrigation water to water users by gravity and with very large flows (10-20 cfs). The delivery system was originally designed to deliver flood irrigation water on rotation (availability of water on a pre-determined rotation – typically every 10-20 days). Water delivery on rotation can be an effective and efficient method to deliver irrigation water to flood irrigated level basins (level land parcels with borders – typically 1-5 acres in size). As growers began to convert the on–farm irrigation systems from flood to pressurized irrigation systems, the requests for irrigation water began to shift from rotation to arranged-demand (availability of water on request as consumed by the crop - typically from daily to every 2-3 days).

Since water delivery on rotation is not compatible with water demands of pressurized irrigation systems, MID Board of Directors has approved funding to upgrade the District's water delivery system and enhance the water delivery flexibility. With District and private upgrades, MID is capable of delivering irrigation water to most of its customers on a modified demand schedule (availability of water on demand with advanced notice – typically a 1-3 days minimum advance notice). As summarized on Table 6. MID delivers water to its water users using modified demand and rotation schedule.

Table 6. Supplier Delivery System	
Type	Check if Used
On Demand	X
Arranged Demand	X
Rotation	X

Don Pedro Reservoir is a multipurpose water storage facility. Since one of Don Pedro functions is to generate electricity, it operates under the jurisdiction of the Federal Energy Regulatory Commission (FERC) license and requirements. The licensing requirements mandate that minimum fish flows downstream of Don Pedro be maintained to protect downstream fisheries. As a result of the most recent FERC agreement signed in 1995, the minimum flows below La Grange Dam are based on a 10-step water year classification similar to the California Department of Water Resources. During wet years required flows can be as high as 300cfs and dry years as low as 50cfs. The minimum flows were increased several times over the prior license requirements. In addition to the minimum flows, MID and TID release pulse flow water in the spring and fall to encourage salmon juvenile fish to migrate downstream though the delta to the open ocean. As per Table 7., the required minimum flows have an impact on the storage of water behind the Don Pedro dam.

Table 7. Restrictions on Water Sources		
Restrictions	**Name of Agency Imposing Restrictions**	**Operational Constraints**
Storage Amount /Time of Diversion	SWRCB	Water Storage and Time of Diversion
Minimum Instream Flow Requirements	FERC	Water storage and Rate of Change in River Flow

As per table 8., currently there are no plans to change the MID service area. However, as the City of Modesto continues to expand, the irrigated acreage continues to be reduced.

Table 8. Expected Changes to Service Area	
Change to Service Area	**Affect on the Water Supplier**
Reduced Service Area Size	Not anticipated
Increased Service Area Size	No expansion plans at this time
New Governmental Entity	No
Reduced Irrigated Land	Decrease demand for irrigation water and increase demand for urban water

2C: Terrain and Soils

The geologic formations of MID land area consists mainly of sediments that have formed broad alluvial plains of the Stanislaus and Tuolumne Rivers. These perennial streams flow in a southwesterly direction and discharge into the San Joaquin River, which in turn flows northwestward to the Sacramento-San Joaquin Delta and Estuary.

Following the period of volcanism, a series of glaciations and a major uplifting of the mountains accompanied by lesser uplifting along the eastern side of the valley resulted in large quantities of granitic rock being ground up, and washed down into the valley. This is reflected by several mantels of granitic alluvium of various ages in the alluvial plains of the area. Recent alluvium is found only along the present river bottoms and in small fans in the trough of the valley. The rivers and their floodplains are entrenched across the fans between sharply defined escarpments, suggesting that the rivers have cut their way down to their present level relatively recently.

The topography on the eastern one-third of the District's service area consists of hilly to rolling land sloping in a westerly direction. Until the last few years, this area was predominately irrigated with impact sprinklers. As in much of the District service area, micro sprinkler and drip irrigation are the current system of choice for permanent crops using pressurized irrigation systems. The western two-thirds of the service area consists primarily of flat land with a westerly slope. The predominant irrigation systems in this area continue to be flood irrigation using level basins. Table 9. summarizes the topography impacts to the irrigation of the land.

Table 9. Topography Impacts	
Topography Characteristic	**Impact of Water Operations**
Rolling Land (20% of Irrigated land)	Land is adaptable to sprinkler and micro irrigation systems.
Flat Land (80% of irrigated land)	Land is adaptable to flood and other types of irrigation systems

The soils of the District consist of a broad range of textures from sand to heavy adobe. The soils are distributed according to their position in six distinct physiographic areas of the district: (1) Alluvial flood plains; (2) basin land; (3) young alluvial fans; (4) low alluvial terraces; (5) high alluvial terraces, partially eroded into rolling hills; and (6) uplands of the Sierra Nevada. The eastern fringe of arable land occurs in the rolling hills of the upland range where the older granitic alluvium supports irrigated trees, mainly almonds. The western fringe consists of mixed alluvium of low relief with some occurrence of heavy adobe and clay containing alkali. Much of the alkali area has been reclaimed, and supports mostly pasture, with some row and other field crops. The largest area of land within the basin rim consists commonly of sand to sandy loam which also supports a wide range of crops and growing conditions. Hardpan occurs mostly in the eastern and western edges of the area and varies in hardness from a slightly cemented mass, which easily disintegrates, to material so firmly indurated (physically hardened) that it is practically impenetrable to plant roots and impervious to water.

Irrigation wells drilled in the District areas where the Corcoran Clay is present penetrate aquifers both above and below the clay. However, some deeper wells are perforated exclusively below the Corcoran Clay. Because there are so few wells completed in the confined aquifer, not much information is known about the groundwater movement. Generally, wells screened mostly above the clay exhibit better production characteristics than those perforated in zones below the clay. Although numerous silt and clay beds occur above and below the Corcoran Clay, they are not correlated over large areas. Therefore, those beds are only of local importance to the confinement of groundwater.

Table 10. Soil Characteristic Impacts	
Soil Characteristic	**Impact of Water Operations**
Clay Loam	No irrigation operations impact
Sandy Loam	"
Loam	"

2D: Climate

The major features of the climate are hot, dry summers and cool, wet winters. Temperature distribution is uniform throughout the area, but average annual rainfall increases from about 10 inches at the San Joaquin River to about 14 inches at the edge of the foothills. Most of the precipitation occurs from December to March with little to none occurring during the summer months June through August; the pattern for potential evapotranspiration and evaporation from a water surface are just the reverse. Summer temperatures commonly are above 85°F. and may exceed 100° F., but are rarely in excess of 105°F . Winter temperatures commonly fall below 32°F., but they are rarely lower than 25°F. Table 11. shows the average rainfall, maximum summer high and minimum winter low for Modesto. Prior to the installation of the irrigation system, dry land crops (primarily wheat) were grown in this area but the hot, dry summers require the use of irrigation water for most types of intensive agriculture.

Table 11.
Climate Characteristics

Climate Characteristic	Annual Value
Average Precipitation	12 Inches
Minimum Temperature (Avg. Winter)	37°F
Maximum Temperature (Avg. Summer)	95°F

2E: Operating Rules and Regulations

Rules Governing the Distribution of Water in the Modesto Irrigation District (1986 revision) are used as a guideline for the operation and delivery of water to the water users. The rules contain procedures to distribute irrigation water orderly, efficiently, and equitably to the water users. Currently, the District is in the process of revising the rules to reflect changes in policy regarding water distributions. As indicated on Table 12., the irrigation water allocation policy, which establishes the amount of water available to the landowners and the cost of the water, is adopted by the Board of Directors annually. The allocation is based on the volume of water in storage and the projected runoff from the watershed. The allocation is not finalized and adopted until after the rainy season and when runoff information has been made available by the California Department of Water Resources. In addition to establishing the water allocation and cost, the Board sets a tiered pricing structure for those water users who exceed the annual water allocation.

Table 12.
Water Allocation Policy

	(Check if applicable)			
Basis of Water Allocation	**Flow**	**Volume**	**Seasonal Allocations**	**Normal Year Allocation**
Land within the service area		X		
Reservoir storage		X		
Riparian rights				
Water year		X		

MID operates a decentralized water ordering and shut-off system. The Ditchtenders (personnel who manage the water delivery to the water users) take water orders from water users and coordinate deliveries based on demand and water flow capacity of the distribution system. As the District moves away from rotation to the more flexible arranged demand water delivery, the Ditchtenders' functions become less routine and more customer oriented. Some water users on flood irrigation may continue to irrigate on a fairly constant rotation while the water users with pressurized irrigation systems may request irrigation water on an arranged demand. Therefore, water orders lead times may vary depending on the time of year, system capacity to move the water, and where water is needed in the system. For example, a water users close to the water source, next to a large canal, and early in the season would have a greater probability of receiving water on short notice than someone at the end of the canal, away from the water source, and in the middle of the summer. The District's goal is to supply water to the water user when the water is needed for the crop. Table 13. shows the variation of water orders and shut-off lead times.

Table 13.
Actual Lead Times

Lead Times	Hours/Days
Water orders	0-72 hours
Water shut-off	End of Irrigation

2F: Water Delivery Measurement or Calculations

MID employs a variety of water measurement methods. The sidegate submerged orifice using pressure deferential between the canal and the discharge is the predominant method to calculate water flow from canals. Properly calibrated, the submerged orifice can be a reasonably accurate method of water measurement as shown in Table 14. The main disadvantage of this method of measurement is in obtaining a representative flow for the duration of water delivery. Canal water elevation changes during the water delivery period will change pressure deferential between the canal and the delivery point, and consequently, change the flow. This change in flow will affect the total volume of water delivered to the water user. Therefore, in order to accurately measure the volume of water delivered, the Ditchtender's water flow calculations must take into consideration fluctuations in flow during the delivery. By using the water elevations and sidegate opening with the aid of calibrated tables, the Ditchtender can field calculate the volume of water delivered to the water user. The filed information is also submitted weekly for input into a computer program which calculates cumulative water delivered to the water user. The computer information is later used to bill the water user for water used in excess of the allocated amount and in accordance with the tiered price.

Table 14. Water Delivery Measurements				
Type of Measurement	**Frequency of Measure (Days)**	**Frequency of Calibration (Months)**	**Frequency of Maintenance (Months)**	**Est. Level of Accuracy (%)**
Orifices	As required	Infrequently	As needed	10
Propeller meters	"	"	"	5
Weirs	"	"	"	10
Flumes	"	"	"	7
Venturi meters	"	"	"	5
Pump, runtime	"	"	"	10
Pump, kwh	"	"	"	10

2G: Water Rate Schedules and Billing

As discussed under Section 2E, the MID Board of Directors establishes an annual irrigation water allocation policy. Within the allocation policy is an increasing block rate (tiered) pricing structure for water users who exceed the amount of allocated water. The block rate structure is modified annually but typically contains two to three blocks of water with increasing price rates. Therefore, as Table 15. shows, MID has a uniform water allocation followed by an increasing block pricing structure..

Table 15. Rate Structure	
Type of Billing	**Check if Used**
Uniform	X
Increasing Block Rate	X

MID bills its irrigation water users annually at the end of the irrigation season. Towards the end of the year, the water users will receive a bill for the base water allocation which includes improvement district charges, if applicable. This bill is payable in two equal installments. If the water user exceeds the base water allocation, another bill for the increasing block rate charges will also be mailed to the water user.

Table 16. Frequency of Billing	
Frequency	**Check if Used**
Annually	X

2H: Water Shortage and Allocation Policies

Water supplies on the Tuolumne River vary according to the amount of watershed precipitation and the prior year carryover storage in New Don Pedro Reservoir. As such, water supply planning must take into consideration the amount of water that will be available when the irrigation season starts and current year water needs. The planning must also consider carryover to the following year should it be a dry year. The objective is to carryover enough water to satisfy at least the permanent crop water needs.

During water short years, MID will decrease the water allocation accordingly and may shorten the irrigation season. In water short years, MID will also conjunctively use its irrigation water pumps to supplement river diversions. In addition, water users may turn-on their private irrigation wells to supplement District supplied surface water. During the drought of the early 1990's, MID established contingency plans to restrict water deliveries to annual crops if there was not enough water from existing sources to supply all crops. The contingency plans were not needed, and consequently, a policy of restricting water deliveries based on the type of crop grown was not implemented or tested.

Table 17.
Decreased Water Supplies Allocations

Allocation Method	Check if used
Decrease Allocated Water	X
Shorten Irrigation Season	X
Restrict Water to Certain Crops	X

Rule No. 12 of *MID Rules Governing the Distribution of Water in the Modesto Irrigation District* specifically addresses consequences to water users who waste water. Rule No. 12 states the following: "Persons wasting water on roads or vacant land, or land previously irrigated, either willfully, carelessly, or on account of defective ditches or pipelines or inadequately prepared land, or who shall flood certain portions of the land to an unreasonable depth or amount in order to properly irrigate other portions, will be refused the water until such conditions are remedied."

Table 18. summarizes enforcement methods used against wasteful water uses.

Table 18.
Enforcement Against Wasteful Water Use

Enforcement Method	Check if used
Shut-off of Water	X
Fines	X

Step 3: Inventory of Water Supplies

MID obtains its surface water supplies from the Tuolumne River. Figure 3 shows the total annual water diversions from the Tuolumne River by the District and the number of acres irrigated each year between 1905 and 1995.

3A: Surface Water Supply

The Tuolumne River water is diverted to storage at Don Pedro Reservoir and re-diverted downstream at La Grange dam into the District's canal system. The District diverts water according to a series of pre and post-1914 appropriative and storage rights recognized by the State of California. Most of the diverted water flows through the Upper Main Canal into the Modesto Reservoir for release to downstream agricultural lands and to the Modesto Regional Water Treatment Plant. Some water is diverted directly form the Upper Main Canal to water users. Table 19. shows MID's water diversions from the Tuolumne River for the years 1994-1998 in acre-feet per year.

Table 19.
Surface Water Diversions

Source	Diversion Restriction	1994	1995	1996	1997	1998
Water Diverted from the Tuolumne River at La Grange (USGS Provisional Data)	Storage Capacity and River flows	285,100	305,100	340,300	350,300	272,500

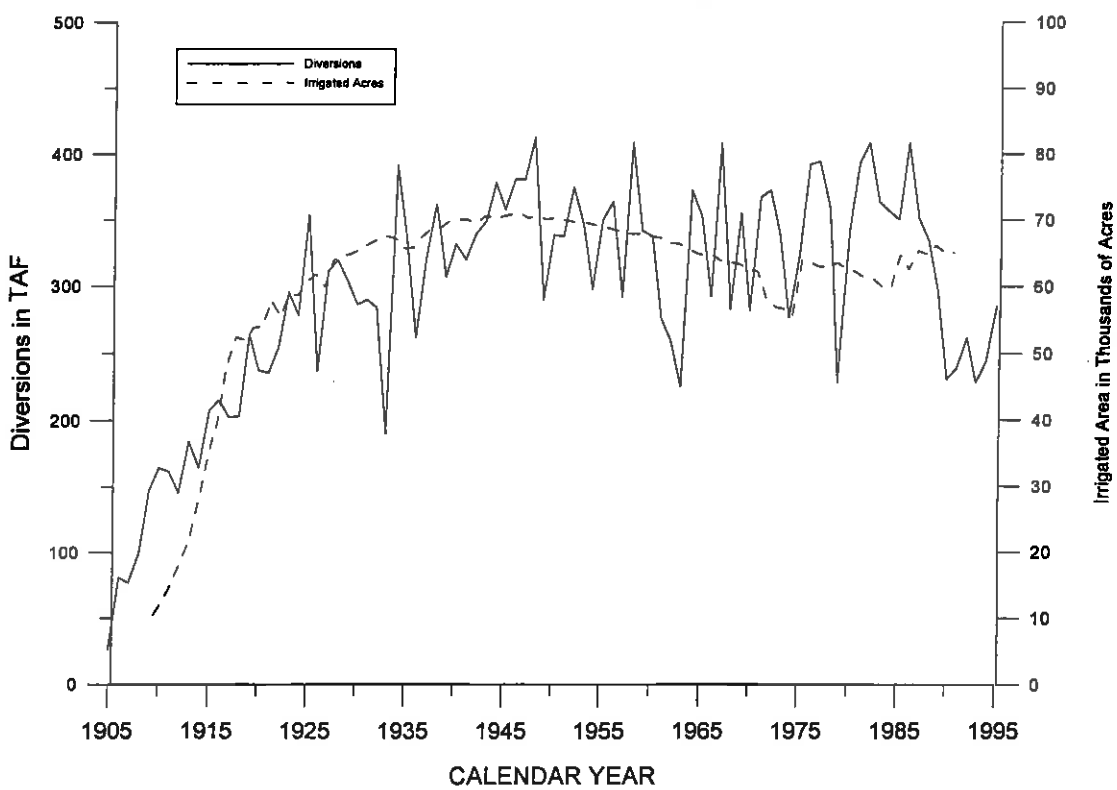

Figure 3: Annual Tuolumne River Diversions by MID
Versus Annual Irrigated Area--1905 to 1995.

3B: Groundwater Supply

Through 1994, the Modesto area experienced a growing urban population dependant on groundwater as its sole source of water supply. Under the City of Modesto, groundwater levels declined about 42 feet between 1924 and 1994, with most of this taking place after World War II. As the city grew, so did the cone of depression. In 1994, MID completed the Modesto Regional Water Treatment Plant, a 30 million gallons per day (33,000 acre-feet/yr.) domestic water project. The treatment plant is projected to be increased to 60 MGD (67,300 acre-feet/yr.) at some future date. This municipal and industrial water supply is to help offset decreasing groundwater levels in the Modesto area via in-lieu recharge.

The depth to groundwater in the District ranges from less than five feet on the west side near the San Joaquin River to over 100 feet on the east side. The hydraulic gradient of the unconfined groundwater is generally southwesterly from the mountains toward the valley trough parallel to the slope of the river channels. In areas influenced by the rivers or by urban pumping centers or agricultural pumping, the direction of the local groundwater flow gradient is altered significantly. Within the area where surface water supplies are not available, groundwater pumping has lowered the groundwater table as much as 88 feet between 1971 and 1992 (Department of Water Resources, 1992). Water level declines in the Modesto urban area have been as much as 20 feet during that same time period.

Surface water diversion from the Tuolumne River by MID, and the deep percolation of applied surface water to agricultural areas, comprises the major source of groundwater recharge for the groundwater basins. Significant other sources of recharge include stream-aquifer interactions and precipitation. In 1996, the Modesto Groundwater Basin Management Plan was established. In addition to MID, other groundwater basin partners include Oakdale Irrigation District, the City of Modesto, Stanislaus County, the City of Oakdale, and the City of Riverbank. Table 20. summarizes statistics regarding the Modesto Groundwater Basin.

Table 20.
District Groundwater Basins

Basin Name	Size (Sq. Mi.)	Usable Capacity (AF)	Safe Yield (AFY)
Modesto Groundwater Basin	• 360	• 1,370,000	• 221,000

- DWR San Joaquin District Modesto Groundwater Basin Information: http://wwwdpla.water.ca.gov/sjd/groundwater/118modes.html

Table 21.
Groundwater Management Plan

Written By:	Black & Veatch, et al
Year :	1996
Is Appendix Attached?	Yes

Drainage Wells

Drainage wells have been employed by the District to control shallow groundwater levels (perched water table) in the western part of the District since 1918. Drainage wells are relatively shallow (usually less than 100 feet deep), and are perforated throughout their depth. They are generally pumped during the irrigation season to lower groundwater levels below the crop root zone which allows for favorable root development growth. In some areas, drainage wells are used more as irrigation water supply wells as a result of groundwater level declines since the 1970's. Although drainage well water is of lesser quality than surface water, it is suitable for agriculture and in most cases meets drinking water standards. As table 22. summarizes, there are no flows to saline sinks and flows to a perched water table are minimal.

Table 22. Deep Percolation Characteristics	
	Volume (AF)
Flows to saline sink	N/A
Flows to perched water table	Minimal

Irrigation Wells

The older alluvium, in the western half of the area, is the most extensively developed aquifer in the District's service area, yielding water to large numbers of wells. In the northern part of the area, the older alluvium ranges in thickness from about 0 to 400 feet, whereas in the southern part, it ranges in thickness from about 0 to 700 feet. Yields to wells are reported as large as 4,500 gallons per minute. Younger alluvium occurs near the surface and as narrow bands along the river channels in the area. Near the western boundary of the area, the younger alluvium is interbedded with the flood basin deposits. The alluvium ranges in thickness from 0 to about 100 feet. Because in most places the younger alluvium is not completely saturated, it yields only moderate quantities of water to wells.

Because of the availability of surface water, groundwater pumping by the District as a source of supply has generally been used to supplement reduced surface water diversions from the Tuolumne River and to serve areas where water cannot be delivered. Some groundwater pumping occurs adjacent to downstream laterals to reduce fluctuations in canals and to meet on-farm deliveries when flow mismatches occur.

Little or no private agricultural pumping occurred prior to the early 1940's. Beginning in the late 1940's, reliance on District surface water began to erode as some alfalfa land converted to tree crops. Because the District's gravity flow facilities were designed for large volume flood irrigation on rotation, water users requiring more frequent irrigation for the new tree crops turned to the abundant supply of groundwater underlying the District. Over the next several decades, droughts and urban development increased the demand for groundwater. Since the mid-1970's, increasing changes in land use, population, crop types, and irrigation technology again fostered a growing trend in groundwater consumption for irrigated agriculture. Urban growth in the District created higher land values spurring additional irrigated acreage to be converted to urban land uses. During this same period, many local growers switched to permanent crops, such as trees and vines, and began converting from flood irrigation to pressurized irrigation system (drip and micro-spray) technologies for convenience and to maximize potential profits. The growing of tree crops and vines with pressurized irrigation systems requires more frequent irrigation. Pressurized irrigation systems also requires cleaner water free from debris. As a result, a growing number of water users are converting to groundwater for their pressurized irrigation systems water supply rather than installing the more expensive filtration required for surface water.

Groundwater levels declined significantly between the 1970's and the 1990's as a result of increasing levels of urban groundwater consumption and agricultural pumping. As a result, the use of many District's drainage wells have been discontinued or are used as supply wells. To balance the use of surface water versus groundwater, the District is providing incentives and developing management strategies to minimize fluctuations for historical gravity flow irrigators, but provide irrigation on arranged demand for those customers requiring greater flexibility. Measures being considered to accomplish this objective include:

- Increasing use of automated District control structures and deep wells
- Using canals as short-term reservoir systems
- Methods to enhance groundwater recharge during wet years
- Reducing the length of the water conveyance system between the canal and water user
- Providing cost incentive programs for water conveyance system improvements

The objective of these new strategies is to ensure that farmers use surface water when its available. The ratio of surface water to groundwater use is an important water resource management tool to the District. If groundwater levels decline to the extent it becomes a problem, additional groundwater management measures will need to be exercised by the District to protect the availability of groundwater. Without these District measures, the transition to greater conjunctive use of groundwater could have far-reaching effects on the local area's water reliability.

3C: Other Water Supplies

MID obtains its irrigation water from Tuolumne River diversions and from groundwater supplies. There are no State or Federal water supplies available to the District. A small amount of water is captured from Oakdale Irrigation District (OID) operational spills. OID serves water to irrigated land located upstream and to the northeast of MID's service area. OID water originates from the Stanislaus River and is of similar quality as water diverted from the Tuolumne River. When possible, MID uses water from OID operational spill to supplement its supplies.

3D: Source Water Quality Monitoring Practices

Groundwater quality in the District ranges from mostly good in the unconfined aquifer to poor quality in some areas of the confined aquifer. Total dissolved solids (TDS) in groundwater in the eastern two-thirds of the District is generally less than 500 milligrams per liter (mg/L), with a range from 90 mg/L to 700 mg/L: High TDS (2,000 mg/L) groundwater is present beneath the District at a depth from about 400 feet in the west to over 800 feet in the east. This water originates in a regional deposition of marine sediments underlying the San Joaquin Valley. The shallowest high TDS groundwater (TDS greater than 1,000 mg/L) may occur at around 120 feet below land surface within a 5 to 6 mile wide zone parallel to the San Joaquin River.

Groundwater quality data show that average TDS concentrations increased over 100 mg/L from 1950 to 1990. Research indicates that the deep saline water is under sufficient hydraulic head to cause its upward migration through wells, cracks, fissures, and faults. MID maintains a water monitoring program that tracks agricultural water use suitability and domestic water standards as indicated on Table 23.

Table 23. Water Quality Monitoring Practices	
Monitoring Location	**Monitoring Practice**
Canals	Agricultural Suitability, Dissolved Oxygen (DO)
Irrigation Wells	Agricultural Suitability, DO
Modesto Reservoir	Domestic Suitability

3E: Water Uses Within the Water Supplier's Service Area

Don Pedro Reservoir is a multiple purpose facility. In addition to storing and supplying irrigation water for agriculture, it is used to generate electricity, recreation, and water sports. MID's water is also used for the environment and Municipal and Industrial uses. As a co-owner of Don Pedro hydropower facilities, MID receives 31.54% share of the electricity generated from it to serve its electrical customers.

As indicated on Table 24., water year 1997 was considered as the representative year for the data listed in subsequent tables.

Table 24. Representative Year	
Representative Year Data is Based Upon	1997
First Month of Representative Year	January
Last Month of Representative Year	December

3E1: Agricultural Use

MID supplies irrigation water to many crops as listed in Table 25. The primary products grown within the MID service area are trees (mostly almonds), vines, grain, row, and pasture crops. The average irrigation account serves approximately 20 acres with nearly 3,200 accounts. The evolution of irrigation and changing economic conditions has brought many crop changes to the District. Extensive agricultural cropping patterns of thousands of acres planted to a single crop were replaced with intensive agriculture cropping patterns of numerous smaller parcels planted to a wide variety of high value specialty crops. Nuts such as almonds and walnuts have been the fastest growing crops in the District. During the last several years, thousands of acres of pasture land have been converted to permanent crops. As the land is converted, pressurized irrigation systems such as drip and micro sprinkler replace flood irrigation as the predominant method of irrigation. Similarly, the on-farm irrigation water efficiency improves as the irrigation system conversions materialize. Table 25 also summarizes the total crops water needs for the crop mix within the District service area.

Table 25.
Agricultural Crop Data

Type of Crop	Total Acreage	Planting Month	Harvest Month	ETc	Cultural Practices	Leaching Requirement	Total Crop Water Needs
Alfalfa Hay	3,300			4.15		226	13,910
Almonds	18,182			3.08		1,168	57,241
Apples	219			3.56		17	798
Apricots	21			3.08		1	66
Beans – Dry	907			1.70		52	1,596
Berries – Bush	83			3.39		6	288
Cherries	145			3.56		11	528
Garden – Other	39			1.95		2	78
Grain – Barley	370			1.82		2	677
Grain – Corn	562			2.22		24	1,270
Grain – Hay	6,235			1.53		44	9,574
Grain – Milo	0			1.44		0	0
Grain – Oats	1,197			1.82		11	2,194
Grain – Other	110			1.82		0	201
Grain – Rye	0			1.82		0	0
Grain – Wheat	1			1.82		0	2
Grapes – Table	10			2.46		0	25
Grapes – Wine	3,478			2.46		190	8,752
Kiwi	6			3.30		0	20
Lawn – Garden	89			3.64		2	327
Melons –Other	10			1.64		0	17
Melons	25			1.80		0	46
Miscellaneous	718			2.79		35	2,039
Nursery Stock				2.20		7	272
Other Fruit & Nut				3.10		16	831
Pasture – Irrig.	11,968			4.34		422	52,333
Peaches	3,842			2.98		224	11,683
Pumpkins	9			1.48		0	14
Rice	975			3.39		36	3,339
Silage – Corn	8,898			2.05		86	18,314
Strawberries	0			1.91		0	0
Sudan	325			1.87		7	615
Trees–Christmas	48			4.62		4	227
Vegetables–Misc	512			1.95		28	1,025
Walnuts	8,141			3.06		487	25,398
TOTAL	70,8O8			AVG. 2.57		3,108	213,700

The District's service area encompasses 108,000 acres. As shown on Table 26., approximately

71,000 acres are irrigated with 63,000 receiving surface irrigation water and 8,000 acres using other sources of water - mostly private irrigation pumps. A majority 37,000 acres of non-irrigated land in the service area is within the City of Modesto Although this land is not considered irrigated, MID delivers treated water to the City of Modesto for M&I consumption of which some of the water is used for urban irrigation.

Table 26.
Irrigated Acres

Total Irrigated Acres	71,000

For purposes of this report cropped acreage is the same as irrigated acreage. The amount of irrigated land that is not cropped at any point in time during the year is small. Over 50% of the cropped land is planted with permanent crops. Most of the land not planted with permanent crops is devoted to pasture and corn sillage used primarily for dairy cattle feed. Land planted to corn silage is typically double cropped during the winter and spring months with winter forage also used primarily for dairy cattle. As shown in Table 27, inter-cropping is not a common practice for the crop mix grown within the MID service area

Table 27.
Multiple Crops

Cropped Acres	71,000
Inter-cropping	Negligible
Double Cropping	8,400

3E2: Environmental

The United States Fish and Wildlife Service (USFWS) has purchased over a thousand acres of land within the MID service area for a wildlife preserve. This land receives an annual water allocation from MID of over 3,000 acre-feet. As per Table 28., the FERC agreement for the operation of Don Pedro hydropower plant requires that MID contribute a minimum of 94,900 acre-feet annually down the Tuolumne River. MID's share of water releases to the Tuolumne River is approximately 31.54% of the 300,900 acre-feet minimum water releases on the Tuolumne. This is for specific year types. The actual amount of water is year specific and includes fall and spring pulse fish flows.

Table 28.
Nonconsumptive
MID Environmental Water Uses

Environmental Resources	Volume (AF)
Wildlife Refuges (USFWS)	3,000
• FERC Releases	94,900
Total	97,900

3E3: Recreational

Lake Don Pedro is one of the major recreational areas in northern California. Recreational activities at the lake include swimming, camping, fishing, and boating. MID and TID are the owners of Don Pedro Reservoir. The City and County of San Francisco (CCSF) is a partner with the districts in the operation of the Don Pedro Recreation Agency which administers the recreational activities at the lake. Modesto Reservoir is also a well known and popular water recreation facility offering similar activities as Lake Don Pedro. MID is the sole owner of Modesto Reservoir but has an agreement with the County of Stanislaus to operate the recreational activities of the reservoir. Table 29. Summarizes the facilities nonconsumptive water uses.

Table 29.
Nonconsumptive Recreational Water Uses

Recreational Facility	Volume (AF)
Don Pedro Reservoir	2,030,000
Modesto Reservoir	29,000
Total	2,059,000

3E4: Municipal and Industrial

Historically, the City of Modesto, other local communities, area residents and businesses have used groundwater from the basin. Over time, drought conditions and communities' growth demands have contributed to the depletion of the groundwater and created a cone of depression. This cone of depression combined with increasingly stringent federal and state water quality requirements, prompted a 1983 study of the water supply. In 1984, the study recommended a conjunctive water use program that would use surface water to supplement the Municipal and Industrial groundwater supply. In 1986, MID decided to pursue the construction of a water treatment plant to supply treated water to the City of Modesto. The treatment plant was built and is operated by MID. The water from the treatment plant is wholesaled to the City of Modesto water distribution system per a mutual agreement. Currently the treatment plant is producing 34,000 acre-feet of treated water annually. The plant was designed to treat and deliver 68,000 acre-feet annually when expanded sometime during the first decade of the 21st century.

3E5: Groundwater Recharge

The major source of groundwater recharge in the Modesto Groundwater Basin is the result of deep percolation of applied surface water to the agricultural lands and water seepage from the local streams. Other sources of recharge include winter rainfall and seepage from Modesto Reservoir and the canal distribution system. The Modesto Reservoir seepage losses are estimated at over 20,000 acre-feet per year most of which recharges the groundwater basin. Approximately 85% of MID canals are concrete lined, and thus, the amount of canal seepage is relatively small. Runoff from urban irrigation and rainfall also contributes to the recharge. The 34,000 acre-feet of treated water being delivered to the City of Modesto annually for urban usage is a major contributor to in-lieu water recharge; prior to 1995, the City relied 100% on groundwater. Table 30. lists the acreas of land where groundwater recharge occurs and the method of recharge.

Table 30.
Groundwater Recharge

Recharge Area (acres)	Method of Recharge
70,808	On-farm Irrigation
805	Canal Seepage
2,400	Reservoir Seepage

3E6: Transfer and Exchange

During the past ten years, MID has participated in several water transfers. During the 1987 through 1992 drought, MID and the City and County of San Francisco (CCSF) cooperated in the transfer of several thousand acre-feet of water from agricultural to M&I use. MID has also participated in the transfer of water through the U. S. Bureau of Reclamation for river and fishery enhancement. In a cooperative arrangement, MID, TID, and CCSF transfer and exchange water and storage rights in Don Pedro Reservoir.

Table 31.
Transfers and Exchanges

From What Agency	To What Agency	Type of Transfer or Exchange (Ag to M&I, M&I to Ag, or Ag to Ag)
Modesto ID	CC San Francisco	Agricultural to M&I
"	USBR	Agricultural to Environment
"	Turlock ID	Agricultural to Agricultural
Turlock ID	Modesto ID	"

3E7: Other - Improvement Districts

Substantial improvements to MID's main and secondary canals from the early part of the century has improved the effectiveness of water deliveries. However, by the early 1920's, despite the improvements to the canals and other water service facilities many private community ditches were not being well maintained. The lack of maintenance to private ditches and lack of coordination among the water users, resulted in frequent water shortages and inefficient water deliveries. Because the MID could not carry the financial burden of improving the private community ditches without raising taxes to cover the cost of maintenance and repairs, the District initiated state legislation allowing for the establishment of local ditch and pipeline improvement districts within irrigation districts. The legislation to create improvement districts was sponsored by a local state senator and it became state law in 1927.

Improvement districts are small districts within the MID service area created for the purpose of more equitably providing improvements to the land and water conveyance facilities. Improvement districts are, in effect, legal subdivisions of the irrigation district. Improvement districts use the technical and financial expertise of the MID, while leaving the basic decision of whether or not to make the improvements in the hands of the water users using the community facility. The result is an improvement in irrigation efficiency, adding flexibility and shorter rotation times for water delivery to the water user. Today, MID has approximately 250 active improvement districts.

3F: Drainage from the Water Supplier Service Area

The land serviced by MID does not have a subsurface drainage water problem. There are no on-farm subsurface drainage tiles. As stated previously, drainage wells are used by the District to lower the water table in the western part of the service area. However, the shallow water is of good quality (less than 500 ppm of dissolved solids) and suitable for most irrigation purposes. During the irrigation season, some of the drainage well water is used to supplement the District's irrigation water supply.

On-farm tail (surface) water drainage within the District's service is also minimal due to the use of pressurized and level basin irrigation systems. In the cases where on-farm tailwater is generated, the water users typically contain it within the property. In some instances, surface drainage water may be used by downstream water users. Table 32. summarizes drainage water destinations.

Table 32.
Drainage Discharge Locations

Surface	Sub-surface	Location
X		Downstream Flows
X		Groundwater
	X	Irrigation

MID's groundwater and surface water quality is generally good to excellent except on a few isolated locations along the river. Surface water diverted from the Tuolumne River originates from snowmelt in the high Sierras. The water is of excellent quality with a total dissolved solids (TDS) content of less than 20 ppm. Groundwater is also of relatively high quality with a TDS generally less than 500 ppm. Other than recommend water quality specifications for certain crops, there are no minimal water quality requirements for agricultural groundwater. However, as demonstrated on Table 33., MID conducts periodic agricultural water suitability analysis for major ions, boron and nitrate.

Table 33.
Water Quality Monitoring Programs for Surface/Sub-Surface Drainage

Monitoring Program	Analyses Performed	Frequency of Analysis
Surface Water	Ag – Suitability – Lab	Annually
Groundwater	"	"
Surface Water	In-situ : EC, Temp., DO,ORP	Semi-Annually
Groundwater	"	"

Even when supplementing diverted river water with groundwater during dry years, the amount of dissolved solids and other elements in the agricultural water are relatively minor. Therefore, as indicated on Table 34., leaching of salts from the crops' root zone may be recommended for some crops but is not a major concern for the MID service area.

Table 34. Constituents Found						
Constituents that Limit Reuse	**Measurable Quantity Detected (Check)**	**Usage Limitations (Check if used)**				
		Increased Leaching	**Blending Supplies**	**Restricted Area of Use**	**Restricted Crops**	**Other**
TDS	X					
Se						
B	X					
Mo						
As						
Na	X					
Cl	X					
Pesticide						
Herbicide						
Fertilizer						

3G: Water Accounting

Water diversions from the Tuolumne River at La Grange Dam vary from year to year depending on the weather, the amount of runoff, and operational management decisions. Because 1997 was a fairly representative water year in terms of diversions (with the exception of a major flood event in early January), it was selected as the reference year for purposes of establishing the water accounting calculations as shown on the tables below.

Table 35. MID Tuolumne River Water Diversions for 1997 (AF)			
Month	**Amount of Diversions**	**Month**	**Amount of Diversions**
January	400	July	59,100
February	9,300	August	50,000
March	39,500	September	32,700
April	35,800	October	21,400
May	53,600	November	4,700
June	41,700	December	1,600
Total		349,800	

Table 36. summarizes groundwater pumped by MID, the City of Modesto and private individuals for the 1997 year calendar. The values reported in column (a) are based on MID's supplemental pumped water and does not include drainage water that may have been pumped to lower the shallow water table in the western part of the District. The City of Modesto M&I pumped water is based on the City's records. The private volume of water pumped is estimated and based on the customers' electric power usage converted to acre-feet of water pumped.

Table 36.
Groundwater Supplies Summary (1997)

	Pumped by the Water Supplier (Acre-feet)			Pumped within Service by Customers (Acre-feet)			
Month	MID (a)			City of Modesto (b)	Private (c)		TOTAL (AF)
January	0			900	2,400		3,300
February	100			1,100	2,100		3,300
March	500			2,600	3,400		6,600
April	700			3,700	6,600		11,000
May	2,400			4,800	11,500		18,700
June	800			5,200	14,000		20,000
July	1000			6,900	16,400		34,300
August	700			6,300	14,900		21,900
September	600			4,800	11,100		16,500
October	500			2,600	7,000		11,100
November	0			1,200	3,200		4,400
December	0			1,100	2,500		3,500
TOTAL[1]	6,500			41,200	95,100		142,800

(a) MID pumping includes deep well irrigation pumping as well as drainage pumping on the western part of the District
(b) City of Modesto M&I pumping
(c) Private agricultural pumping within MID boundary (Modeled estimate)

Table 37. shows the volume of water charged to MID's irrigation water customers in 1997. The water charged is based on the field personnel water measurements to the customers. During 1997, the volume of water charged to the customers is within an estimated plus or minus 20% of the actual deliveries. For more information on the calculated crop water usage within MID service area, please refer to Modesto Irrigation District *Assessment of Reasonable Water Requirements* (ARWR), October 1998.

Table 37.
Applied Water

	Volume (AF)
• Applied Water (Charged) to Service Area	185,800

• Water deliveries charged to MID irrigation water users

Table 38. summarizes the crop water use within the MID service area in 1997. Crop evapotranspiration was obtained from the Modesto Irrigation District ARWR report dated October 1998. The estimated water requirement for the crop mix within the District is approximately 25,000 acre-feet greater than the amount of water charged to the water user. This difference is attributed to the District's practice of making sure that, if there is a water measurement error, the water user is not penalized for the error. For this reason, the calculated crop evapotranspiration was used in the water accounting rather than water charged to the water users. Seepage losses from the canal system are based on canal losses calculations performed by the Kings River Water Conservation District on canals of similar characteristics as those at MID and preliminary canal seepage tests conducted by MID. Modesto Reservoir seepage losses are based on preliminary water seepage testing performed at the end of the irrigation season. The 30,000 acre-feet for M&I was based on the actual 1997 water deliveries to the City of Modesto and in accordance with the Treatment and Delivery agreement.

The 46,000 acre-feet of groundwater recharge was based on 50,000 acres of flood irrigated land and an estimated 0.92 acre-foot of water per acre per year in deep percolation. This assumes that the average on-farm flood irrigation system water application is 65% efficient. Assuming an average evapotranspiration of 32 inches per year and minimal surface runoff, the amount of percolation is approximately 0.92 acre-foot per year of deep percolation .

Table 38.
Quantify Water Use (1997)

Water Use		Volume (AF)
Crop Water Use		
1	Crop Evapotranspiration (ARWR Oct. 1998 Report)	210,600
2	Leaching (ARWR Oct. 1998 Report)	3,100
3	Conveyance loss – canal seepage (805 acres x 10 ft.)	8,000
4	Conveyance loss – evaporation (805 acres x 2.5ft.)	2,100
5	Modesto Reservoir seepage (2400 acres x 10ft.)	24,000
6	Modesto Reservoir evaporation (2,400 acres x 3.0ft.)	7,200
7	Conveyance loss – Operational spills	21,300
8	Environmental use – wetlands	Unknown
9	Environmental use – wildlife (Included in Allocation)	Included
10	Riparian vegetation	Unknown
11	Municipal and Industrial (Delivery & Treatment Agreement)	30,000
13	Groundwater Recharge (50,000 acres @ 0.92ac-ft/ac)	46,000
Subtotal (calculated)		350,200

Table 39. summarizes the amount of on-farm surface and subsurface drainage water leaving the service area. As discussed earlier, the amount of drainage water leaving the on-farm area is minimal.

Table 39. Quantify On-Farm Drain Water		
Drain Water		Volume (AF)
1	Surface drain water leaving district (On-farm drains)	Minimal
2	Subsurface drain water leaving district	Unknown
Subtotal (calculated)		Minimal

Table 40. summarizes the total water supplies available in 1997 to the MID service area. Surface water is the volume of water diverted from the Tuolumne River. The groundwater volume includes M&I water pumped by the City of Modesto and the estimated total amount of water pumped by private pumps. Annual effective rainfall precipitation was determined using a USBR formula for calculating effective precipitation in southern San Joaquin Valley. The effective precipitation was based on annual rainfall over 63,400 acres of irrigated land.

Table 40. Quantify Water Supplies		
Water Supplies		Volume (AF)
1	Surface Water (Table 36)	349,800
2	Ground Water (Table 37)	142,800
3	Annual Effective Precipitation (ARWR Report)	34,900
4	Water purchases	0
5	Transfers or Exchanges into district	0
Subtotal		526,500

Table 41. summarizes the water budget for the service area. The subtotal water supply includes estimated water pumped by water users. The volume of excess deep percolation water appears to be consistent with the measured rise in the MID service area water table; MID groundwater monitoring program shows a basin groundwater level rise during the past few years.

Table 41. Budget Summary		
Water Accounting		Volume (AF)
1	Subtotal of Water Supplies (Table 40)	527,300
2	Subtotal of Water Uses (Table 38)	(348,000)
3	On-Farm Drainage Water Leaving District (Table 39)	Minimal
4	Groundwater Pumped (Table 40)	(142,800)
5	MID Drainage Water Pumped (1997 MID Data)	(17,800)
Excess Deep Percolation (estimated)		18,700

3H: Supply Reliablity

The Tuolumne River is the largest of the three major tributaries (the Tuolumne, Merced, and Stanislaus Rivers) of the San Joaquin River. Within the upper Tuolumne River watershed, the City & County of San Francisco regulates approximately 47 percent of the unimpaired flow, which is the true natural stream flow. The hydrology within the Tuolumne is driven primarily by snowmelt runoff during the spring months.

The median annual unimpaired runoff from the Tuolumne River basin at La Grange is 1,800 TAF (California Department of Water Resources 50-Year Average: 1946 to 1995). The annual hydrologic pattern of the Tuolumne is representative of the orographic uplifting created by the Sierra Nevada in this part of California. Annual runoff is highly variable with no predictable year-to-year correlation. The driest year of record was the 1977 water year, and the worst 2-year drought occurred in 1976-1977. More recently, the drought of 1987-1992 created greater water supply uncertainty because of the persistent below-normal runoff.

Excluding dry years, sufficient natural precipitation and watershed runoff occurs to satisfy local needs. During the dry years, irrigation wells are used to supplement river water diversions. In recent years, however, new demands on MID's water supplies are creating greater water supply uncertainty. As a result of this uncertainty, MID is developing a physically-based hydrologic model that will enable MID staff to evaluate risks associated with various water year types and operational scenarios.

Step 4: Review Previous Water Management Activities

The Water Management Practices Net Benefit analysis includes discussions on the implementation of previous and current water management practices. Over the last few years, the District has expanded its ability to ability to remotely monitor and control the water flows from the Tuolumne River to the operational spills at the tail end of the canal system. MID has also been proactive in the implementation of computerized modeling of water conservation activities and practices. For example, MID is in the process of implementing a watershed Hydrologic Forecast Analysis Model to better forecast and manage the District's water resources. MID has implemented a Ground Water Data Manager program to better analyze, evaluate and manage water wells and groundwater quality. With this software, MID will more efficiently and effectively locate new well locations and operate existing wells. As discussed earlier, MID currently has established an incentive water conservation program to help water users upgrade their water conveyance facilities. MID will contribute up to 50% and finance the other 50% of the cost to install on-farm water conveyance systems. This incentive facilitates the water users conversion from flood to pressurized irrigation systems. Phase I of the MID Irrigation Master Plan completed in 1996 identified water operations issues and practices currently in effect and others that are currently under review for implementation. Table 42. lists previous and current water management efforts to improve water management.

Table 42. Current Efficient Water Management Efforts							
	Results						
Efficient Water Management Practices		**(Check if results were experienced)**					
Water Management Plan	Less Applied Water (AF)	Better Water Qual.	Better Soil Qual.	Inc. Yield	Inc. Crop Qual	Reduce Ops Costs	Others
Water conservation coordinator	N/A						
Customer water management service	Unknown						
Improved communication and coordination	Unknown						
Improve pump efficiencies	Unknown						
Facilitate alt. land uses	Unknown						
Facilitate use of recycled water	Unknown						
Capital improvement financing	Unknown						
Facilitate voluntary water transfers	Unknown						
Line or pipe ditches and canals	350	X					
Increase ordering and delivery flexibility	250			X	X		
Supplier spill and tailwater recovery systems	16,000						
Optimize conjunction use	1,500	X		X	X		
Automate canal structures	1,500					X	

Step 5: Identify Efficient Water Management Practices

The Net Benefit Analysis report is attached to this Plan. Table 43. Summarizes the status of the Efficient Water Management Practices (EWMPs) at MID.

TABLE 43. - EWMPs SUMMARY FOR MODESTO IRRIGATION DISTRICT			
List A – Generally Applicable EWMPS			
EWMP	**EWMP Description**	**Category**	**Status of EWMP**
1	Prepare and adopt a Water Management Plan	Mandatory	Water Management Plan completed on July 13, 1999 in accordance with AB 3616 MOU. WMP to be updated every five years.
2	Designate a Water Conservation Coordinator	Mandatory	Water Conservation Coordinator was appointed on July 25, 1996.
3	Support the availability of water Management services to water users	Mandatory	MID financial supports the following: 1) Irrigation Mobile lab Evaluations, 2) CIMIS phone and website information, 3) Water flow and measurement inf. 4) Triennial newsletters, 5) Dissemination of co-op extension and other data.
4	Where appropriate, improve communication and cooperation among water suppliers, wate users and other agencies	Mandatory	MID works cooperatively with Turlock Irrigation District, City of San Francisco and other water suppliers. This will be an on-going practice

5	Evaluate the need, if any, for changes in policies of the institutions to which the water supplier is subject.	Mandatory	MID has pre-1914 and other appropriative water rights.
6	Evaluate and improve efficiencies of water suppliers' pumps	Mandatory	MID has initiated a program to install water flow meters on all well pumps. Currently approximately 60% of the pumps have meters. MID has also installed a Groundwater Data Manager that will alert low pump efficiency results.
List B – Conditionally Applicable		**EWMPs**	
EWMP	**EWMP Description**	**Category**	**Status of EWMP**
1	Facilitate Alternate Land Use	Exemptible	MID will facilitate and consider requests for alternative land uses.
2	Facilitate Use of Available Recycled Water	Exemptible	MID will facilitate and consider requests of the use of recycled water. Currently, an MID water user has a contract with the community of Salida to use recycled water on his property.
3	Facilitate Financial Assistance	Exemptible	For many years, MID has had financial assistance programs for its water users. The current program contributes up to 50% of the cost to replace ditches and pipelines. The District also provides loans for the other 50% of the project cost.
4	Facilitate Voluntary Water Transfers	Exemptible	Current MID policy allows water transfers between water users. The policy allows water users to transfer water to parcels owned or rented by the water user.
5	Line and Pipe Ditches and Canals	Exemptible	MID has lined approximately 80% of its canals. The remaining 20% lie in soils with low permeability and in areas where groundwater recharges is beneficial.
6	Increase Water Ordering and Delivery Flexibility	Exemptible	MID strives to add flexibility to water ordering and delivery. Most water orders and deliveries are based on an arranged demand system where the frequency and duration is flexible. The rate is flexible to the extent that the delivery system capacity allows. As water users convert flood to pressurized irrigation systems, the District's ability provide greater water delivery flexibility increases.

7	Construct and Operate Tailwater and Spill Recovery System	Exemptible	An operational spill recovery system could recycle as estimated 12,000 acre-feet of water to the District. This water currently flows to the local rivers and streams and is lost to the District. The benefit/cost ratio is currently below 1.0 and not economically feasible implement such a system.
8	Optimize Conjunctive Use	Exemptible	MID currently has a strong conjunctive use program. In dry years the District can pump up to 45,000 acre-feet of water to supplement river diversions. MID also delivers up to 34,000 acre-feet of water to the City of Modesto in-lieu of using pumps when the water is available. A large number of private water users have also installed groundwater pumps that could be used during drought years.
9	Automate Canal Structures	Exemptible	All of MID's major water diversions points (approximately 25) have been automated through an in-house SCADA system. The District installing controls to automate some irrigation water wells. With the automation the wells can be turned on and off remotely and automatically turn on when the water in the canal drop below a predetermined point.
List C – Other Efficient Water Management Practices			
EWMP	**EWMP Description**	**Category**	**Status of EWMP**
10	Water Measurement and Water Use Update	Exemptible	MID currently measures, monitors, and controls flows throughout its water delivery system. The District also measures water deliveries to its water users in order to establish the tiered water pricing system. As water users convert their irrigation from flood to pressurized systems, cumulative water measuring devices such as meters are being installed. MID is financially supporting the water users water conveyance facilities which include water measuring.
11	Pricing and Incentives	Exemptible	MID's water allocation and pricing system includes a tiered water pricing component. As water users exceed the allocation, a higher cost of water is applied. Currently, water costs are being increased at a rate of 10% per year.

Step 6: Develop Schedules, Budgets and Project Results

The 1999/00 MID Water Operations budget includes $463,000 for capital expenditures which include the following projects: irrigation well rehabilitation, pump automation, canal SCADA, new pipelines, and drainage spill recorders.

Step 7: Review, Evaluate, and Adopt the Water Management Plan

This Water Management Plan satisfies one of MID's obligations as signatory to the Memorandum of Understanding Regarding Efficient Water Management Practices in California as required by the Agricultural Water Suppliers Efficient Water Management Practices Act of 1990 AB 3616 dated November 13, 1996.

Step 8: Implement Justified Efficient Water Management Practices

MID will endeavor to implement the justified efficient water management practices as the result of the net benefit analysis evaluation.

Step 9: Monitor, Evaluate, and Update the Water Management Plan

MID will monitor, evaluate, and update the Water Management Plan as required by the MOU and a deemed necessary for the effective and efficient operation of its water resources.

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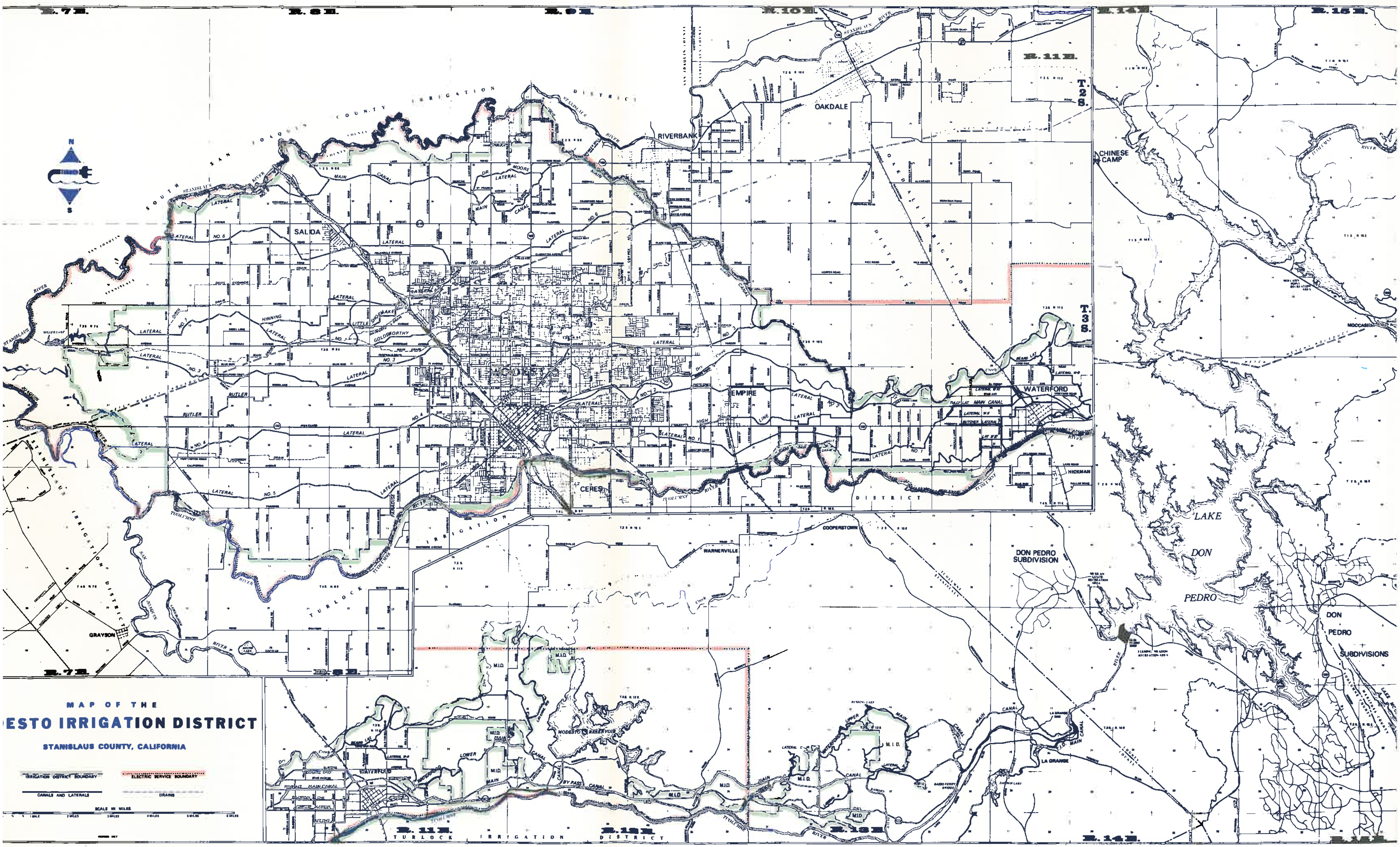
Modesto Irrigation District

Water and Power

Water Management Plan

District Map



MAP OF THE
ESTO IRRIGATION DISTRICT
STANISLAUS COUNTY, CALIFORNIA
IRRIGATION DISTRICT BOUNDARY
ELECTRIC SERVICE BOUNDARY
CANALS AND LATERALS
DRAINS
SCALE IN MILES
1 MILE
2 MILES
3 MILES
4 MILES
5 MILES
6 MILES
R.7E.
R.8E.
R.9E.
R.10E.
R.11E.
R.12E.
R.13E.
R.14E.
R.15E.
T.2S.
T.3S.
N
S
SOUTH SAN JOAQUIN COUNTY IRRIGATION DISTRICT
OAKDALE IRRIGATION DISTRICT
TURLOCK IRRIGATION DISTRICT
STANISLAUS RIVER
TUOLUMNE RIVER
SAN JOAQUIN RIVER
RIVERBANK
OAKDALE
SALIDA
EMPIRE
WATERFORD
HICKMAN
CERES
GRAYSON
COOPERSTOWN
WARNERVILLE
CHINESE CAMP
LA GRANGE
MODESTO RESERVOIR
DON PEDRO SUBDIVISION
LAKE DON PEDRO
DON PEDRO SUBDIVISIONS
MAIN CANAL
LATERAL NO. 6
LATERAL NO. 5
LATERAL NO. 4
LATERAL NO. 3
LATERAL NO. 2
LATERAL NO. 1

Modesto Irrigation District
Water and Power

Water Management Plan

Efficient Water Management Practices

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
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July 8, 1999

EWMP 1. Facilitate Alternate Land Use

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis

Question A	Yes
Question B	Yes
Question C	Yes
Question D	Yes
Question E	Yes
Question F	Yes
Question G	Yes

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Decision about EWMP	Yes

EWMP 1. Facilitate Alternate Land Use

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

The District has and will continue to facilitate alternate land uses with its customers and other agencies. For example, the USFWS has recently purchased several hundred acres of private land for environmental purposes along the northwest boundary of the District; this acreage was previously used for cattle grazing by a private landowner. Some of this acreage is within the boundaries of the District and receives a water allocation. The USFWS is currently considering purchasing additional lands along the western boundary of the District for environmental purposes. Current District policy allows for lands within its boundaries to change purpose and use. In some instances where the land continues to receive an indirect water use benefit from the District, a Facilities Maintenance Fee may be imposed. Although the District will continue to facilitate alternative land uses, it is concerned with the continuing conversion of agricultural land into urban uses.

The District communicates its policies and operational procedures with its customers, the public and other interested parties through a variety of means. Some of the more common means of communication include: annual meetings with the irrigation customers (the District schedules several annual meetings where all irrigation customers are invited to attend), newsletters, monthly local cable TV programs, board meetings, press releases, a website, customer surveys, and staff contacts. Special staff meetings and committees are also scheduled to discuss specific issues. For example, the Board of Directors appointed an Irrigation Water Use Committee composed of water users to discuss and solicit programmatic and operational incentive programs to retain water customers. (There is a growing trend for District customers converting from flood to pressure irrigation systems to opt for the use of groundwater. This trend is of concern to the District due to the potential for a surface/groundwater use imbalance).

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

<u>Please press here to continue.</u>

EWMP 1. Facilitate Alternate Land Use

Part 2. Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

This EWMP can possibly impact EWMP#4, if water is transferred from agricultural uses to environmental purposes. It can possibly impact EWMP#6, if water transferred to environmental or other purposes requires different water delivery scheduling than for agricultural crop growing uses.

B. Does the water supplier have the legal authority to implement this EWMP?

◉ Yes ○ No

C. Has the water supplier approached or been approached by any customers or other entities concerning the potential for implementing this EWMP?

◉ Yes ○ No

Discussion:

The District has recently been contacted by the USFWS of its intent and eventual purchase of several hundred acres of land within the Ditricts's boundary. The water use for this land is being transferred from primarily agricultural to primarily wildlife and other environmental uses. The land purchase is part of a larger wildlife preserve planned for the area where the San Joaquin, Tuolumne, and Stanislaus Rivers converge.

D. If the water supplier were to be approached with a proposal endorsed by water users, would the water supplier be willing to take an active role in facilitating this request?

◉ Yes ○ No

Discussion:

The District will continue to facilitate alternative land uses within the District's boundary using the programs discussed in Part I (A). However, the District is concerned with the continuing conversion of agricultural land for urban uses.

E. Does the water supplier have adequate funding sources, or could funds reasonably be made available to implement this EWMP?

◉ Yes ○ No

Discussion:

If the alternative land use selected by the landowner continues to take District surface water, the landowner may qualify for District grants and loans funding. For budget years 1999/2000, the District has budgeted for grant contributions to water users and authorized the continuation of the loan program for qualifying projects.

F. Could the water supplier provide any incentives for customers for this EWMP?

◉ Yes ○ No

Discussion:

The District has implemented an incentive program that, in addition to providing loans to qualifying projects, provides grant contributions of up to 50% of the cost for new or replacement of water conveyance systems. This incentive program will replace a Water Conservation Program implemented from 1989 through 1996. Under the new program, which was designed primarily for the replacement of ditches and old cast-in-place pipelines, a landowner may request to have up to 50% of the cost of the new or upgraded conveyance system reimbursed by the District. The District will also finance the remaining 50% of the water conveyance facilities cost with loans of 7% interest rate for a period of 5 or 10 years. In effect the water user may have up to 100% of the cost to upgraded a water conveyance system paid for and financed by the District.

G. Does the water supplier have the ability to secure and/or administer low-interest loans for customers?

◉ Yes ○ No

Discussion:

The District has and continues to make loans available for customer water conveyance projects. The loans are for a period up to 10 years at 7% interest.

Please press here to continue.

EWMP 1. Facilitate Alternate Land Use

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	**Yes**	**No**
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

Decision about this EWMP

	Yes	**No**
Is this EWMP accepted?	X	

EWMP 1. Facilitate Alternate Land Use

Discussion:
Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

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EWMP 2. Facilitate Use of Available Recycled Water

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis

Question A	Yes
Question B	Yes
Question C	No
Question D	Yes
Question E	Yes
Question F	Yes
Question G	Yes

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Decision about EWMP	Yes

EWMP 2. Facilitate Use of Available Recycled Water

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

Urban water suppliers who treat sewage water within the District's service area include Modesto, Salida, and Waterford communities (the City of Modesto's secondary sewage water treatment plant is actually located within Turlock ID's service area). The sewage treatment plants currently use the recycled water to irrigate crops, groundwater recharge or discharge back into the rivers for downstream uses. Thus, most water from the sewage treatment facilities is already being reused. The Salida sewage water treatment facility has a contract with a water user within the District who applies recycled water to agricultural land.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Please press here to continue.

EWMP 2. Facilitate Use of Available Recycled Water

Part 2. Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

This EWMP may impact EWMPs #1,4, 8, and 11. (Water users may request compensation for the use of recycled water which may be of lower quality than current supplies.) EWMP #1 (Facilitate Alternate Land Use) may be affected by this EWMP due to the fact that land growing certain crops may not be able to use recycled water. For example, some food processors do not accept produce that has been in contact with recycled water. EWMP #4 (Facilitate Voluntary Water Transfers) may be affected by the potential difficulty in transferring recycled water. EWMP #11 (Pricing Incentives) can be affected by different water pricing for recycled water. Direct agreements between the recycled water supplier and the water user may be necessary for the effective implementation of this EWMP.

B. Does the water supplier have the legal authority to implement this EWMP?

◉ Yes ○ No

C. Has the water supplier been approached by any customers or other entities concerning the potential for implementing this EWMP?

○ Yes ◉ No

D. If the water supplier were to be approached with a proposal endorsed by water users, would the water supplier be willing to take an active role in facilitating this request?

◉ Yes ○ No

Discussion:

The District is willing to work with water users who choose to use recycled water. A water user who elects to use recycled water may also continue to receive District surface water consistent with District policy.

E. Does the water supplier have adequate funding sources, or could funds reasonably be made available to implement this EWMP?

(◉) Yes ( ) No

Discussion:

The current Incentive Program is designed to encouraged water users to take advantage of District surface water. It is possible that, in cooperation with a recycled water supplier, the District could make funding available to implement this EWMP.

F. Could the water supplier provide any incentives for customers for this EWMP?

(◉) Yes ( ) No

Discussion:

As discussed above, the current Incentive Program is designed to encouraged the water users to take advantage of District surface water. However, new incentives programs could be made available for this EWMP if appropriate agreements can be negotiated between the District, recycled water suppliers, and water users.

G. Does the water supplier have the ability to secure and/or administer low-interest loans for customers?

(◉) Yes ( ) No

Discussion:

The District has the ability to secure funding and administer low-interest loans to water users. The MID Board of Directors would have to authorize the District to make such funding and loans available to recycled water users if such users do not take District supplied surface water.

Please press here to continue.

EWMP 2. Facilitate Use of Available Recycled Water

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	X	

EWMP 2. Facilitate Use of Available Recycled Water

Discussion:
Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

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EWMP 3. Facilitate Financial Assistance

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis

Question A	Yes
Question B	Yes
Question C	Yes
Question D	Yes
Question E	Yes
Question F	Yes
Question G	Yes

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Decision about EWMP	Yes

EWMP 3. Facilitate Financial Assistance

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes	○ No

Details:

The District has approved an Incentive Program that, in addition to providing loans, may also assume up to 50% of the cost of new and upgraded water conveyance systems. Under this program, a water user can receive a grant contribution of up to 50% of the cost of the water conveyance improvement and a loan at 7% interest for a period of 10 years for the remaining 50% of the cost. In effect, 100% of the cost for a conveyance system improvements is financed by the District. The Incentive Program is designed to encourage the water users to take advantage of the District surface water supplies. The current Incentive Program replaced a Water Conservation Program implemented in 1989. The 1989 program terminated in 1996 but was extended through 1998. The 1989-1996 Water Conservation Program allocated a total of $6 million to finance various District, improvement district, and private landowner facility improvements . With funding from this program, several miles of District canals were concrete lined, and several miles of improvement district and private ditches were piped.

The Water Conservation Program provided grant contributions of up to 2/3 of the cost for these improvements.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes	◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes	◉ No

EWMP 3. Facilitate Financial Assistance

Part 2. Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

This EWMP may impact other EWMPs (such as 1,2,4,5,6,7,8,9 and 10) where financing for the respective practice projects could be made available.

B. Does the water supplier have the legal authority to implement this EWMP?

◉ Yes ○ No

C. Has the water supplier approached or been approached by any customers or other entities concerning the potential for implementing this EWMP?

◉ Yes ○ No

Discussion:

As discussed above, the District has approved an Incentive Program that, in addition to providing loans, it may assume up to 50% of the cost of a new water conveyance system. This Incentive Program replaces a Water Conservation Program implemented in 1989 and which expired at the end of 1996. Under the new program, a customer may receive a grant of up to 50% of the cost of the improvement and a loan for the remaining 50% of the project cost.

D. If the water supplier were to be approached with a proposal endorsed by water users, would the water supplier be willing to take an active role in facilitating this request?

◉ Yes ○ No

Discussion:

The District is encouraging water users to take advantage of the Incentive Program. The District is soliciting program participation by both individual water users and groups of water users sharing the same water distribution facilities. The District has advertised the Incentive Program to water users through landowner meetings, newsletters, and the local media.

E. Does the water supplier have adequate funding sources, or could funds reasonably be made available to implement this EWMP?

◉ Yes ○ No

Discussion:

Please see EWMP # 2.

F. Could the water supplier provide any incentives for customers for this EWMP?

(●) Yes ( ) No

Discussion:

The District has implemented a conservation incentive program that, in addition to providing loans, could also assume up to 50% of the cost of a new water conveyance system. This incentive program will replace a Water Conservation Program implemented in 1989 and expired at the end of 1998. Under the new program, a customer could receive a grant of up to 50% of the cost of the improvement and a loan for the remaining 50% of the cost.

G. Does the water supplier have the ability to secure and/or administer low-interest loans for customers?

(●) Yes ( ) No

Discussion:

See above answer.

Please press here to continue.

EWMP 3. Facilitate Financial Assistance

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	X	

EWMP 3. Facilitate Financial Assistance

Discussion:
Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

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EWMP 4. Facilitate Voluntary Water Transfers

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis

Question A	Yes
Question B	Yes
Question C	Yes
Question D	Yes
Question E	Yes
Question F	Yes
Question G	Yes

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Decision about EWMP	Yes

EWMP 4. Facilitate Voluntary Water Transfers

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

Current District policy allows the water users to transfer water within the District's irrigation boundary. Water users may transfer water from one parcel to another parcel without incurring additional charges. During drought, a water user may also transfer water to another water user if the transfer is coordinated through the District. A water loss and administrative charge may be imposed by the District to transport the water from one water user to another. Currently, the District does not allow water users to sell/transfer water outside the irrigation boundary. With Board approval, the District may sell/transfer water to entities outside the irrigation boundary. Through the San Joaquin River Group Authority (SJRGA) the District has transferred water to the Bureau of Reclamation. The SJRGA water transfer is part of pre-Vernalis Adaptive Management Program (VAMP) being negotiated to comply with Bay/Delta clean water standards adopted by the SWRCB.

In 1990, during the drought, the District signed an agreement to transfer water to the City and County of San Francisco.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

EWMP 4. Facilitate Voluntary Water Transfers

Part 2. Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes	○ No

Discussion:

Could impact EWMP#3 by providing additional revenue to District. The revenue could be used to fund projects under other EWMP's.

B. Does the water supplier have the legal authority to implement this EWMP?

◉ Yes	○ No

C. Has the water supplier approached or been approached by any customers or other entities concerning the potential for implementing this EWMP?

◉ Yes	○ No

Discussion:

Current policy does not allow individual District water users to sell/transfer surface water. However, District water users may sell/transfer water to other users within the District's boundary. As discussed earlier the District has directly and indirectly sold/transferred water to the Bureau of Reclamation and the County and City of San Francisco.

D. If the water supplier were to be approached with a proposal endorsed by water users, would the water supplier be willing to take an active role in facilitating this request?

◉ Yes	○ No

Discussion:

The District will discuss and debate issues and take an active role on requests which are brought before the Board of Directors. The Board is elected by the public which includes water users. It will will consider their will if consist with the law.

E. Does the water supplier have adequate funding sources, or could funds reasonably be made available to implement this EWMP?

◉ Yes	○ No

Discussion:

The District has the ability to fund internal and external projects as approved by the Board.

F. Could the water supplier provide any incentives for customers for this EWMP?

◉ Yes	○ No

Discussion:

It is not possible to know if the District would provide incentives to water users for this EWMP without discussing and debating the issues and knowing what the impacts of such an issue would be.

G. Does the water supplier have the ability to secure and/or administer low-interest loans for customers?

◉ Yes ○ No

Discussion:

Through the current Incentive program, the District has funds available for improvements of water conveyance systems. On a case-by-case basis, the District could also consider loans for other on-farm programs.

Please press here to continue.

EWMP 4. Facilitate Voluntary Water Transfers

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	X	

EWMP 4. Facilitate Voluntary Water Transfers

Discussion:
Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

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EWMP 5. Line or Pipe Ditches/Canals

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	Yes
Question B	n/a
Question C	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant
Question E	Indeterminate
Question F	Beneficial
Question G	Beneficial
Question H	Insignificant
Question I	Insignificant
Question J1	Insignificant
Question J2	Insignificant
Question J3	Insignificant
Question J4	Insignificant

Third-Party Effects

EWMP 5. Line or Pipe Ditches/Canals

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Beneficial
Question E	Beneficial

Indirect Economic Effects

Question A	Yes
Question B	Insignificant
Question C	Beneficial
Question D	Insignificant

Part 5 Economic Analysis

Question A	291.00
Question B	Yes
Question C	Yes
Question D	Unknown
Question E	Yes

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.02
Decision about EWMP	Yes

EWMP 5. Line or Pipe Ditches/Canals

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

The District has a total of 208 miles of canals and pipelines in its service area, of which approximately 10% remain unlined. Several miles of canal were concrete lined between 1989 and 1998 under the District's Water Conservation Program. Most of the unlined canals located on the eastern end of the District are small in size and water carrying capacity and contribute to groundwater recharge. Since these canals contribute to needed groundwater recharge, there are no current plans to have the remaining canals lined. However, from time to time the District may evaluate the need to concrete line the remaining sections of canals as lining may be performed for several reasons including reduction of water losses, reduction in maintenance costs, and improved water delivery flexibility.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

EWMP#6 (water ordering and delivery flexibility) may be positively impacted. Lined canals have less water friction loss and water flows are more consistent. However, because of the relatively small percentage of unlined canals, any impacts to the overall water distribution system will be minimal.
EWMP #8 (conjunctive use) may be negatively impacted as a result of canal lining. By lining canals the amount of groundwater recharge will decrease. Since the some District's water users and the local communities rely on groundwater to meet their total water demands, decreasing groundwater recharge as a result of canal lining may negatively impact those supplies.

B. Complete a matrix and attach a description of how seepage flows were determined.

Discussion:

The data inputted into the matrix are estimates. The canal seepage estimates were based on an average of 5.0 ft. of seepage per year for the wetted perimeter.

C. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

Potential groundwater recharge impacts within the District and third parties were considered. The District and other local agencies have formed the Modesto Basin Groundwater Association under AB3030 requirements.

Part 3. General Information for Detailed Analysis

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 3. General Information for Detailed Analysis

Matrix about Seepage Flows

Estimated length of canals, ditches in service area (miles)	**110**
Ditches/canals currently unlined (miles)	**24**
Ditches/canals currently lined (miles)	**86**
Pipelines in service area (miles)	**98**
Potential average seepage flows from unlined ditches/canals (ac-ft/yr)	**291**
Potential average recovered seepage flows from unlined ditches/canals (ac-ft/yr)	**29**
Estimated average seepage flows which exit and are lost to service area (ac-ft/yr)	**145**
Estimated average seepage flows which exit and are lost to the basin (ac-ft/yr)	**0**
Estimated average seepage flows which exit and are lost to the saline sink (ac-ft/yr)	**0**

EWMP 5. Line or Pipe Ditches/Canals

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes	◉ No	○ Unknown

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes	◉ No	○ Unknown

Discussion:

There are no known habitats in the service area supported/supplied by existing groundwater levels.

C. Shallow Groundwater

Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes	◉ No	○ Unknown

D. Insert Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes	○ No	○ Unknown

Discussion

During the irrigation season, the District's water distribution system may contribute operational spill water to Dry Creek, the Tuolumne, Stanislaus and San Joaquin river systems.

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes	○ No	○ Unknown

F. Fertilizer/Herbicide/Pesticide Use

Are pesticides/herbicides used to control vegetative growth or burrowing along ditches/canals?

◉ Yes	○ No

Discussion

The District uses aquatic herbicides to control weed and algae growths along he canal system. Canal lining will decrease aquatic weed growth and consequently contribute to the decrease of the volume of herbicides applied. The District also uses pesticides to control the squirrel populations along the canal banks.

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

◉ Yes	○ No	○ Unknown

Discussion:

By concrete lining the canals the amount of soil erosion will also be decreased.

H. Field Burning and/or Fugitive Dust

Is vegetation removed from canal banks by burning?

○ Yes	◉ No

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease	○ Increase	◉ Neither	○ Unknown

J. Habitat Effect

Do ditches/canals that might be considered for lining/piping supply or support any of the following habitats?

(1) Vernal pools and swales

○ Yes ◉ No

(2) Riparian

○ Yes ◉ No

(3) Open water bodies

○ Yes ◉ No

(4) Marshes (permanent or seasonal)

○ Yes ◉ No

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels
Will implementation of the EWMP affect groundwater elevations?

◉ Yes ○ No ○ Unknown

B. Insert Flows
Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes ○ No ○ Unknown

C. Drain Flows
Do drain flows supply or support any third-party user?

◉ Yes ○ No

Discussion:

Neighboring water users and domestic water suppliers use deep well pumps for irrigation and domestic pumping. By concrete lining the canals a potentially insignificant impact may be felt by groundwater water users and domestic water suppliers.

D. Herbicide/Pesticide Use
Are pesticides/herbicides used to control vegetative growth or burrowing along distribution system banks?

◉ Yes ○ No

Discussion:

The District uses aquatic herbicides to control weed and algae growths along the canal system. Canal lining will decrease aquatic weed growth and consequently contribute to a decrease on the volume of herbicides applied. The application of pesticides should also decrease since the burrowing rodents are less of a problem.

E. Wind/Water Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

(●) Yes	( ) No	( ) Unknown

Discussion:

Soil and wind erosion are expected to decrease as a result of the canal concrete lining.

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies

Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

(●) Yes	( ) No	( ) Unknown

Discussion:

Concrete lining of canals would encrease the District purchases of services and goods from the community. The purchases would contribute to the local economies.

B. Effects on crop inputs

Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

( ) Increase	( ) Decrease	(●) Neither	( ) Unknown

C. Effects on local employment

Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

(●) Increase	( ) Decrease	( ) Neither	( ) Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

( ) Increase	( ) Decrease	(●) Neither	( ) Unknown

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows				X
F	Fertilizer / Herbicide / Pesticide Use	X			
G	Soil Erosion	X			
H	Field Burning and Fugitive Dust			X	
I	Energy Use			X	
J	Vernal Pools and Swales			X	
K	Riparian Habitat			X	
L	Open Water Bodies			X	
M	Marshes (permanent or seasonal)			X	

EWMP 5. Line or Pipe Ditches/Canals

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use	X			
E	Win/Water Soil Erosion	X			

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor	X			
D	Processing of Farm Products			X	

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

291.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

The District has an estimated 24 miles of unlined canals. Assuming the average canal has an average of 20 feet of wetted perimeter, the total wetted area for the 24 miles is 58 acres of land. Assuming five acre-feet per acre water losses due to canal percolation, the total water potentially saved during the irrigation season is 291 acre-fee per year.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

(●) Yes ( ) No ( ) Unknown

Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

(●) Yes ( ) No ( ) Unknown

Please press here to view the worksheet

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

( ) Yes ( ) No (●) Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

(●) Yes ( ) No ( ) Unknown

Please press here to view the worksheet

Which alternative is to be selected as benefit measure? Please explain in the box below.

Unknown

Please press here to view the worksheet

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 291.00 acre-feet

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning		20,000	15%	3,000	23,000
Land		-	15%		
		-	15%		
Structure		500,000	15%	75,000	575,000
		-	15%		
Equipment	& Materials	1,500,000	15%	225,000	1,725,000
		-	15%		
Mitigation		2,000	15%	300	2,300
Other		-	15%		
Subtotal Capital Costs					2,325,300
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					2,325,300
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					181,838

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
0	24,000	0	24,000

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
181,838	24,000	205,838	291.00	707

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
Unknown	291.00		

Please press here to go back to Part 5.

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	291.00	20	75%	15		15

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,

[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 5. Line or Pipe Ditches/Canals

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**707**
Benefit/Cost Ratio	**0.02**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows				X
F	Fertilizer / Herbicide / Pesticide Use	X			
G	Soil Erosion	X			
H	Field Burning and Fugitive Dust			X	
I	Energy Use			X	
J	Vernal Pools and Swales			X	
K	Riparian Habitat			X	
L	Open Water Bodies			X	
M	Marshes (permanent or seasonal)			X	

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use	X			
E	Win/Water Soil Erosion	X			

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor	X			
D	Processing of Farm Products			X	

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.02**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?		X

Decision about EWMP

	Yes	No
Is EWMP accepted?	X	

Discussion:

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 6. Increase Water Ordering/Delivering Flexibility

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	Yes
Question B	n/a
Question C	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Beneficial
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant
Question E	Indeterminate
Question F	n/a
Question G	Insignificant
Question H	n/a
Question I	Negative
Question J	n/a

EWMP 6. Increase Water Ordering/Delivering Flexibility

Third-Party Effects

Question A	Beneficial
Question B	Negative
Question C	Insignificant
Question D	n/a
Question E	Insignificant

Indirect Economic Effects

Question A	Yes
Question B	Beneficial
Question C	Beneficial
Question D	Indeterminate

Part 5 Economic Analysis

Question A	3,000.00
Question B	Yes
Question C	Unknown
Question D	No
Question E	Yes

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.06
Decision about EWMP	Yes

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes	○ No

Details:

During the past several years, the land within its service area which receives flexible water delivery service has expanded (the District can respond to on-demand requests within a reasonable amount of time). Flexibility in water delivery is critical to water users who have or are in the process converting their irrigation systems from flood to micro-irrigation. Today, it is estimated that approximately 60% of the service area has flexibility in water ordering. For the remaining 40% of the District, flexibility of delivery can be improved by upgrading the District's distribution system and improvements to customers' water conveyance systems. There has been a significant trend for permanent crop landowners within the District to convert to sprinkler and drip irrigation technologies and away from flood irrigation. Although this trend is being driven primarily by improved crop management and yields, flexible water delivery will lead to reduced water applications. The more sophisticated irrigation technologies require flexible water delivery availability.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes	◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes	◉ No

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

(●) Yes ( ) No

Discussion:

This EWMP can potentially impact EWMPs # 3,4,5 ,7 and 8 (Conjunctive Use–the MID staff believes that it is in the long term best interest of the water users and the District for water users to have the capability to use groundwater). However, the water users need to apply District surface water when such water is available. This EWMP may also affect EWMP 10 (water measurement as water users connect with more sophisticated irrigation systems).

B. Please attach a description of any additional facilities and/or components that may be needed to increase operational flexibility and how quickly a supplier can go from receiving an order to delivering an order. Include in this description: any facilities that may need to be installed to increase flexibility; how quickly a supplier can go from receiving an order to delivering an order; estimated project life span; estimated potential annual water savings; and how those savings were estimated. Also briefly discuss whether other variations of the project were considered.

Discussion:

Currently MID is capable of delivering water on an arranged demand basis to all customers whose property is adjacent to the main canal system. Water delivery flexibility is difficult to those customers who rely on the old cast-in-place concrete pipelines and ditches that serve multiple properties. Most cast-in-place pipelines and ditches serving multiple properties are owned and maintained by the water users. Once flexibility of water delivery is made to the pipelines and ditches, the water users are more likely to implement improved irrigation system technologies. (If these conveyance system improvements are not made, the water users may still switch to different irrigation system technology by using wells for the crop water needs - a concern to the District.) An opportunity for additional water savings will occur when more cast-in-place pipelines ditches and improvements are made and the on-farm irrigation systems are upgraded

Part 3. General Information for Detailed Analysis

The district Board of Directors has approved funding,, for fiscal budget year 1999/2000, to be used as contributions (up to 50% of the cost in grants) to water users who replace existing water conveyance systems with new systems that will give greater flexibility in water delivery. In addition, the District will loan the water users the other 50% of the project cost at an interest rate of 7% per year for a period of ten years. In effect, the water users may upgrade the water conveyance systems without tapping into their savings or obtaining a loan from a bank.

C. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

This EWMP can only be implemented by considering its effect on other EWMPs (such as conjunctive use, system automation, etc.) and its effects upon neighboring water districts.

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

(●) Yes ( ) No ( ) Unknown

F

Discussion:

This EWMP, in combination with improved irrigation technologies and scheduling, could result in reduced crop applied water. As a result, diversions from Don Pedro Reservoir could be reduced accordingly. However, there is also a possibility that water applications may actually increase as a result of improved water ordering/delivering flexibility. The increase in water application could occur if a water user was not applying adequate water to a crop due to the inflexible delivery system.

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

( ) Yes (●) No ( ) Unknown

Discussion:

The US Fish and Wildlife Service operates wildlife habitats within the service area of the District. The wildlife habitats receive canal water from the District. The USFWS also has the ability to pump water from the local rivers.

C. Shallow Groundwater

Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

( ) Yes (●) No ( ) Unknown

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes ○ No ○ Unknown

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes ○ No ○ Unknown

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Discussion:

The implementation of this EWMP should not increase nor reduce the amount of soil erosion in the service area.

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease ◉ Increase ○ Neither ○ Unknown

J. Habitat Effect (not applicable)

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels

Will implementation of the EWMP affect groundwater elevations?

◉ Yes ○ No ○ Unknown

Discussion:

Greater water delivery flexibility alone will not have an affect on groundwater elevations. However, if as a result of greater flexibility water users switch from groundwater use to District surface water supplies, there will be a positive affect upon groundwater levels. On the other hand, if greater flexibility accelerates the conversion from flood irrigation to the potentially more efficient micro-irrigation systems, there will be less groundwater recharge and a potential negative impact on the groundwater table.

B. Insert Flows

Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes ○ No ○ Unknown

Discussion:

With more efficient water applications, water discharges to rivers and streams may be reduced.

C. Drain Flows

Do drain flows supply or support any third-party user?

◉ Yes ○ No

Discussion:

The District maintains three pipe drains which flow into rivers and streams. The total flow from these drains is estimated at 3-6 acre/feet per year. This EWMP would not have an significant impact on those drains.

D. Herbicide/Pesticide Use (not applicable)

E. Wind/Water Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

◉ Yes	○ No	○ Unknown

Discussion:

If an increase in water ordering/delivering flexibility accelerates the conversion of flood to micro pressure irrigation systems, then this EWMP will have a positive effect on the local economies. The switch to more sophisticated irrigation technologies should increase local sales of irrigation equipment and labor demands.

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

◉ Increase	○ Decrease	○ Neither	○ Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

◉ Increase	○ Decrease	○ Neither	○ Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase	○ Decrease	○ Neither	◉ Unknown

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply	X			
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows				X
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 6. Increase Water Ordering/Delivering Flexibility

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels	X			
B	Instream Flows		X		
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs	X			
C	Local farm Labor	X			
D	Processing of Farm Products				X

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

3,000.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

The degree to which water users convert to more efficient water applications systems as a result of increased water ordering/delivering flexibility is unknown. However, Phase I of the District Irrigation Mater Plan (January 1996) estimated that by 2020 60% of the tree and vine acreage (18,100 acres) would will use drip or micro-spray irrigation systems(The current (1999) estimate is 5,000 acres). Assuming that for the next 20 years an average of 12,000 acres has drip and micro-sprinkler irrigation systems and that 50% of the acreage is converted as a result of increased flexibility in water ordering, then 6,000 acres of land converted would be attributed to greater ordering and delivery flexibility. If drip and micro-sprinklers apply 0.5 acre-feet per acre less water than flood irrigation, then the total water not used on-farm as a result of the conversions would be 3,000 acre-feet.

The 3,000 acre-feet of water potentially not ordered or delivered to land converted to the more efficient irrigation systems has been recharging the groundwater supply. Nevertheless, in order to obtain greater delivery flexibility as discussed above, 40 miles of District and 150 miles of water user owned cast-in-place pipelines would need to be replaced with plastic or other higher pressure pipelines. The District cost alone to replace its 4o miles of pipelines (assuming $40/ft) would be $8,448,000.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

◉ Yes ○ No ○ Unknown

0 Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes	○ No	◉ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes	◉ No	○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

◉ Yes	○ No	○ Unknown

Please press here to view the worksheet

Which alternative is to be selected as benefit measure? Please explain in the box below.

Water transfers would be the most logical alternative for the conserved water. The sales could be consummated with local or state wide buyers. However, the party(is) who would benef from the additional water would be a decision made by the Board of Directors.

Please press here to view the worksheet

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 3,000.00 acre-feet

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning	Systems desgin	50,000	15%	7,500	57,500
Land		-	15%		
		-	15%		
Structure	Materials/labor	6,500,000	15%	975,000	7,475,000
		-	15%		
Equipment	Equipment usage	1,500,000	15%	225,000	1,725,000
		-	15%		
Mitigation		398,000	15%	59,700	457,700
Other		-	15%		
Subtotal Capital Costs					9,715,200
Deduct Expected Salvage Value after 25 Years					285,000
Total Capital Costs					9,430,200
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					737,442

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
0	12,500	0	12,500

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
737,442	12,500	749,942	3,000.00	250

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
	3,000.00		

Please press here to go back to Part 5.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	3,000.00	20	75%	15	0	15

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,
[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**250**
Benefit/Cost Ratio	**0.06**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply	X			
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows				X
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels	X			
B	Instream Flows		X		
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs	X			
C	Local farm Labor	X			
D	Processing of Farm Products				X

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.06**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	No
Is EWMP accepted?	**X**	

Discussion:

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	No
Question B	No
Question C	No

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	Yes
Question B	n/a
Question C	n/a
Question D	n/a
Question E	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Indeterminate
Question C	Insignificant
Question D	Beneficial
Question E	Insignificant
Question F	n/a
Question G	Indeterminate
Question H	n/a
Question I	Negative
Question J	n/a

Third-Party Effects

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Question A	Indeterminate
Question B	Negative
Question C	Indeterminate
Question D	n/a
Question E	Insignificant

Indirect Economic Effects

Question A	Yes
Question B	Insignificant
Question C	Beneficial
Question D	Insignificant

Part 5 Economic Analysis

Question A	16,725.00
Question B	Yes
Question C	Yes
Question D	No
Question E	Yes

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.81
Decision about EWMP	Yes

EWMP 7. Construct/Operate Tailwater and Spill Recovery Sys

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

○ Yes ◉ No

(Please see note at the bottom of this page)

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Please press here to continue.

Note:

The MID water distribution system was designed to deliver water to the water users by gravity. The water is diverted from the River at La Grange and flows in an westerly direction through a network of canals, ditches and pipelines. The Modesto Reservoir is used as storage and as a regulation facility for the water deliveries. Inherent gravity water distribution system is the loss of water due to unavoidable operational spills that occur at the ends of the canals. Operational spills flow into the Tuolumne, Stanislaus, and San Joaquin Rivers. These spills were estimated to be approximately 21,000 AF in 1997. Although District operational spills are of concern to the District as a loss of resources, the water is of high quality when it spills into the rivers and streams.

EWMP 7. Construct/Operate Tailwater and Spill Recovery Sys

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

(●) Yes ( ) No

Discussion:

This EWMP could positively affect water deliveries (EWMP #6 - Increase Water Ordering Flexibility) and reduce the need for automation (EWMP # 9 - Automate Canal Structures). EWMP # 8 - Optimize Conjunctive Use - could also be positively affected. For example, if the District built an operational spill return system, water users at the end of the current irrigation system, who periodically ran out of water due to canal fluctuations, would receive irrigation water from the return system with greater ordering flexibility. A spill water return system would complement canal automation and the optimization of conjunctive use.

B. Complete a matrix and attach a description of how spill and seepage losses were determined.

Please click here to view the completed matrix.

Discussion:

The operational spills were determined by using calibrated rectangular weirs with real time flow measuring charts and a computer SCADA system. The District has installed automated measuring devices at all major canal spills. There are a fee ditches without measuring devices. The operational spills from these ditches are minor with the volume of spill water at less than 1,000 acre-feet per year.

C. If available, provide information on the average spill/tailwater/drainage water quality leaving the service area in the following matrix.

Please click here to view the completed matrix.

Part 3. General Information for Detailed Analysis

D. Please attach a description of the potential spill/tailwater reuse system. Include in this description: number and types of recovery pumps to be used; expected capacity of the recovery system (cfs or gpm); estimated project life span; estimated potential annual water recovery (acre-feet); and how those recoveries were estimated and method of estimation. Also briefly discuss whether other variations of the projects were considered.

Spill recovery could be accomplished through one or more reservoirs located near the ends of laterals to capture water otherwise "lost" to the District. A report (1996) by Dr. Charles Burt Director of Cal Poly's Irrigation Training and Research Center (ITRC) discusses the potential design and the benefits of an end of the the canal water return system. Until the design and implementation phases of such a project are undertaken, the specific are not known.

The return system does not include capturing on-farm tail water.
The volume of on-farm tailwater is nonexistent to small due to the predominate use of level basin flood irrigation systems. With level basin, excess applied water is contained within the irrigation parcel and will normally percolate into the groundwater table . Micro-irrigation systems are also becoming a increasingly significant method of irrigation for the predominate tree and vine crops grown within the District. These systems do not produce a significant amount of runoff.

E. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

An operational recovery system could have an impact on neighboring water suppliers. The extent of such an impact will not be known until such design and implementation is undertaken.

Please press here to continue.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 3. General Information for Detailed Analysis

Question B (Matrix about Spill and Seepage Losses)

Estimated average amount of spill/tailwater produced (ac-ft/yr)	**21000**
Quantity of average spill/tailwater/drainage released from service area (ac-ft/yr)	**21000**

Please click here to go back to Part 3.

Question C (Matrix about Spill/Tailwater/Drainage Water Quality Leaving the Service Area)

Constituent	**Concentrations**
Total Dissolved Solids/EC	**100**
Selenium (if applicable)	**n/a**
Boron (if applicable)	**n/a**
Other constituents of concern that may be detrimental for soil or crop production:	**n/a**

Please click here to go back to Part 3.

EWMP 7. Construct/Operate Tailwater and Spill Recovery Sys

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply
Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

B. Confined/Unconfined Ground Water Levels
Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes ○ No ◉ Unknown

C. Shallow Groundwater
Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes	○ No	○ Unknown

Discussion

Operational spill water flows into the Tuolumne, Stanislaus, and the San Jaquin Rivers. If a spill water recovery system is built, the flows to these water bodies will be affected.

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes	○ No	○ Unknown

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes	○ No	◉ Unknown

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease	◉ Increase	○ Neither	○ Unknown

J. Habitat Effect (not applicable)

Please press here to continue.

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels
Will implementation of the EWMP affect groundwater elevations?

○ Yes ○ No ◉ Unknown

B. Instream Flows
Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes ○ No ○ Unknown

Discussion:

Some Districts' canals, ditches and pipelines flow into the rivers and other natural streams.

C. Drain Flows
Do drain flows supply or support any third-party user?

◉ Yes ○ No

Discussion:

The installation and operation of a spill recovery system could impact third party users who may use the spill water downstream. However, a spill recovery system does not add or reduce the overall water available. Water recovered through a spill recovery system will be reused withing the surface area. Water diverted will be reduced and be available for other uses.

D. Herbicide/Pesticide Use **(not applicable)**

E. Wind/Water Soil Erosion
Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

(◉) Yes ( ) No ( ) Unknown

Discussion:

There would be positive affects due to the need for the purchase of goods and services.

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

( ) Increase ( ) Decrease (◉) Neither ( ) Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

(◉) Increase ( ) Decrease ( ) Neither ( ) Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

( ) Increase ( ) Decrease (◉) Neither ( ) Unknown

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels				X
C	Shallow Groundwater Elevations			X	
D	Instream Flows	X			
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				X
B	Instream Flows		X		
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor	X			
D	Processing of Farm Products			X	

EWMP 7. Construct/Operate Tailwater and Spill Recovery Sys

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

16,725.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

The District monitors and records the volume of water that spills to rivers and streams at most of its facilities. The records show an average spill of 21,300 acre-feet per year(20 year average). It is estimated that another 1,000 acre-feet may spill from the smaller unrecorded canals and ditches. However, only 75% of the operational spills could feasibly be captured and reused. Some of the operational spills are in small systems where it would be uneconomical to build the facilities to recover the water.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

◉ Yes ○ No ○ Unknown

Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

◉ Yes ○ No ○ Unknown

Please press here to view the worksheet

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ◉ No ○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

(●) Yes	( ) No	( ) Unknown

Please press here to view the worksheet

Which alternative is to be selected as benefit measure? Please explain in the box below.

The recovery of spill water would reduce the amount of water diverted and pumped. Consequently, there would be additional supplies for use, sale, or for other transfers.

Please press here to view the worksheet

Please press here to continue.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 16,725.00 acre-feet

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning	Design	20,000	15%	3,000	23,000
Land	Reservoir Site	300,000	15%	45,000	345,000
		-	15%		
Structure	Pipelines and Pumps	2,000,000	15%	300,000	2,300,000
		-	15%		
Equipment	Equipment and Service	200,000	15%	30,000	230,000
		-	15%		
Mitigation	Mitigation Costs	200,000	15%	30,000	230,000
Other	Misc.	120,000	15%	18,000	138,000
Subtotal Capital Costs					3,266,000
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					3,266,000
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					255,401

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
30,000	25,000	0	55,000

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
255,401	55,000	310,401	16,725.00	19

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
Diversions and Pumped Water	16,725.00	15	

Please press here to go back to Part 5.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	16,725.00	20	75%	15	0	15

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,
[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**19**
Benefit/Cost Ratio	**0.81**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 7. Construct/Operate Tailwater and Spill Recovery Sys

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?		X
Demonstrably Inappropriate?		X
Technically Infeasible?		X

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels				X
C	Shallow Groundwater Elevations			X	
D	Instream Flows	X			
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				X
B	Instream Flows		X		
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor	X			
D	Processing of Farm Products			X	

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.81**

EWMP Financial Analysis (from Part 6)

	Yes	**No**
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	**No**
Is EWMP accepted?	**X**	

Discussion:

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 8. Optimize Conjunctive Use

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	No
Question B	n/a
Question C	n/a

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant
Question E	Negative
Question F	n/a
Question G	Insignificant
Question H	n/a
Question I	Negative
Question J	n/a

EWMP 8. Optimize Conjunctive Use

Third-Party Effects

Question A	Negative
Question B	Insignificant
Question C	Indeterminate
Question D	n/a
Question E	Insignificant

Indirect Economic Effects

Question A	Yes
Question B	Beneficial
Question C	Beneficial
Question D	Indeterminate

Part 5 Economic Analysis

Question A	1,540.00
Question B	Yes
Question C	No
Question D	No
Question E	Yes

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.23
Decision about EWMP	Yes

EWMP 8. Optimize Conjunctive Use

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes	○ No

Details:

District water users have access to District surface water and groundwater. By having access to two water supplies the water users and the District are better prepared to withstand water shortages during drought periods. Water users who irrigate with surface water and use flood irrigation typically provide a source of groundwater for the basin. During years of abundant surface water the District may supply additional water to the water users for groundwater recharge. Since 1995 the District also provides 34,000 acre-feet per year of treated surface water to the City of Modesto which historically relied on groundwater for 100% of its supply. This significant in-lieu groundwater recharge will be doubled within the next few years as the water treatment plant capacity is expanded as planned and designed.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes	◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes	◉ No

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

○ Yes ◉ No

B. Please provide estimates in the following matrix.

Please click here to view the completed matrix.

C. The goal of this EWMP is to optimize conjunctive use for the water supplier. It is understood that to optimize conjunctive use, components will vary drastically in any given year in order to most efficiently use available supplies.
With this in mind, please attach a description of the current program (if any) and the proposed program. Include specifics when permanent facilities (e.g. ponding basins, regulatory reservoirs, etc.) or the equipment (e.g. extraction wells) would be needed.
Otherwise, briefly discuss the following: method of conjunctive use (e.g. direct recharge, in-lieu exchanges with other suppliers, incidental recharge through overapplication of applied water, or a combination), location of permanent facilities or equipment to be installed for the program, estimated life span of facilities and equipment, estimated potential annual water savings and method of estimated savings, and potential sources of surface water to be used for recharge within and outside of the water supplier's service area. Additionally, please discuss whether possible conjunctive use opportunities with other water suppliers were considered.

MID has supplemented its surface water supplies with groundwater for many years. During dry years when water is in short supply, the District has relied on its wells to supplement the surface supply. In 1995, the District completed the Modesto Regional Water Treatment Plant which treats raw water and wholesales it to the City of Modesto. Until the completion of the plant, the City of Modesto relied 100% on groundwater for the 65,000 acre-feet per year urban water needs. MID treats and delivers approximately 34,000 acre-ft of surface water to the city annually. Within a few years, the water delivery to the City from MID will double to 68,000 ac-feet as per the Treatment and Delivery agreement.

Part 3. General Information for Detailed Analysis

The reduction of groundwater pumping by the City of Modesto results in in-lieu groundwater recharge to the basin. Since the city did not have a groundwater recharge program, the water table under and around the city developed a large cone of depression. The water table has begun to recover since the surface water deliveries were initiated.

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 3. General Information for Detailed Analysis

Question B Matrix

Ground water pumping in average supply year (ac-ft/yr)	**8,000**
Maximum ground water pumping capability (ac-ft/yr)	**43,200**
Surface water deliveries in normal year (ac-ft/yr)	**208,000**
Surface water deliveries in deficit year (ac-f/yr)	**180,000**

EWMP 8. Optimize Conjunctive Use

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply
Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

B. Confined/Unconfined Ground Water Levels
Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes ◉ No ○ Unknown

Discussion:

C. Shallow Groundwater
Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

D. Insert Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes ○ No ○ Unknown

Discussion

Operational spill water flows into the Tuolumne, Stanislaus, and the San Jaquin Rivers. Optimizing conjunctive use should not appreciably affect the flows to these water bodies.

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes ○ No ○ Unknown

Discussion:

The District maintains a small subsurface drainage tile system (approximately 200 acres). An expansion of the conjunctive use program would have some effect on the volume of water that drains into the Tuolumne River. However, the volume of water is small during wet years and nonexistent in dry years.

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Discussion:

Implementation of a greater conjunctive use program should not increase or decrease the amount of soil erosion.

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease ◉ Increase ○ Neither ○ Unknown

J. Habitat Effect (not applicable)

EWMP 8. Optimize Conjunctive Use

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels
Will implementation of the EWMP affect groundwater elevations?

◉ Yes	○ No	○ Unknown

Discussion:

Increasing the current conjunctive use of the aquifers will likely result in greater fluctuations of the groundwater levels. Groundwater users may be negatively affected by the fluctuations in the water table elevations.

B. Instream Flows
Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes	○ No	○ Unknown

C. Drain Flows
Do drain flows supply or support any third-party user?

◉ Yes	○ No

Discussion:

As discussed earlier, operational spill water will flow into local streams. Downstream users may make use of this water.

D. Herbicide/Pesticide Use (not applicable)

E. Wind/Water Soil Erosion
Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes	◉ No	○ Unknown

EWMP 8. Optimize Conjunctive Use

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

<u>*Indirect Economic Effects*</u>

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

(●) Yes ( ) No ( ) Unknown

Discussion:

The optimization of conjunctive use will result in greater activity in the economies related to water wells construction and maintenance. The use of energy resources will increase due to additional groundwater pumping. It is also possible that the installation of pressure irrigation systems using wells would stimulate the irrigation equipment economies. However, the cost of crop production would increase and potentially have a negative impact on the local economy if reduction on crop acreage were to occur.

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

(●) Increase ( ) Decrease ( ) Neither ( ) Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

(●) Increase ( ) Decrease ( ) Neither ( ) Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase	○ Decrease	○ Neither	◉ Unknown

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows		X		
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 8. Optimize Conjunctive Use

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels		X		
B	Instream Flows			X	
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs	X			
C	Local farm Labor	X			
D	Processing of Farm Products				X

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

1,540.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

By otpimizing conjunctive use, the water distribution and delivery system can be better managed to minimize operational spill and consequently, water losses will decrease. The 1,500 acre-feet per year in water conserved is based on the assumption that as a result of greater conjunctive use optimization a 7% reduction in operational spills will occur.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

◉ Yes ○ No ○ Unknown

Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ◉ No ○ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ◉ No ○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

(●) Yes	( ) No	( ) Unknown

Please press here to view the worksheet

Which alternative is to be selected as benefit measure? Please explain in the box below.

The alternative to be selectes as benefit measure unknown at this time .

Please press here to view the worksheet

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 1,540.00 acre-feet

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

<u>Worksheet 2. EWMP Water Supplier Costs</u>

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning	System Design	5,000	15%	750	5,750
Land		-	15%		
		-	15%		
Structure	Water wells (8)	360,000	15%	54,000	414,000
		-	15%		
Equipment	Pumps and Electrical (	360,000	15%	54,000	414,000
		-	15%		
Mitigation	Domestic Wells Reab.	150,000	15%	22,500	172,500
Other	Misc.	50,000	15%	7,500	57,500
Subtotal Capital Costs					1,063,750
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					1,063,750
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					83,185

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
15,000	3,000	0	18,000

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
83,185	18,000	101,185	1,540.00	66

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
	1,540.00		

Please press here to go back to Part 5.

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor [1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%)[1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	**1,540.00**	**20**	**75%**	**15**	**0**	**15**

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,
[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 8. Optimize Conjunctive Use

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**66**
Benefit/Cost Ratio	**0.23**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows		X		
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use		X		
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels		X		
B	Instream Flows			X	
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs	X			
C	Local farm Labor	X			
D	Processing of Farm Products				X

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.23**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	No
Is EWMP accepted?	**X**	

Discussion:

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 9. Automate Canal Structures

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	Yes
Question B	No
Question C	No

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	Yes
Question B	n/a
Question C	n/a
Question D	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Insignificant
Question C	n/a
Question D	Indeterminate
Question E	Insignificant
Question F	n/a
Question G	Insignificant
Question H	n/a
Question I	Insignificant
Question J	n/a

Third-Party Effects

EWMP 9. Automate Canal Structures

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	n/a
Question E	Insignificant

Indirect Economic Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant

Part 5 Economic Analysis

Question A	1,500.00
Question B	Yes
Question C	No
Question D	No
Question E	Unknown

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.39
Decision about EWMP	Yes

EWMP 9. Automate Canal Structures

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

The District's main canals and laterals are now fully automated. Side gates to the individual farmer turnouts (estimated to be over 800 in number) are not automated.

B. Is this EWMP demonstrably inappropriate for implementation by water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Please press here to continue.

EWMP 9. Automate Canal Structures

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

This EWMP enhances the district's efforts to improve water delivery services to its customers. Automation of canal structures will enhance the ability of the water delivery personnel to have greater flexibility in conveying water through the canal system. For example, field personnel can schedule gates to open or close and pumps to be turned on or off if the demand for irrigation water changes.

B. Please complete the following matrix.

Please click here to view the completed matrix.

C. Please attach a description of the potential automated canal structure system. Include in this description: number and types of canal structures to be used; estimated project life span; estimated potential annual water savings (acre-feet); and how those savings were estimated. Also briefly discuss whether other variations of the project were considered.

Attach ITRC Report and recommendation dated March 25-26, 1996.

D. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

This EWMP was considered with EWMPs 6 and 8.

Part 3. General Information for Detailed Analysis

Please press here to continue.

EWMP 9. Automate Canal Structures

Part 3. General Information for Detailed Analysis

Question B (Matrix about Automated Locations)

Number of locations within the distribution system which are automated	**40**
Estimate the number of locations within the distribution system which could potentially be automated	**30**

Please click here to go back to Part 3.

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply
Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

B. Confined/Unconfined Ground Water Levels
Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes ◉ No ○ Unknown

Discussion:

C. Shallow Groundwater (not applicable)

D. Insert Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes ○ No ○ Unknown

Discussion

Operational spill water flows into the Tuolumne, Stanislaus, and the San Joaquin Rivers. Optimizing canal automation should not appreciably affect the flows to these water bodies.

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes ○ No ○ Unknown

Discussion:

The District maintains a small subsurface drainage tile system (approximately 200 acres). Canal automation would have a minimal effect on the volume of water that drains into the Tuolumne River. The volume of water is small during wet years and nonexistent in dry years.

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Discussion:

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease ○ Increase ◉ Neither ○ Unknown

J. Habitat Effect (not applicable)

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels

Will implementation of the EWMP affect groundwater elevations?

○ Yes ◉ No ○ Unknown

Discussion:

Automation of canal structures will have little to no effect in groundwater elevation.

B. Instream Flows

Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes ○ No ○ Unknown

C. Drain Flows

Do drain flows supply or support any third-party user?

◉ Yes ○ No

Discussion:

The volume of subsurface drain water flows are minimal and will vary between dry and wet years. The greater effects will occur in dry years, when a greater amount of water would be pumped from groundwater sources. As a result, less surface water from the drains could flow into the local rivers and streams.

D. Herbicide/Pesticide Use **(not applicable)**

E. Wind/Water Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes ◉ No ○ Unknown

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase ○ Decrease ◉ Neither ○ Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase ○ Decrease ◉ Neither ○ Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase ○ Decrease ◉ Neither ○ Unknown

Please press here to continue.

EWMP 9. Automate Canal Structures

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations				
D	Instream Flows				X
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 9. Automate Canal Structures

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

1,500.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

Automation of the canal structures is a practice which has been gradually implemented and upgraded by MID for the 25 years. Water releases from Modesto Reservoir and the water control at the main diversion points within the canal system have been automated. The water distribution staff can remotely set water flows for the various diversion points and the system will automatically change the flows accordingly. The automated canal structures save labor costs and has the potential to conserve water by accurately timing the flow of water as the water travels through the system. It is estimated that automation of the canal system contribute to a 7% reduction in operational spills. Therefore, 1,500 acre feet of water is conserved as a result of the automation.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

(●) Yes ( ) No ( ) Unknown

Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

( ) Yes (●) No ( ) Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes	◉ No	○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes	○ No	◉ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

MID reserves the right to decide the type of benefit measure to be selected. The conserved water may be used by the existing customers or may be transferred to new customers. The decision on the benefit measure will be made by the Board of Directors.

Please press here to view the worksheet

Please press here to continue.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 1,500.00 acre-feet

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning	Engineering/Design	20,000	15%	3,000	23,000
Land		-	15%		
	Labor	250,000	15%	37,500	287,500
Structure	Materials/Parts	75,000	15%	11,250	86,250
		-	15%		
Equipment	Equipment	15,000	15%	2,250	17,250
		-	15%		
Mitigation		-	15%		
Other	Mislaneous	7,000	15%	1,050	8,050
Subtotal Capital Costs					422,050
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					422,050
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					33,004

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
5,000	**20,000**	**0**	**25,000**

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
33,004	**25,000**	**58,004**	**1,500.00**	**39**

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
		0	

Please press here to go back to Part 5.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
Diversions	1	0.0782	0	1	1	1,500	0

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	1,500.00	20	75%	15	0	15

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,

[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**39**
Benefit/Cost Ratio	**0.39**

Please press here to go back to Part 5.
Please press here to continue.

EWMP 9. Automate Canal Structures

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	X	
Demonstrably Inappropriate?		X
Technically Infeasible?		X

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations				
D	Instream Flows				X
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.39**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	No
Is EWMP accepted?	**X**	

Discussion:

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 10. Water Measurement/Water Use Update

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required
(not applicable)

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	No
Question B	n/a
Question C	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant
Question E	Insignificant
Question F	n/a
Question G	Insignificant
Question H	n/a
Question I	Insignificant
Question J	n/a

EWMP 10. Water Measurement/Water Use Update

Third-Party Effects

Question A	Insignificant
Question B	Insignificant
Question C	Indeterminate
Question D	n/a
Question E	Insignificant

Indirect Economic Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant

Part 5 Economic Analysis

Question A	1.00
Question B	Yes
Question C	No
Question D	No
Question E	No

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.00
Decision about EWMP	Yes

EWMP 10. Water Measurement/Water Use Update

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

○ Yes ◉ No

B. Please describe the current and/or proposed water measurement/calculation practices. The description should include measurement/calculation of volume of water delivered within a reasonable range of accuracy. The description may be based on deliveries to individual water users or other reasonable measurement options

Discussion:

The District currently measures and monitors water flows throughout its system. The USGS measures deliveries to the District at the river diversion point. The District measures flows throughout its canals at numerous places in the system. Deliveries to water users to sprinkler irrigation systems (about 8,000 acres) is accomplished by flow meters which can be read by both the District's staff and the water user. Deliveries to water users on flood irrigation (about 54,000 acres) is performed by the ditchtenders who measure differential head to calculate water flow and total water used (flow meters cannot economically be used with open canal systems). Currently approximately 1,500 acres of land within the District is being converted from flood to low pressure irrigation systems annually. District policy requires the installation of meters for farmers converting to sprinkler systems. (Attached is a copy of the District's Irrigation Master Plan Executive Summary.)

C. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

Measurement of District supplies are coordinated with other agencies such as the USGS, Turlock Irrigation District, Oakdake Irrigation District, and the City of Modesto.

Part 3. General Information for Detailed Analysis

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes ◉ No ○ Unknown

Discussion:

C. Shallow Groundwater

Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

(●) Yes	( ) No	( ) Unknown

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

(●) Yes	( ) No	( ) Unknown

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

( ) Yes	(●) No	( ) Unknown

Discussion:

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

( ) Decrease	( ) Increase	(●) Neither	( ) Unknown

J. Habitat Effect (not applicable)

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels
Will implementation of the EWMP affect groundwater elevations?

○ Yes ◉ No ○ Unknown

Discussion:

B. Instream Flows
Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes ○ No ○ Unknown

C. Drain Flows
Do drain flows supply or support any third-party user?

◉ Yes ○ No

Discussion:

The water quality of the small subsurface drainage is good.

D. Herbicide/Pesticide Use (not applicable)

E. Wind/Water Soil Erosion
Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ◉ No ○ Unknown

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes ◉ No ○ Unknown

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase ○ Decrease ◉ Neither ○ Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase ○ Decrease ◉ Neither ○ Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase ○ Decrease ◉ Neither ○ Unknown

Please press here to continue.

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

1.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

MID measures water deliveries to most of its water users. Water is accurately measured the City of Modesto which receives approximately 34000 acre-ft water per year. Approximately 5,000 acres of land irrigated by micro sprinklers and drip irrigation has metered water. Approximately 55,000 acres of land with impact sprinklers and flood irrigation receives measured water deliveries. Canal water measurements to water users with impact and flood irrigation are made through sidegates using pressure differential. Approximately 3,000 acres of land to "garden heads" (typically accounts with less than five acres of land each) may individually receive unmeasured water through improvement districts. Water measurements to water users alone do not contribute to water conservation. Growers will apply only the amount of water they believe is necessary to grow a crop regardless of the type of measurement used by the water supplier.

However, the 5,000 acres of land that has been converted from flood to micro irrigation uses less water due to greater system application efficiency. Assuming that a micro irrigation system saves 6" of water per acre over a flood irrigation system, the total water application to 5,000 acres would decrease by 2,500 acre-feet annually. This water is not saved as a result of water measurement but rather as a result of improved water application technologies. Therefore, this EWMP alone does conserve water within the District. Additionally, the impact of large conversions from flood irrigation to low pressure systems will drastically impact the current groundwater recharge of the basin. For purposes of establishing a cost/benefit analysis 1.0 acre-foot of water savings was used for this EWMP.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

◉ Yes ○ No ○ Unknown

Please press here to view the worksheet

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ◉ No ○ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ◉ No ○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes ◉ No ○ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

This EWMP alone would not contribute to water savings.

Please press here to view the worksheet

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 1.00 acre foot

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning	Engineering/Design	500,000	15%	75,000	575,000
Land		-	15%		
		-	15%		
Structure	Materials/labor	5,000,000	15%	750,000	5,750,000
		-	15%		
Equipment	Equipment	1,000,000	15%	150,000	1,150,000
			15%		
Mitigation	Mitigation	200,000	15%	30,000	230,000
Other	Miscelaneous	500,000	15%	75,000	575,000
Subtotal Capital Costs					8,280,000
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					8,280,000
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					647,496

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
5,000	10,000	0	15,000

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
647,496	15,000	662,496	1.00	662,496

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
	1.00		

Please press here to go back to Part 5.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
City of Ceres	**1.00**	**20**	**75%**	**15**	**0**	**15**

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,
[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**15**
EWMP Costs ($/af)	**662,496**
Benefit/Cost Ratio	**0.00**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion			X	
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion			X	

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.00**

EWMP Financial Analysis (from Part 6)

	Yes	**No**
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	**No**
Is EWMP accepted?	**X**	

Discussion:

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
July 8, 1999

EWMP 11. Pricing and Incentives

OVERVIEW

Part 1 Information to Determine if Detailed Analysis is Required
(not applicable)

Part 2 Detailed Analysis
(not applicable)

Part 3 General Information for Detailed Analysis

Question A	n/a
Question Ba1	Yes
Question Ba2	Yes
Question Ba3	Yes
Question Ba4	Yes
Question Bb1	No
Question Bb2	Yes
Question Bb3	Yes
Question C	Yes
Question D	Yes

EWMP 11. Pricing and Incentives

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	Insignificant
Question B	Insignificant
Question C	Insignificant
Question D	Insignificant
Question E	Insignificant
Question F	n/a
Question G	Beneficial
Question H	n/a
Question I	Insignificant
Question J	n/a

Third-Party Effects

Question A	Insignificant
Question B	Indeterminate
Question C	Indeterminate
Question D	n/a
Question E	Beneficial

Indirect Economic Effects

Question A	Indeterminate
Question B	Indeterminate
Question C	Indeterminate
Question D	Indeterminate

EWMP 11. Pricing and Incentives

Part 5 Economic Analysis

Question A	1.00
Question B	No
Question C	No
Question D	No
Question E	No

Part 6 Financial Analysis

Question	

Part 7 Summary of Analysis

Benefit-Cost Ratio	0.00
Decision about EWMP	Yes

EWMP 11. Pricing and Incentives

Part 3. General Information for Detailed Analysis

A. Specific Objectives

A clearly defined, specific objective must be established before a pricing incentive procedure is implemented. Please describe the objective.

Modesto Irrigation District was established in 1887 for the purpose of supplying irrigation water to the land. In 1923, the MID Board of Directors elected to serve electric power to the residents of the District and in 1995 the Board elected to deliver treated water to the City of Modesto. (Please refer to this report's narrative for additional MID historical information) Every year the Board sets an Irrigation Water Allocation Policy (copy attached) that establishes the annual base allocation of water and water service cost to the water users. During the last few years, MID has increased the water service charge by 10% per year consistent with the MID Business Plan.

B. Practices

Please identify those pricing and other incentives practices the supplier is considering and those that are currently in place as identified in the EWMP. Has the water supplier considered the following practices?

(a) Pricing

(1) Tiered water pricing (increasing block rates)

◉ Yes ○ No

Discussion:

MID has had a tiered water pricing system since 1988. For the 1997 Irrigation Water Allocation Policy MID established a 42" base irrigation water allocation plus 6" water for groundwater recharge. In years of normal to above normal runoff, MID may add additional water to the allocation for purposes of recharging the aquifers. The 42" allocation plus the recharge water was included in the base charge of $10.10 per acre. Additional water up to 72" inches is available at $8.75 per acre-foot and water usage above 72" is charged at a rate of $20.14 per acre-foot. (A copy of MID's 1997 irrigation pricing policy is attached).

Part 3. General Information for Detailed Analysis

(2) Wet vs. dry year pricing structure

◉ Yes ○ No

Discussion:

In addition to being a water supplier, MID is also a retail electric power supplier. MID went unto the electric business in 1923 to supply power to its customers. MID and Turlock Irrigation District (TID) took advantage of their reservoirs and irrigation falling water to generate hydropower and, therefore, increased sources of revenue. As a result, MID credits the irrigation operations with revenues generated by the hydropower facilities. This revenue source helps reduce the irrigation charges to the water customers. MID has reduced the water allocation and increased water charges during drier years. Even if the base rate does not change, a lower water allocation will increase the irrigation water charges due to the tiered pricing structure.

(3) Uniform block pricing

◉ Yes ○ No

Discussion:

As discussed above, MID water allocation and pricing system is variable depending on the water year. The cost of water increases as the water users exceed the established water allocation. The tiered water price structure increases as more water is used per unit area.

(4) Other

◉ Yes ○ No

Discussion:

Part 3. General Information for Detailed Analysis

The water allocation and pricing structure also applies to the domestic water delivered to the City of Modesto (City). In addition to the raw water charge, MID passes-on the cost to filter and treat the water delivered to the City. The City has been taking approximately 34,000 acre-feet of water annually or over 50% of its total water needs. If MID did not supply surface water to the City, the City would use its groundwater wells for its water. Prior to 1995, the City relied on the groundwater wells for 100% of its water need. The Delivery and Treatment agreement with the City, contains language to expand the water treatment plant to 68,000 acre-feet per year sometime after the year 2,000. The water delivered to the City can be considered as in lieu water recharge to the local groundwater basin..

(b) Other incentives

(1) Supplier buy-back program

○ Yes ◉ No

Discussion:

MID does not have a water buy-back program with its water users. MID holds its water rights (including pre-1914 rights) in trust for the approximately 3,200 accounts.

(2) Low interest loans

◉ Yes ○ No

Discussion:

For the past 11 years, MID has made available to its water users, water conservation project loans at 7% interest and payable in semi-annual installments within 10 years. These loans are patterned after the financing of capital improvements to "irrigation improvement districts" as outlined by the California Water Code. A number of water users have taken advantage of these loans which have no amount limits.

(3) Cost sharing for on-farm improvements

◉ Yes ○ No

Discussion:

Part 3. General Information for Detailed Analysis

MID has implemented an Incentive Program where water users may request grants of up to 50% of the cost to install water conveyance pipelines, lift pumps and other canal facilities required for the installation of pressurized irrigation systems. This incentive program replaces a Water Conservation Program implemented in 1989. The program expired at the end of 1996 after disbursing nearly $6 million. The Water Conservation Program provided water users with grants of up to 50% of the cost to replace irrigation ditches and absolete pipelines with new pipelines. In addition to the grants to water users, the Water Conservation Program made funds available to line several miles of MID owned canals with concrete and provided grants to improvement districts for new pipelines and the replacement of old pipelines. Prior to 1988, MID contributed 100% of the "improvement district" improvements.

Under the above programs, a water user could receive a grant of up to 50% of the cost of the improvement and then request that the remaining project cost be financed with a loan from MID. In effect, the water user can have 100% of the on-farm project paid for and financed by MID.

C. Does this EWMP impact any of the other EWMPs?

(•) Yes ( ) No

Discussion:

The MID Business Plan identifies water rate increase of about 10% per year for the next few years in order to better match revenues to costs of providing water service. If MID were to increase the surface water costs substantially over a short period of time, water users in large numbers could switch to groundwater supplies for their water needs. This will require expanding the District's conjunctive use program especially during dry years when surface supplies are short. Even with the current pricing system, many water users have opted to convert their irrigation systems from flood to pressurized systems and switched from MID supplied surface water to groundwater. The decision by water users to switch to groundwater is based on many factors including MID's water costs. If this trend continues, the groundwater supplies will decrease and MID's flexibility to pump groundwater and use its water conjunctively during dry years will be strained.

D. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

(•) Yes ( ) No

Discussion:

Part 3. General Information for Detailed Analysis

As discussed above, increases in water pricing could impact EWMP 8 (Optimize Conjunctive Use).

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

<u>*Environmental Effects*</u>

A. Source of Supply
Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

B. Confined/Unconfined Ground Water Levels
Are there any habitats in the water service area that are supported /supplied by existing groundwater levels?

○ Yes ◉ No ○ Unknown

Discussion:

As discussed in an earlier EWMP, there are no known habitats supported/supplied by groundwater levels.

C. Shallow Groundwater
Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

◉ Yes	○ No	○ Unknown

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

◉ Yes	○ No	○ Unknown

F. Fertilizer/Herbicide/Pesticide Use (not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

◉ Yes	○ No	○ Unknown

Discussion:

Canal lining and piping of ditches promoted by the incentive program have reduced the amount of soil erosion from the channel.

H. Field Burning and/or Fugitive Dust (not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease	○ Increase	◉ Neither	○ Unknown

J. Habitat Effect (not applicable)

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels
Will implementation of the EWMP affect groundwater elevations?

◉ Yes	○ No	○ Unknown

B. Instream Flows
Do the water supplier's distribution flows contribute to any natural streams?

◉ Yes	○ No	○ Unknown

C. Drain Flows
Do drain flows supply or support any third-party user?

◉ Yes	○ No

D. Herbicide/Pesticide Use (not applicable)

E. Wind/Water Soil Erosion
Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

◉ Yes	○ No	○ Unknown

Discussion:

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (Continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes ○ No ◉ Unknown

B. Effects on crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase ○ Decrease ○ Neither ◉ Unknown

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase ○ Decrease ○ Neither ◉ Unknown

D. Effects on local processing of farm products

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase ○ Decrease ○ Neither ◉ Unknown

Please press here to continue.

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion	X			
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows				X
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion	X			

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				X
C	Local farm Labor				X
D	Processing of Farm Products				X

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

1.00

In the box below please discuss your assumptions and methodology for deriving this estimate.

Incentive programs that promote water conserving projects such as canal lining, pipelines, and on-farm structures will generate some surface water conservation. However, the potential water conservation as a result of these projects has already been calculated in prior EWMPs benefit analysis. As discussed earlier, reduction in surface water deliveries as a result of landowners switching to groundwater will not conserve or save water. The cost-of-service is based on demographics and the decisions of the locally elected Board of Directors. For purposes of establishing a cost benefit analysis 1.0 acre-foot of water savings was used for this EWMP.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

○ Yes ◉ No ○ Unknown

Discussion:

The Incentive Program costs have already been calculated in earlier EWMPs analysis.

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ◉ No ○ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes	◉ No	○ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes	◉ No	○ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

Please press here to view the worksheet

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: **1.00** acre foot

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs:

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning		20,000	15%	3,000	23,000
Land			15%		
			15%		
Structure			15%		
			15%		
Equipment			15%		
			15%		
Mitigation		100,000	15%	15,000	115,000
Other			15%		
Subtotal Capital Costs					138,000
Deduct Expected Salvage Value after 25 Years					0
Total Capital Costs					138,000
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					10,792

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
0	-		0

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Complete the following worksheet for EWMP costs/af summary:

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
10,792	0	10,792	1.00	10,792

Please press here to go back to Part 5.

Worksheet 3. EWMP Water Supplier Benefits

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	Amount of Water (af)	Annual O&M Costs ($/af)	Sources to Used as Benefit Measure
(a)	(b)	(c)	(d)
	1.00		

Please press here to go back to Part 5.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor[1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a 25-year period with 6% discount rate.

Please press here to go back to Part 5.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	Amount of Water (af)	Selling Price ($/af)	Expected Frequency of Sales (%) [1]	Expected Selling Price ($/af)	Option Fee ($/af)	Total Selling Price ($/af)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
Unknown	1.00	60	75%	45		45

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,
[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

Please press here to go back to Part 5.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	**45**
EWMP Costs ($/af)	**10,792**
Benefit/Cost Ratio	**0.00**

Please press here to go back to Part 5.

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

Please press here to continue.

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion	X			
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J	Vernal Pools and Swales				
K	Riparian Habitat				
L	Open Water Bodies				
M	Marshes (permanent or seasonal)				

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows				X
C	Drain Flows				X
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion	X			

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				X
C	Local farm Labor				X
D	Processing of Farm Products				X

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**0.00**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?		**X**

Decision about EWMP

	Yes	No
Is EWMP accepted?	**X**	

Discussion:

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Table 1. EWMP Analysis Summary Table

	EWMP	EWMP			Environmental Effects				Third Party Allocation Effects				Indirect Economic Effects				Water Supplier B/C Ratio (25 years)	Financial Analysis	EWMP Accepted? (Yes/No)
		Fully Implemented?	Demonstrably Inappropriate?	Technically Infeasible?	B	N	I	IN	B	N	I	IN	B	N	I	IN			
List A. Facilitating Practices	1. Facilitate Alternate Land Use	Yes	No	No															Yes
	2. Facilitate Use of Available Recycled Water	No	No																
	3. Facilitate Financial Assistance	Yes	No	No															Yes
	4. Facilitate Voluntary Water Transfers	Yes	No	No															Yes
List B	5. Line or Pipe Ditches/Canals	Yes	No	No	2	0	10	1	2	0	3	0	1	0	2	0	0.02	No	Yes
	6. Increase Water Ordering/Delivering Flexibility	Yes	No	No	1	1	4	1	1	1	2	0	2	0	0	1	0.06	No	Yes
	7. Construct/Operate Tailwater and Spill Recovery System	No	No	No	1	1	3	2	0	1	1	2	1	0	2	0	0.81	No	Yes
	8. Optimize Conjunctive Use	Yes	No	No	0	2	5	0	0	1	2	1	2	0	0	1	0.23	No	Yes
	9. Automate Canal Structures	Yes	No	No	0	0	5	1	0	0	4	0	0	0	3	0	0.39	No	Yes
List C	10. Water Measurement/Water Use Update				0	0	7	0	0	0	3	1	0	0	3	0	0.00	No	Yes
	11. Pricing and Incentives				1	0	6	0	1	0	1	2	0	0	0	3	0.00	No	Yes

Shading = "Facilitate" EWMPs that use a different analysis to determine the extent a water supplier is able to facilitate them.

B = Beneficial; I = Insignificant; N = Negative; IN = Indeterminate

Irrigation Master Plan Phase I

Executive Summary

Modesto Irrigation District

Irrigation Master Plan
Phase I

Executive Summary

Introduction

This report summarizes the findings, conclusions, and recommendations from the first phase of an Irrigation Master Plan which was initiated by Modesto Irrigation District in December 1994. The master planning process (see Figure ES-1) is divided into three phases. Phase 1 focused on assessing existing District facilities and the procedures, policies, and programs under which they are operated. The Phase 1 report includes interim recommendations and identification of future needs. MID staff will be implementing interim recommendations to improve customer service as future studies are being completed. Phase 2 will serve to develop and evaluate alternative improvements with a 5-year plan for implementation. An implementation plan will also be developed for project elements the District wishes to pursue on its own. Phase 3 will include preparation of engineering drawings and specifications for construction of capital improvements and development and implementation of procedures and policies to support other changes adopted by the District.

This Phase 1 report is organized into subject areas addressing irrigation facilities, customer service, water ordering and delivery, construction and maintenance, system automation, information management, and water accounting and measurement. These subject areas are presented in a question and answer format within the report. The questions, developed in conjunction with District staff, focus on current and anticipated issues and needs associated with the District's facilities, operations, and levels of customer service. A separate section discusses the overall need for action by MID. Recommendations and implementation strategies are also provided for consideration by the MID Board of Directors.

This Executive Summary provides an overview of the Phase 1 findings and the needs identified in the initial phase of the study. Recommendations for interim and long-term activities are also summarized. All of these items are discussed in greater detail in the remaining sections of the report.

Phase 1 Findings, Identified Needs, and Recommendations

Table ES-1 summarizes the principal findings and associated recommendations identified in Phase 1 of the Master Plan. Findings, identified needs, and recommendations resulting from the Phase 1 master planning effort are discussed in the following paragraphs. The discussion is organized into the seven subject areas defined above.

Irrigation Facilities

The original design constraints, condition, function, and reliability of MID's irrigation facilities are fundamental to the level of service the District can provide to its customers.

Table ES-1
Summary of Findings, Needs, and Associated Recommendations

Finding/Need	Conclusion/Action Recommended
Facilities	
MID's open canal facilities are in excellent condition, with 85 percent concrete lined (142 miles). Maintenance practices should be updated by implementing cost-effective planning and maintenance tracking systems.	Update gunite relining program. Develop 5-year maintenance programs to guide 2-year budget cycles. Implement maintenance scheduling and management systems. Expand cost accounting systems to automate and track maintenance costs and accomplishments.
MID has a total of 44 miles of cast-in-place (CIP) concrete pipelines. The pipelines are old (average age is 45 years), and have capacity and pressure restrictions that limit the District's ability to meet existing and future needs.	Develop pipeline capacity and pressure criteria to guide replacement program to meet future delivery requirements. Evaluate alternative repair/rehabilitation methods for MID-owned CIP concrete pipe.
Half of MID's service acreage is served by 270 Improvement Districts, which are served through 152 miles of CIP pipelines. Many pipelines are old (average age of 45 years), and have capacity and pressure limitations.	Commit MID resources to assist Improvement Districts and private system owners in developing facility master plans to meet current and future service needs. Continue close alliance with system owners and coordinate immediate needs with the master plan process.
MID is rehabilitating and converting its drainage wells for future operation as multipurpose drainage and peaking irrigation supply wells.	Monitor groundwater levels, and develop a facility master plan for MID wells as part of MID's Groundwater Management Plan (AB 3030). Integrate Groundwater Management Plan with Phase 2 of the Irrigation Master Plan.
Customer Service	
A growing number of farmers served by pipelines have installed micro-spray or drip systems which were not designed to be served from CIP pipelines.	Develop service criteria and options to deliver MID water to micro-spray and drip systems. Inventory system and evaluate capabilities to meet future needs.
Without significant modification or replacement of existing MID and Improvement District CIP pipelines, MID may not be able to provide adequate service to meet changing customer needs.	As allowed by the Water Code, MID should develop plans and cost estimates consistent with revised MID policy to assist Improvement Districts and private systems in providing needed upgrades.

A growing number of landowners (up to 500 acres per year) are installing groundwater wells as their primary source of irrigation supply.	Develop and implement master plans for MID and Improvement District system improvements that will reverse this trend and maintain MID's customer base.
MID staff focus on water deliveries and are not able to furnish on-farm management advice to customers, which could influence customers' decisions to continue with MID service or switch to private wells.	MID should consider ways to support a water management unit (mobile lab) and work with growers to evaluate existing on-farm irrigation system performance and promote efficient water management practices.

Water Ordering and Delivery	
The existing water ordering and delivery system is labor intensive because high flow rates are delivered to small land parcels. Customer ordering times are not monitored. Opportunities exist to reduce costs and help track wait time.	Comprehensive ordering and delivery procedures should be developed after customer service objectives are confirmed. The water ordering and delivery process should be computerized.
Highly variable drain flows from Oakdale Irrigation District are conveyed into the Main Canal. Drainage flows complicate the management of Main Canal flows, making it difficult to order water and causing mismatches in flow and demand.	Continue plans to add intermediate SCADA flow monitoring point to track and adjust for variations in Main Canal flows.
Opportunities exist to improve customer service and reduce spills with more frequent flow changes in MID's system.	Continue making improvements to the Main Canal and lateral headworks daily flow and demand scheduling system used by Irrigation Supervisors.
Water Accounting and Measurement	
As the need develops for more accurate water accounting water measurement devices and methods will need to be evaluated and an action plan implemented.	Continue and standardize the sidegate flow metering program. Evaluate water measurement and accounting technology to meet long-term needs (i.e., remote digital assistants or data loggers).
System Automation	
The Main Canal, lateral headworks, spills, and some intermediate measuring points are automated through the MID SCADA system.	
Further automating MID's system could provide more responsive service to users who want it, reduce operations labor requirements, and reduce operational spills from the system.	Develop options to extend MID's automation (SCADA) program to include laterals, sidegates, wells, and other additional facilities. Upstream and downstream flow control strategies could be developed and compared in future studies to identify the most cost-effective and desirable overall water management strategy.
MID's existing SCADA facilities can be updated to improve the archiving of data and to improve water reporting and recordkeeping.	Develop options to upgrade MID's automation (SCADA) system to upgrade archiving and reporting capabilities.
Construction	
To improve service and conjunctively manage MID surface-water and groundwater supplies, MID should develop and analyze alternatives to add, modify, and automate MID canal structures, gates, wells, and regulatory storage.	Model canal and groundwater pumping strategies to develop least-cost alternatives. Evaluate supply response and storage capability of MID canals. Integrate AB 3030 Groundwater Management Plan with ongoing master planning efforts.
To meet future service requirements, MID should consider revisions to CIP pipeline design and construction practices for MID and non-MID-owned delivery systems.	Identify facility plan improvements to MID facilities to meet customer needs.

Improvement District and community pipeline facilities may not be capable of meeting current or future customer service needs. These facilities should be inventoried and evaluated for capability to meet future customer needs.	Define legal and policy constraints to ID systems. Conduct inventories and field evaluations, and develop pipeline delivery criteria, plans, and estimates to meet specific service objectives.
No capital improvement program is in place for the Improvement District pipeline facilities because MID has limited responsibility for Improvement District improvements and none for community and private systems.	Implement capital improvements consistent with adopted master plan policies and procedures.
Information Management	
MID's Irrigation Division information systems are being enhanced.	Review existing report formats, identify reporting needs, and modify practices to meet needs.
	MID should continue to work toward fully automating and integrating the water ordering, delivery, information collection, billing, management, and data storage information systems.

During Phase 1 of the master plan, CH2M HILL and District staff developed and implemented a comprehensive facilities inventory and database program. The database was divided into six major types of MID irrigation facilities: canals/laterals, structures, MID wells/pumps, sidegates, drainage facilities, and flow measurement and control facilities. The database lists facility names, locations, and key attributes (capacity, age, condition, configuration, etc.). Facilities not owned by MID but through which service is provided to MID customers were also identified to the extent that information was available.

MID's open canal facilities are generally in excellent condition. The District's aggressive capital improvement and maintenance programs include canal lining construction and rehabilitation, sediment removal, algae and weed control, access road and right-of-way improvements, and structure maintenance and improvements. Approximately 85 percent of the District's open canals are lined.

Approximately 20 percent of MID's total distribution system consists of pipelines, and most of the Improvement District laterals are also piped. These piped segments are typically non-reinforced, cast-in-place concrete. Routine maintenance has helped prolong the life of these pipelines, and the customers have not experienced loss of service. However, many of these pipelines are old, were designed for a specific capacity, and do not allow flood and pressure systems to operate concurrently. These limitations restrict the District's ability to meet changing customer requirements.

Approximately half of the MID's 65,000 irrigated acres are served by 270 separate Improvement Districts. Each Improvement District typically owns and operates a pipeline that conveys water from the nearest MID canal to individual parcels. Irrigation valves placed along the pipeline are used to irrigate crops. The owners of Improvement Districts are responsible for the operation, maintenance, and replacement of these pipelines. The average age of the Improvement District pipelines is 45 years, ranging from 1 year to 65 years. **These pipelines are susceptible to deterioration, settlement, cracking, and leaks.** It appears that many of the older lines may be reaching the end of their service life.

Most Improvement District pipelines currently have sufficient capacity when the frequency, rate, and duration of irrigation are controlled by the District (such as rotation service). However, these same pipelines have significant capacity limitations when growers are given the opportunity and flexibility to adjust their irrigation patterns. As a result, many growers in Improvement Districts do not have the flexibility to irrigate when it is most convenient for them, and they may not be able to deviate from normal flood irrigation schedules as is required by drip and micro-spray systems. **Without significant modifications to the Improvement District facilities, MID will not consistently be able to provide adequate service to meet changing customer needs.**

In addition to the Improvement Districts, some pipelines are owned by one or more private individuals that also deliver MID irrigation water. MID has no responsibility for these private pipelines, so little information is recorded as to the pipelines, location, size, length, and condition. **Private pipelines serving one owner likely have adequate capacity to meet customer needs, but private community pipelines may not.**

MID has no responsibility for Improvement District and privately owned pipelines, and growers are solely responsible for implementing improvements to their facilities. Because of the extent of these facilities, MID's customer service issues have become more problematic.

Drainage wells within the MID system are valuable as a supplemental irrigation supply. MID is rehabilitating and converting its drainage wells for operation as drainage and irrigation supply wells. These wells could be automated to help meet changing customer needs. A short-term recommendation is to add time clocks to each well to use water more efficiently. However, a long-term approach involves the development of systemwide automation control strategies to improve operational flexibility and customer service.

Customer Service

MID's customer needs are changing, and although the District's irrigation system is adequate to meet the original objective of providing service to all customers on rotation delivery, changes in irrigation methods have affected the District's ability to meet the needs of all of its customers. These changes involve a shift from low-frequency irrigation methods to higher-frequency drip and micro-spray systems.

MID's irrigation facilities were designed to serve high-volume, low-frequency flood irrigators. MID now has three basic customer types: 1) traditional low-frequency flood and sprinkler irrigators, 2) high-frequency drip and micro-spray irrigators, and 3) garden-head users (small urban parcels fewer than 5 acres). MID provides good, highly responsive service to most low-frequency irrigators, except in cases where system capacity limitations force rotation scheduling. However, in many cases the current system design does not allow flood irrigation to occur simultaneously with micro-spray or drip irrigation. Due to historical system design for flood irrigation, MID cannot meet the daily water demands of micro-spray or drip irrigators located at the ends of long pipelines. Some drip and micro-spray irrigators have been accommodated where such systems are served directly from MID canals. About 7 percent of MID irrigated land has been converted to private groundwater pumping to better accommodate the shift to high-frequency drip and micro-spray systems. **Unless this trend is reversed, more land will be served by groundwater, which could cause a surface water versus groundwater imbalance.**

Water Ordering and Delivery

MID has been transitioning from rotation delivery to arranged demand service over the last 10 to 15 years. MID uses a decentralized water ordering process by which most customers place their orders directly with ditchtenders as opposed to a single order center. The existing water ordering process works well but can be improved. Under this system, each ditchtender takes orders for an assigned area and arranges them in a sequence to ensure that the order is filled within the 3-day window specified by MID rules.

From an operations and management perspective, the existing water ordering system has two significant drawbacks, both tied to the decentralized nature of the existing process. First, the existing ordering system is labor intensive and, therefore, is in conflict with MID organizational goals to cut costs, reduce water operations staffing levels, and improve service. If the existing ordering system is retained, customer service may suffer if staffing cuts are made. Second, the existing system is lacking from a management information perspective. With the decentralized nature of the process (i.e., with each ditchtender acting as a dispatcher) and the lack of consistent records, District management has no way to monitor and evaluate the responsiveness of MID's service from the customer viewpoint.

MID has automated major water control structures and installed level control and measuring weirs, which allow for monitoring and controlling flow at key delivery points. These facilities have helped to improve the District's flexibility in serving its customers.

Groundwater is pumped into MID canals with both District irrigation and drainage wells at various locations throughout the District. The groundwater pumps are used for drainage and to supplement surface-water supplies, improve system responsiveness, and reduce fluctuations.

Construction and Maintenance

MID's Construction and Maintenance, Engineering, and Irrigation Services departments are responsible, either separately or jointly, for construction and maintenance activities. Different practices and procedures are employed for maintenance and construction programs, and MID's policies and procedures for non-MID-owned facilities are different from those for MID-owned facilities.

In general, maintenance planning and programs are adequate for MID-owned facilities. Improved tracking of maintenance costs and budgets by facility and location will help the District better track maintenance activities for planning, budgeting, and cost accounting.

Existing maintenance programs and capabilities are not as adequate for non-MID-owned facilities, including Improvement District, community, and private pipelines. Under the existing program, Improvement District pipeline repairs are initiated by request of the landowners, completed by MID crews, and billed to the Improvement District upon completion. This practice results in deferred maintenance by growers seeking to postpone and minimize costs. Inventories, condition assessments, and capacity/pressure assessments are needed to determine the suitability of the pipelines to meet future (Master Plan) service requirements.

MID has no responsibility for private pipelines (known as community pipelines when multiple owners are involved), and little information is recorded by MID as to the pipelines' locations, sizes, lengths, and conditions.

Construction planning is done for capital improvement budgeting purposes. Staff are involved in setting priorities for the 2-year budget cycle, and adjustments are made to fit changing conditions. A portion of the current construction program is covered by the plan developed and funded in 1989, through the adoption of the Conservation Fund. The fund is available to finance capital improvements to private, community, Improvement District, and District facilities consistent with MID policy. The conservation program expires in 1996. MID staff has identified the need for a new comprehensive plan, or an update to the current plan. Construction under the capital improvement budget requires work order preparation and approval prior to engineering and construction.

Construction planning for the Improvement Districts requires meeting with the Improvement District farmers and deciding whether the needs are to be paid for by the Improvement District, or by cost sharing for capital improvements (pipeline replacement or canal lining) under the Conservation Program. A significant portion of the construction and maintenance work is performed in response to requests from the farmers. This work usually takes priority, although it is time consuming and cumbersome to complete. The Improvement Districts do not have master plans, and they do not anticipate and budget for future capital expenditures. For this reason, much of the work is low-cost, short-term-fix work.

No capital improvement program is in place for the non-MID-owned facilities because MID has limited responsibility (emergency repairs) for Improvement Districts and none for community and private pipelines. The current MID policy of replacing pipelines with cast-in-place pipe has low initial costs, but is no longer effective in many locations because it does not provide seepage control and pressure capabilities for micro-spray and drip irrigation. **For Improvement District facilities, the current policy of replacing existing pipelines with cast-in-place concrete pipe may not be adequate to meet future operating conditions.**

The efficiency and cost-effectiveness of MID's maintenance programs could be improved by developing a maintenance management system. Five-year planning cycles should be developed for canal re-lining, pipeline maintenance, and lateral repair and maintenance programs. For non-MID-owned pipelines, a capital improvement plan should be developed to ensure that MID service is adequate to meet future customer needs. Incentives for farmers to participate in the program should be provided by continuing or building on the existing conservation program. Alternative methods for repairing and rehabilitating cast-in-place (CIP) pipelines should be investigated. Possible methods include sliplining of pipes (flexible pipe insertion techniques) and cured-in-place lining. Capital improvement needs identified by District staff for the MID-owned facilities include:

Continue rehabilitating drainage wells and deep wells, and construct new wells as needed.

Continue equipping groundwater wells with flowmeters.

Develop a pilot pump automation program to complement existing surface-water operations.

Install additional pipeline flowmeters.

Equip several additional flow measurement sites with supervisory control and data acquisition systems (SCADA) capabilities.

System Automation

MID's largest canals are equipped with remote-controlled headgates with flow-sensing devices. Using a radio-controlled SCADA system, instantaneous flow rates can be monitored and adjusted at 10 lateral headings, the Modesto Reservoir outlet, the Tuolumne River diversion, and at other locations. MID also uses manual chart recorders at the Modesto Reservoir inlet, the MID Main Canal at Scow Drop, and at numerous other locations.

Chart recorders have been installed to measure operational spills at the end of major laterals. Four of these recorders are equipped with SCADA system remote data transmitters that permit real-time flow monitoring.

Further automating MID's system could allow the operators to provide more responsive service to users. Automation would also reduce operations labor requirements, and reduce operational spills from the system. These objectives could be accomplished by automating the existing lateral systems, combined with automated pumping from groundwater wells at the ends of most laterals. These improvements would help to minimize the need for costly physical changes to the existing system. Physical changes may include enlarged canal sections or reservoirs that could provide some regulating storage near the ends of laterals to help dampen the effects of flow changes within the system.

With more automation and comprehensive operational planning, flow changes could be passed through the entire system more quickly and reliably. Ditchtenders could then more effectively respond to variable customer demand. The wells and enlarged canal sections would compensate for unanticipated demand changes and system fluctuations until necessary flow corrections could be made.

Upstream and downstream flow control strategies could be developed and compared in future studies to identify the most cost-effective and desirable overall strategy, but first it is necessary to establish the service criteria the system must satisfy and characterize the dynamic nature of irrigation demand.

Water Delivery, Measurement, and Accounting

Water is measured to facilitate customer billing and internal water management and to provide accountability. For billing purposes, each ditchtender is required to maintain a "day book," in which the flow rate and duration of deliveries to each account are recorded. Garden-head users are billed a flat rate, and therefore deliveries are not individually measured. Water orders from ditchtender daybooks are entered into the database on a weekly basis. This information is used for end-of-the-year billing.

Deliveries to water users are generally measured at the lateral sidegate using a gate opening/pressure differential technique. In cases where multiple users are on one sidegate, the flow and total time are recorded. With the aid of the water users, the water delivered is proportioned among the various users.

Water deliveries to the ditchtenders are measured and recorded so that managers can account for water separately for the nine ditchtender areas. The efficiency of ditchtender water ordered versus actual deliveries is expressed as a percentage of the total surface water ordered and delivered to the ditchtender area. This provides managers with a water delivery efficiency index for each ditchtender area.

Because water is charged at a flat rate up to a preset allocation, most growers do not exceed their allocation. Current measurement methods work well under existing conditions, despite difficulties in precisely measuring deliveries. However, as water rates increase or rate structures change, MID may need to develop a more refined procedure for accounting and billing of water deliveries.

For the portions of the system served by open channels, flow measurement capabilities can be improved without extensive modifications to existing structures. Modern water level sensors, such as pressure transducers or ultra-sonic sensors, can be added at most locations. These devices are conducive to automated data logging, telemetry, and automatic flow or water level control, all of which are desirable as MID looks to the future.

The major challenges in improving MID's flow measurement capabilities lie at the lateral sidegate and individual user levels. Sidegate deliveries are generally measured using rated canal gates. Such measurements may be inaccurate because of variable head conditions. These problems can be resolved by hydraulically isolating the non-MID facilities from the MID laterals by installing an overpour weir at the turnout, automating the existing gates to adjust the gate position as needed to hold the discharge constant, or installing totalizing flowmeters, which could also serve as the sensor for automated gate control.

Information Management

MID handles large amounts of information dealing with the irrigation facilities, operation and maintenance programs, customer accounts, billing, and related subjects. Managing and sharing this information between departments has become a major task. The District continues to standardize hardware and software systems to provide the framework to enable the District to take full advantage of advancements in information technology in order to accomplish this information transfer task.

Most of the current MID Irrigation Division information systems are adequate but can be enhanced. Many of the systems are either totally or partially manual, noncomputer systems. Also, many District drawings and maps are not in a digital format. If necessary, these elements could be scanned and converted to a digital format that would make access and distribution much easier for MID staff. Digital maps could also be used and accessed via a more comprehensive geographic information system. MID is exploring these options.
MID is currently using RBASE to enter water usage data, but is moving toward conversion to a large relational database (Oracle) as the standard data "warehouse." The District has adopted and is using Microsoft Access as the relational database tool for data analysis, queries, and reporting. Several computer systems are currently used to compile and analyze pertinent data for customer accounts, billing, water delivery, land use, engineering, maintenance, and construction functions. The District is also beginning to convert existing paper records such as letter drawings and figures to a common computer system (i.e., Oracle, Computer Aided Drafting (CAD), or Geographic Information System (GIS) software systems).

In the long-term, MID should work toward fully automating and integrating the water ordering, delivery, information collection, billing, management, and data storage information systems.

Need for Action

A water budget was developed to depict changing water supply and demand conditions within the District. The purpose of developing the water budget was to test how changing land use, water demand, and population projections might require a change in MID's operations and practices in the future. The baseline condition for the water budget analysis was a continuation of existing conditions, policies, and practices.

The water budget accounts for the predominant sources of water to the District, including river diversions, precipitation, and MID and private groundwater pumping. It also accounts for the ultimate fate of the water, including consumptive use, deep percolation, evaporation, and runoff. Using changing land use, water demand, and population estimates, water budgets can be developed at specific time intervals to reveal important trends that will affect MID facilities, programs, and policies.

One of the important elements that was evaluated through the use of the water budget is the conversion from flood irrigation to drip and micro-spray systems. Discussions with MID staff indicate that the number of acres served by drip and micro-spray systems has doubled (from 1,600 acres to 3,200 acres) in the past 3 years, and these trends are expected to continue well into the future, according to agricultural professionals and local growers. By 2020, it is estimated that nearly 60 percent of all tree and vine acreage (18,100 acres) will use drip or micro-spray systems. The transition usually occurs when new tree and vine crops are planted or old crops are replaced, or when land ownership changes.

Groundwater pumping is attractive to drip and micro-spray system operators compared with surface water because there is less debris and algae in groundwater, which can plug emitters. Groundwater is also advantageous because it is available on demand, thus accommodating the more frequent irrigations required by drip and micro-spray irrigators. A grower's decision to convert to groundwater pumping is particularly sensitive to the relative cost of surface water and groundwater, the availability of water on demand, the condition of Improvement District pipelines, and the quality of the water. Conversions to groundwater pumping can have a significant impact on the District's future. If conversions to groundwater pumping continue to occur at a rapid rate, the District's ability to provide adequate levels of service to its remaining customers will be adversely affected. Also, recharge to the groundwater basin would be reduced beyond the normal reductions expected as a result of urbanization. Therefore, without a change in practices, such as the installation of recharge basins, net groundwater recharge will decline at the same time as the demand for groundwater is increasing.

Because of increasing urbanization of the Modesto area and the conversion to drip and sprinkler irrigation systems, the total agricultural water demand is declining. Urban consumers will become an increasingly important aspect of MID's operations, but agriculture will continue to account for the majority of water demands through the year 2020. If MID takes no action by 2020, river diversions are projected to fall below current levels. Assuming that maintaining current diversion levels is desirable, MID should consider an expansion of the existing water treatment plant, implementation of groundwater recharge and recovery facilities, or other alternatives to maintain a stable future water supply.

Other factors affecting the area's water balance are increased runoff of precipitation in urbanizing areas, reduced levels of irrigation runoff and recharge attributable to the higher efficiency irrigation systems being constructed, and increases in wastewater treatment plant discharges. The net effect of these changes will be an overall increase in the net runoff within the study area and a reduction in the historical recharge of the groundwater basin.

MID may also be affected by external regulatory issues as a result of federal and state legislative and regulatory initiatives. These initiatives may have an impact on the District's operations, but the resolution of issues associated with water resources management, water quality, and endangered species protection are far from certain. However, decisions by MID need to be made with the recognition of emerging trends such as watershed management, conjunctive use of surface-water and groundwater resources, and increasing concern for environmental issues.

Concurrent with the changes cited above, the District will also be affected by the deregulation of electrical power. This change may impact the current water pricing system and result in lower operations and maintenance budgets. The District will face a major challenge in meeting increasing service expectations of its water and electrical customers.

These factors demonstrate the need for MID to be proactive in planning for the District's future. MID staff have recognized and are developing programmed responses to a number of the issues identified during the Phase 1 studies. Some of these efforts were initiated prior to the authorization of the Irrigation Master Plan, and others have been initiated in response to the early findings of the master planning studies.

The District has two primary alternatives in planning for its future. The first alternative is to continue with current programs and policies. The second alternative is to have the District staff develop and implement new programs, policies, and procedures to respond to anticipated changes and future needs. Because of the major irrigation system change currently occurring within the District, a no-action alternative is not acceptable. District staff believes that special studies and programs (master plan) are needed to ensure that MID can meet future customer needs.

Some of the Phase 1 recommendations not already being addressed by the District can be implemented without significant additional study. These recommendations should be evaluated by the District and those that the District wishes to pursue should be incorporated with the other ongoing programs.

Implementation Strategies

Interim recommendations can be "spun off" and implemented in accordance with the District's assessment of the priority and benefit of the recommendations. A strategy for implementing recommendations requiring additional study and development is shown in Figure ES-2. The figure shows a schedule of activities in a two-step process. The first step identifies the direction and planning activities needed before Phase 2 of the master plan begins. This step is needed to set direction and policy, to develop scope, budgets, and detailed schedules, and to define coordination requirements (which activities are best done by staff, which by consultant, etc.). These activities are scheduled to take place during the first quarter of 1996.

The second step, also shown in Figure ES-2, is to execute those activities needed to define service objectives, develop alternatives, and complete the facility improvement and implementation plans. To develop alternatives, plans and estimates need to be prepared for options identified in Phase 1. Examples of options are a well and pump automation plan, regulating storage options, automated gates, improvements to Improvement District systems, and the other options that have been recommended. After physical options have been developed, they can be combined into alternatives. Physical, operational, and implementation plans and estimates can then be developed for evaluation. The careful planning, execution, and review of this process (plan, do, check) will result in an Irrigation Master Plan that guides improvements, operations, and management of MID's system to meet District goals and objectives.

Phase 2 recommendations provide the direction for ongoing master plan investigations. As shown in Figure ES-3, MID has an important decision to make with respect to District involvement in operation and maintenance of non-MID facilities. This decision is critical because it relates to the service MID wishes to provide. If the Board elects to take a more active role (relative to current policy), then improving non-MID facilities becomes a key element of the master plan, along with improvements to MID operations and facilities. However, should the Board elect to take a less active role (relative to current policy) with non-MID facilities, then the master plan would concentrate only on MID operations and facilities. Even if MID elects to take an active role with non-MID facilities, all improvements would have to be implemented indirectly through Improvement Districts and other private owners of these facilities.

Modesto Irrigation District

Water and Power

ITRC Report

March 29, 1996

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Report and Recommendations from ITRC Visit to Modesto ID on March 25- 26, 1996

Background of ITRC visit

CH2MHill recently completed a comprehensive "Irrigation Master Plan" for the district. That Master Plan identified several areas for modernization, including:

- Centralized water orders
- Automation of the existing upstream controlled canal system
- Automation of pumping from groundwater wells near the ends of most laterals
- Use of existing or new enlarged canal sections near the ends of laterals

ITRC was asked by MID staff to make a quick visit to the district with the goal of brainstorming some specific water delivery modernization options, including those recommended by CH2MHill. Mike Lehmkuhl, (ITRC SCADA , Supervisory Control and Data Acquisition, specialist), and Dr. Charles Burt (ITRC Director) visited MID, met with MID irrigation and SCADA staff, and toured some of Laterals 4 and 5.

During the visit, MID staff mentioned several concerns regarding future modernization efforts. These included:

- The use of groundwater for drip/micro systems will increase unless delivery service is improved.
- It is desirable to reduce spills at the ends of canals.
- Land purchases for regulating reservoirs near the city of Modesto are very expensive
- Many of the Cast in Place (CIP) concrete pipes have leakage problems, but they are very expensive to replace.

The visit was short, so obviously the observations and recommendations listed below are subject to debate and correction. This report was also developed quickly and without attempts to make it a polished product. However, it is clear that some options exist which MID can implement rather rapidly to achieve noticeable improvements in service.

General ITRC Observations

Canal Operation at Present

Existing Automation. MID already has a reasonable form of canal automation in place. This automation has 2 major components:

- Automated upstream water levels on laterals with long crested weirs. These provide a robust and simple form of automated upstream water level control. For the immediate future, there is no need to replace those weirs; they provide much better water level control than any other form of manual structure, and they are more reliable and less expensive than many computerized gates. Although there are some advantages to computerized gate controls on the check structures along the laterals, conversion to this form of automation would be very expensive and there are much better opportunities to achieve major operation improvements at this time.
- Flow control at all of the major canal division points. MID has implemented automatic flow rate control at the heads of most of the major canals and splitting points. This is a wise decision, as it concentrates most of the major flow rate fluctuations in a few locations rather than having major problems throughout the whole system. In effect, each canal lateral with flow control at its inlet is unaffected by upstream disturbances.

However, MID is lacking several essential items which could enable it to make better use of the existing automation system. These are:

- A good information management system which would allow an operator at a central location to make better and more frequent decisions on water releases from Modesto Reservoir. This information management system would include:
  - A SCADA (Supervisory Control and Data Acquisition) system which would allow real-time centralized monitoring of key flow rates and water levels at canal inlets and spills.
  - A SCADA system which would allow simple and quick remote changes in flow rate or water level setpoints at key control points.

- Centralized collection of water orders, so that operators at a central location would know what flow rates are desired at key points in the system.

- Special hardware near the tail ends of laterals (including pumps and reservoirs), discussed later in this report
- Other special practices and/or hardware (discussed later).

Existing Information Management. MID does have an elaborate SCADA system, but it is designed for the Power division. It only monitors 15 irrigation points, and is not designed to provide real-time information for irrigation operations. The small amount of irrigation SCADA hardware in the field is not standardized, and some of the remote controllers are disconnected and function below their capabilities. MID is fortunate in that it has an extra 900 mHz radio frequency available which can be used immediately for a new irrigation SCADA system.

The lack of readily available real-time irrigation operation information from the SCADA system is not a major issue today because the ditchtenders control the most of the irrigation system, its information, and its performance. The system is largely run by the ditchtenders using "art". "Art" is non-transferable knowledge, and it will serve MID well to switch from "art" to "science and engineering" in the near future. Operation of MID by "art" presents several problems:

- There is little accountability out in the field. The ditchtenders are the only ones who know what the water orders are. Unless there are complaints by water users, central MID staff have no independent way of verifying the levels of service which are provided to customers throughout the system. Even if complaints occur, it is difficult to determine exactly what is truth.
- Performance improvements are limited. Those who conduct irrigation as an art often work very hard, but hard work should not be confused with excellent performance. A challenge facing MID is a shift toward more flexible water deliveries. Most of California irrigation districts already delivery with less than 24 hours advance notice. Although MID will be able to make some improvements in delivery flexibility without changing the existing operation rules, major changes of this magnitude would be difficult if not impossible without having much more spill.
- Operators are difficult to replace. It is difficult to train a new person if it is impossible to describe exactly what the cause/effect relations are in a canal/pipeline system.
- There are high labor requirements. Many gates and flows must be continually adjusted and personally monitored just to attain mediocre delivery service and minimal spills.

Ditchtenders must scurry from point to point just to check on status and to avoid serious problems.

Pipeline Distribution System

MID has a challenge in trying to service both surface irrigation (high flow rates, short duration) and drip/micro irrigation (lower flow rates, longer duration) from many of the pipeline systems. The MID irrigation staff have developed several alternatives which shorten pipe lengths and reduce the need to use a rotation delivery to all users. Some additional options are discussed later in this report.

What MID Should NOT (or Cannot) Do At This Time

No computer models. There is no need to develop an elaborate computer model of the canal and pipeline system at this time. Major service improvements can be achieved by implementing relatively simple measures; an elaborate computer model would be a waste of money now. In 10-15 years, there may be some benefit to using a model to plan future improvements. ITRC has an excellent canal computer model which it is using on another project at the moment and for gate control algorithm research; the MID situation is different.

No downstream control. There are many forms of automation, and there is no single "best" solution for all districts. One form of automation is downstream control. Downstream control uses special hardware and software which only allows water into a canal pool only if it is needed downstream. The action is automatic, and does not require the knowledge of a water delivery schedule. Some people characterize downstream control as a method which allows excess water to be automatically "backed out" of a canal system. Turnouts on a downstream control system can potentially be operated "on demand" (flow rate changes can be made without advance notice).

ITRC has done extensive research on some downstream canal control techniques, and has 2 working downstream controlled canals at its Water Delivery Facility on the Cal Poly campus. However, ITRC does not recommend that MID pursue downstream control at this time. The reasons for this recommendation are:

- Most of the downstream control techniques exist only on the paper of research journals. Cal Poly has one of the few "implemented" computerized methods in the world, and ITRC does not believe that it is ready for field implementation at this point.
- MID canal pools are relatively short and do not have a lot of extra capacity. These two conditions would probably cause serious stability problems if conventional downstream control was implemented (i.e., uncontrollable waves would develop). Obviously, this was not studied or modeled during the short visit, but the initial opinion is that instability would be a problem.
- The conversion to downstream control would be very expensive and the objectives of improved delivery service with minimal spill can be achieved in other ways.

Outline - Recommended MID Actions (Listed in Order of Priority)

The recommended actions are outlined below in order of priority, and are described in more detail in the subsequent sections.

Short Term

1. Install a trial terminal reservoir with a pumpback system, with ditchtender training and participation.
2. Install a skeleton irrigation SCADA system which includes computers in both the MID irrigation offices and for the central water dispatcher, with direct access to real-time field data, and with the ability to download that data and manipulate/study it without having to work through the power department.
3. Implement automatic or remote control of supplemental well pump supplies to feed some laterals. Include ditchtender training and participation.
4. Modify a few areas of pipelines so that both surface and drip/micro on-farm irrigation systems can be properly serviced. Include ditchtender participation.

Long Term

1. Modify the water ordering procedure so that all water orders come into a central location; ditchriders will still be responsible for controlling deliveries in their own areas.
2. Expand the terminal reservoir program.
3. Expand the SCADA system
4. Develop new centralized operational procedures for reducing the response time of water changes at the heads of laterals.

5. Expand the pipeline modification program.
6. Interlink various canal laterals near the tail ends.
7. Investigate expanded conjunctive use for providing flexibility in the canals. Use dry wells for excess operational water, and wet wells to supply needed operational water.

Short Term Recommendations - Expanded Descriptions

1. Install a trial terminal reservoir with a pumpback system, with ditchtender training and participation.

   The objectives of this would be to:

   - Eliminate lateral spill
   - Eliminate lateral shortages
   - Increase water delivery flexibility
   - Reduce ditchtender labor hassles

   The essential ingredients of this system include:

   a. A terminal reservoir which is connected by canals or pipelines to both laterals 4 and 5. The ideal capacity would probably be approximately 100 - 150 Acre-feet, to handle the fluctuations that will occur with the eventual high flexibility delivery service.
   b. A series of pumps to move water upstream from the reservoir, over the checks. These pumps would be automated with a very simple liquid level control. Each pump station would be independent and automatic. Pumps may be needed on the last 3-4 check structures of each lateral canal.

   This program can be implemented and tested quickly by using the storage capacities of the last section of canal on Lateral 4. However, as the ditchtenders provide water delivery with more flexibility, more reservoir storage would be needed for a successful program.

   The operation would be as follows:

   a. If there is an excess of water in the laterals, that water will flow over the existing check structures and into the terminal reservoir where it is temporarily stored.
   b. If there is a deficit of water in the laterals, that deficit will show up at the tail ends. The deficit will show us as a lack of water flow over the check structure. As soon as a

deficit occurs, a pump in the canal downstream of the check will lift water backwards (towards the upstream direction) over the check to refill the pool. This action would be repeated in as many pools as necessary to bring water from the reservoir to the points of use.

c. The operation of this system does not require any knowledge of required flow rates. Excesses spill into the reservoir; deficits are automatically pumped upstream from the reservoir.

d. The reservoir water level and inflow/outflow from the canals would be remotely monitored with the SCADA system, so that the main water dispatcher and local ditchtender would know if there is a shortage or deficit.

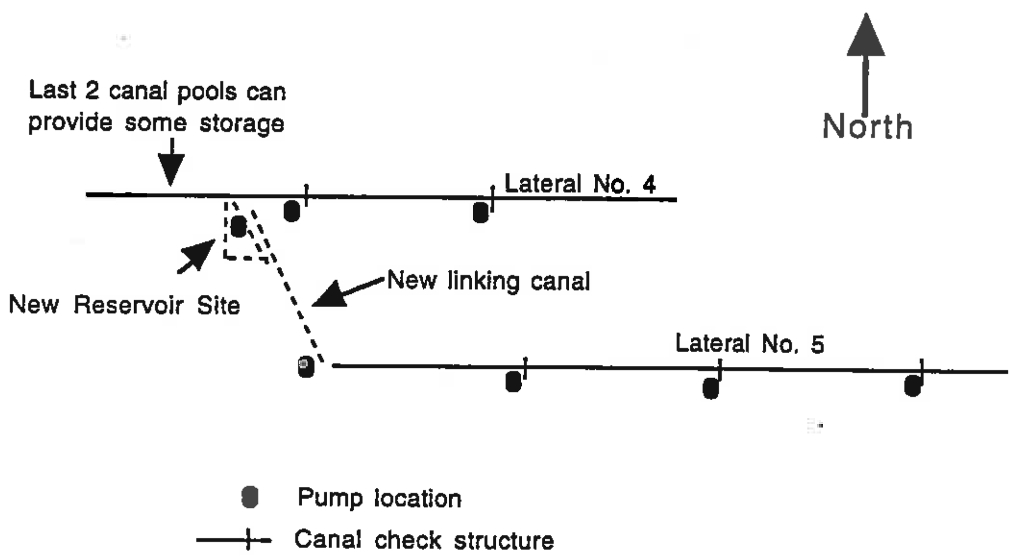


Figure 1. Plan view of terminal reservoir and pumpback system.

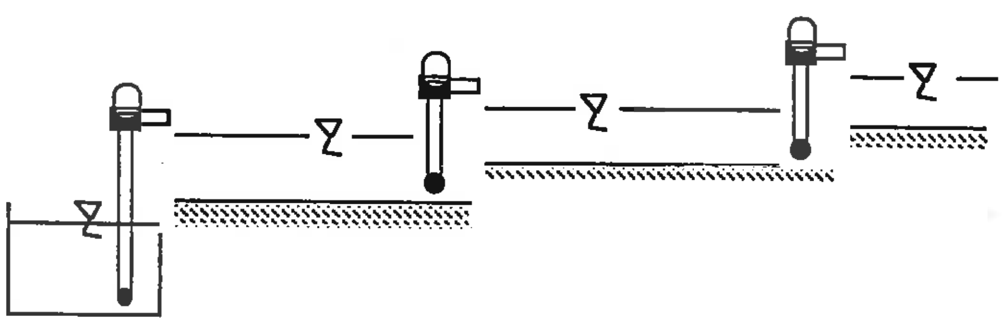


Figure 2. Profile view of existing check structures and new terminal reservoir and new pumps. A pump will be activated automatically if the water level in the upstream pool drops below the lip of the check structure.

It will be essential to include ditchtender input and participation in this program, because their acceptance of the new flexibility capabilities must be obtained so that they will provide better service to customers.

2. Install a skeleton irrigation SCADA system which includes computers in both the MID irrigation offices and for the central water dispatcher, with direct access to real-time field data, and with the ability to download that data and manipulate/study it without having to work through the power department.

A more detailed report will follow next week, as Mike Lehmkuhl is out of the office the week of April 29. However, the following notes can be made at this time:

a. ITRC has determined that drivers do exist which can link new graphical interface packages and data management programs with the existing MID SCADA system (operated by the power division). However, the MID SCADA system is fairly unique, and does not utilize standard communication protocol (MODBUS) which is commonly used in newer systems.
b. MID must decide if it wants to replace and standardize its existing irrigation SCADA, or stay with the older communication protocol. The preliminary recommendation of ITRC is to replace and standardize with readily available, commercial equipment that can be easily expanded in the future.

3. Implement automatic or remote control of supplemental well pump supplies to feed some laterals. Include ditchtender training and participation.

There is a long lag time for flow changes to arrive at the ends of laterals, after a change at Modesto Reservoir. MID staff have identified several wells which are adjacent to Lateral 4 that can be remotely operated if there is a temporary need for more water. Successful implementation of this option will require that the desired flow rates along Lateral 4 are known at MID offices (currently only the ditchtenders know this value). It is recommended that initially the wells be operated with remote manual control. The pumps should be remotely turned on and off from the MID offices, after checking with the ditchtenders. This will enable MID irrigation staff to determine if the transfer of information is sufficiently accurate to automate the pumps.

4. Modify a few areas of pipelines so that both surface and drip/micro on-farm irrigation systems can be properly serviced. Include ditchtender participation.

   It is apparent that the pipeline distribution system needs to be operated differently if it is desirable for more growers to obtain their drip/micro water from MID rather than groundwater. There was insufficient time during the visit to examine the trial areas which MID staff have already identified for trial improvements. It might be helpful to review the proposed improvements with MID staff. Improvements already identified by MID staff include shortening pipeline lengths (by providing more canal turnouts), and constructing inter-ties between pipes.

   Before final plans are made, the options should be discussed with the local ditchtender. The hydraulic gradelines (HGL's) should also be examined under various flow conditions.

Long Term Recommendations - Expanded Descriptions

1. Modify the water ordering procedure so that all water orders come into a central location.

   Most irrigation districts receive water orders at a central office. Those orders are then passed on to the local ditchriders who are responsible for implementing the deliveries. The central water ordering procedure has many advantages, including:

   a. It brings accountability to the field staff. Anticipated flows can be compared against actual flows and deliveries.
   b. It promote equity in water deliveries; everything is out in the open, and favoritism (if it exists) is reduced.
   c. The central water dispatching office knows the anticipated water orders, plus real-time information on current flows and water levels (via the SCADA system), and can effectively shuttle water around in the system to match demands. This removes much of the "art" from water deliveries in the main canals.

d. The data can be used in future studies regarding water ordering trends; this can help in designing future improvements such as canal enlargements, reservoirs, and new control systems.

2. Expand the terminal reservoir program.

   Assuming that the first short term trial is successful, this design option can be implemented at the ends of other laterals to provide increased flexibility with less spills.

3. Expand the SCADA system

   This can include more intermediate flow measurement stations, improved access to the data by field staff, and better data management capabilities. By having better real time information on the status of the system, the system can be manipulated for optimum performance.

4. Expand the distribution pipeline modification program.

   This will be necessary if more farmers are to use MID water for drip/micro irrigation.

5. Develop new centralized operational procedures for reducing the response time of water changes at the heads of laterals.

   This is a step beyond items (1) and (3). Once the information is available, and it is possible to make remote changes to flows and water levels, MID should develop optimized procedures for canal gate movements which can minimize the response time in the system. This may include options such as (i) overcorrecting with high flow rates and then reducing flows to the required steady state flows and (ii) near simultaneous movement of check gates at multiple points in the main canals.

   Such an improvement will require an examination of available canal storage, freeboard, and other hydraulic constraints.

6. Interlink various canal laterals near the tail ends.

By interlinking canal laterals, excesses or deficits can be shuttled around the system to optimize performance.

7. Investigate expanded conjunctive use for providing flexibility in the canals. Use dry wells for excess operational water, and wet wells to supply needed operational water.

   MID staff have identified the possibility of pumping into canals if there is a deficit at the tail ends of laterals. Another option may be to pump into dry wells if there is an excess of water. This would provide two benefits:

   a. Improved flexibility with less spill.
   b. Groundwater recharge.

Consultants and Outside Services

ITRC compliments the efforts of private consulting engineering staffs and the staffs of water districts, rather than substituting for them. ITRC can enhance modernization efforts if a team approach to problem solution is adopted.

ITRC can assist with

- Developing initial specifications,
- Participation in brainstorming sessions,
- Providing technical advice to engineers working on various aspects of the project,
- Training of ditchtenders in how to operate with new conditions,
- Special studies,
- Evaluation of the effectiveness of new hardware and operation techniques

If the recommendations are implemented, ITRC envisions that MID will

- Use ITRC to further develop the initial concepts.
- Hire contractors to provide and install certain SCADA equipment, including training.
- Hire private consulting engineering firms to assist with design drawings on new structures, and construction, or expand its internal staff to accomplish this work.

MID staff should maintain firm control of all phases of planning, construction, and implementation. However, the staff is probably not large enough, and does not have enough time, to do all of the tasks itself.

Drip/Micro Irrigation

The CH2MHill report and MID staff have identified groundwater pumping by drip/micro irrigators as a major concern. The improvements to the pipeline distribution system are targeted specifically at this problem.

Although trials are recommended with improved pipeline distribution systems, ITRC notes that expanded investment in the pipeline distribution system may not have the desired benefits, because farmers have valid reasons to use well water rather than canal water for drip/micro and sprinkler systems when:

1. The district water may not be available during frost control times
2. There are significant costs for filtration systems with canal water
3. There is more flexibility (at the moment) with well water
4. Pumping costs for groundwater may be very low.

If the groundwater pumping is indeed a serious district issue, it seems clear that most farmers would not voluntarily use canal water instead of well water, given the points above.

Therefore, if groundwater pumping is truly a serious issue, and the MID Board of Directors wants farmers to use canal water, MID will probably have to implement a significant standby acreage fee or some other policy which will shift the economics in favor of canal water. However, such an increased fee or policy would be unreasonable if MID does not provide canal water with a high degree of flexibility.

In summary, high standby fees (or other policy) and improvements in the pipeline distribution system, by themselves, may not have a significant impact on groundwater pumping. If they are combined, they may have the intended effect.

Another option may be to accommodate groundwater pumping with a major groundwater recharge program involving ponding basins and injection into dry wells. However, this may not be economical or technically feasible (e.g., the dry wells may silt up from the dirty canal water used in recharging, or recharge rates are low).

Modesto Irrigation District

Water and Power

JM Lord Report

Assessment of Reasonable Water Requirements

JMLord
incorporated

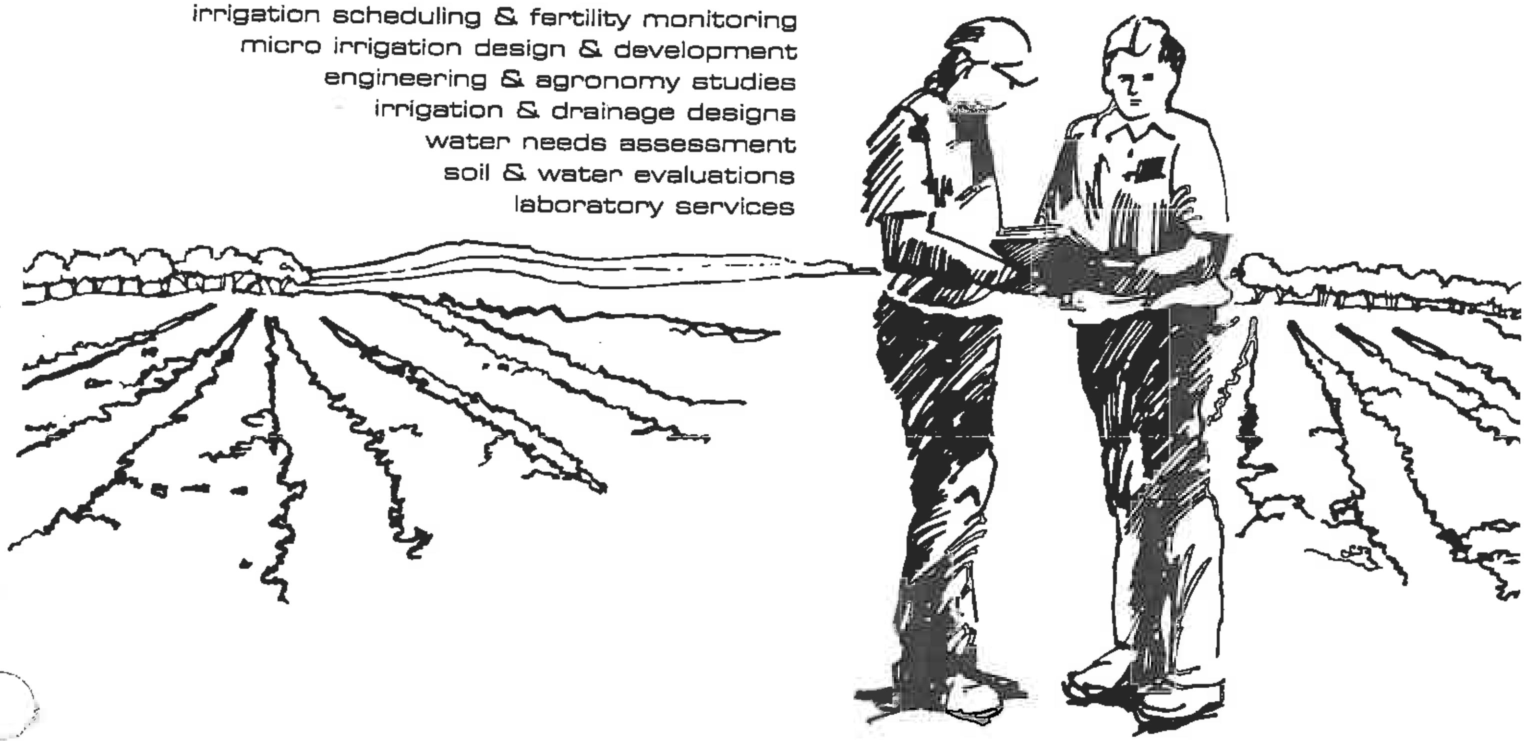
agricultural scientists
consulting engineers

MODESTO IRRIGATION DISTRICT

ASSESSMENT OF REASONABLE WATER REQUIREMENTS

OCTOBER 1998

irrigation scheduling & fertility monitoring
micro irrigation design & development
engineering & agronomy studies
irrigation & drainage designs
water needs assessment
soil & water evaluations
laboratory services



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MODESTO IRRIGATION DISTRICT

ASSESSMENT OF REASONABLE WATER REQUIREMENTS

PREFACE

JMLord, Inc. has been active for the last 20 years working with production agriculture in developing effective management of their water supplies. It is important to recognize and understand the agronomic objectives pertaining to the effective use of an irrigation water supply. In situations where farming interests have a firm and adequate water supply, there are long-term records documenting the successes associated with the use of that water. Conversely, there are similar records of the economic and environmental hazards associated with water supplies that are not firm or adequate.

The U.S. Bureau of Reclamation (USBR) has been the major force in determining the uses of water in federal irrigation projects (USBR 1978). Much of this work has been translated into formal technical procedures for management of farm water (Lord 1975). Today, the approach of using a calibrated evapotranspiration (ET) model and real time climatic data to determine crop water use is widely accepted and commonly applied. The following crop water needs assessment is predicated on USBR procedures as developed by their earlier water use studies.

INTRODUCTION

Efficient use of irrigation water is a primary concern of well-managed farms and water districts. Poor utilization of water resources contributes to reduced crop yields through salinization of soils or leaching of plant nutrients. Thus, good irrigation uniformity and efficiency is desirable to maintain optimum levels of crop production while conserving water.

Irrigation efficiency (IE) is normally defined as that portion of applied irrigation water that is beneficially used to produce a crop. Typically, IE is determined as follows:

$$IE = \frac{BU}{AW} \times 100$$

where,

BU = the amount of applied irrigation water that is beneficially used.

AW = the total amount of applied irrigation water.

As denoted in the above equation, a critical component of IE is the determination of beneficially used water. Beneficially used irrigation water may be defined as the water required for crop evapotranspiration (cropET), leaching, and essential cultural practices. More specifically, beneficial use pertains to applied water (either through irrigation or rainfall) that is directly utilized by the crop or provides an agronomic benefit toward optimal crop production. The essential components of beneficially used water consist of the following:

> <u>ETc</u> = Evapotranspiration of the crop. By definition, this includes both evaporation of water from the soil as well as transpiration of water from plant leaf surfaces. ETc represents the net amount of water required to produce a crop under the given growing environment.
>
> <u>LR</u> = Leaching requirement. The volume of irrigation water in addition to ETc that is required to maintain soil salinity at a level that does not inhibit crop production. The LR is dependent upon the salinity of the irrigation water and the salt tolerance of the crop.
>
> <u>CW</u> = Cultural water. The additional volume of water applied to a field or crop for agronomic or economic benefits other than ETc or LR (e.g., pesticide spraying, weed germination, frost protection). Quantification of this water use is beyond the scope of the analysis.
>
> <u>ER</u> = Effective rainfall. The volume of rainfall that directly contributes to ETc, LR, and CW.

Proper interpretation of IE must also include an allowance for what is considered to be "reasonable use." That is, some losses of irrigation water are unavoidable and should be considered acceptable when it is recognized that these losses are critical to achieving optimum crop production. For instance, the variation of soil types within a field will influence the movement of water and thereby affect the uniformity of application. To overcome this inherent obstacle, an additional amount of water (i.e., in excess of that amount required for all other beneficial uses) must be applied to the field to ensure that all parts of the field receive adequate moisture. In a broad sense, then, IE may be defined as the ability of an irrigation manager to satisfy the beneficial uses of water (as described above). Furthermore, IE may be determined for a single irrigation event or assessed over a full crop production season.

In actual production farming, it is not economically feasible or in many situations, physically possible to meet 100 percent of the crop water demand, 100 percent of the time, over 100 percent of the field. During a single irrigation event, however, it may be possible to obtain a 100 percent IE with less than perfect application uniformity. This condition results in under-irrigation in some parts of the field and may thereby reduce production, particularly if it occurs over several irrigation events.

PROCEDURES TO DETERMINE DISTRICT WATER REQUIREMENTS

Estimates of reasonable irrigation water use for a particular crop should include a determination of three basic components: 1) the net crop evapotranspiration (ETcrop) demand; 2) the leaching requirement (LR); and 3) an operational component (e.g., reasonable losses attributable to soil variability, irrigation system non-uniformity, frost protection, wind, evaporation, management constraints, etc.). The sum total of these three components, representing the reasonable amount of water required to produce the crop, should then be adjusted for any effective rainfall that may occur.

Determination of Crop Evapotranspiration (ETc)

The process of evapotranspiration (ET) depends upon climatic factors as well as the internal status of the cropped field itself. If the internal conditions in a field are kept at an optimum status (i.e., non-stressed growing conditions), then the ET rate is assumed to depend solely upon the climatic environment. The concept of reference or potential evapotranspiration attempts to characterize the climatic environment in terms of its evaporative power (i.e., the maximum evaporation rate that the atmosphere is capable of extracting from a well-irrigated field under a given condition). Thus, the reference ET expresses the climatically imposed evaporative demand (Hillel, 1990).

Several climatic models have been developed to define reference ET and its relationship to crop water use, most of which are reviewed by Doorenbos and Pruitt (1977) and Hatfield (1990). These models utilize either a grass crop (ETo), an alfalfa crop (ETp), or open water (ETpan) as the reference component. Using a calculated reference ET value based on climatic variables, it is possible to account for the effects of specific crop characteristics and other internal field factors on crop water requirements using an empirical crop coefficient (Kc). The Kc is derived from the following formula:

$$Kc = \frac{ETc}{ETr}$$

where,

Kc = the crop coefficient for a particular stage of growth

ETc = the evaporative demand of the crop.

Etr = the evaporative demand of a reference component (e.g., grass, alfalfa, or open water).

Kc values vary widely among crops as well as between different growth stages for particular crops. Values for Kc's are generally derived under carefully controlled growing conditions and are reported in various literature sources (Doorenbos and Pruitt, 1977; Snyder et al., 1989a,b). It is important to note that Kc values are dependent upon which reference ET component (i.e., ETo, ETp, or ETpan) is utilized to estimate the climatic demand.

By rearranging the above equation, the relationship between the ETr and ETc may be described as,

$$ETc = Kc \times ETr$$

Thus, the evapotranspiration demand of a crop (ETc) at any time during the growing season may be estimated through determination of an ETr (e.g., ETo) value and application of an appropriate Kc value.

The daily rate of actual ETc will seldom equal the ETr. This is particularly true when using an alfalfa reference. Crop canopy characteristics, stand density, stage of growth, the degree of surface cover, and the soil moisture regime all affect the actual ET demand by the crop. In the case of annual crops, the seasonal total ETc will usually not equal the total ETr for the same period. Early in the season, during germination and stand-establishment, the rate of ETc is generally small. Later, the ET demand of the fully developed crop canopy may actually exceed the reference ET and then, as the crop matures, the actual ETc will again fall below ETr.

Crop water requirements are defined in this report as the depth of water required to meet the water loss through ETc (as defined above). It is assumed that the ETc demand is representative of a disease-free crop, growing in a field without restrictive soil conditions, and achieving full-production potential under the given environment. ETr is based on a grass crop and is defined in this analysis as ETo.

Reference ETo values were obtained from the California Irrigation Management Information System (CIMIS) network (Modesto and Manteca, California) and are representative of the normal yearly ETo (inches/year) for the years 1993 through 1997 inclusive (Table 1).

Kc values for individual crops were determined on a monthly basis for separate and identified stages of growth. The general steps utilized to determine the Kc values for different growth stages of each crop grown within the Modesto Irrigation District were as follows:

1. Establish typical planting dates for each crop.

2. Determine the total length of the growing season for each crop.

3. Determine the length of various crop growth stages for each crop. The basic crop growth stages are schematically presented in Figure 1 and described in Table 2.

4. Assign an appropriate Kc value for each crop growth stage based upon published literature sources.

5. Calculate the monthly average Kc value for each crop growth stage (assumes a linear response within each crop growth stage as shown in Figure 1).

Information pertaining to crop planting dates and lengths of growing seasons were obtained from the Stanislaus and Fresno County Farm Advisors offices, University of California publications (Snyder et al., 1989a,b; Johnson, 1982;), discussions with agricultural producers, and a knowledge of practices in similar climatic zones.

Once the average Kc values for each month (or partial month) were determined, they were multiplied times the reference ETo value for that month (in that particular year). The resulting monthly crop ET values were then summed to estimate the water requirement of the crop for the entire growing season. This value (i.e., ETc) represents the net amount of water to satisfy the ET demand of the crop.

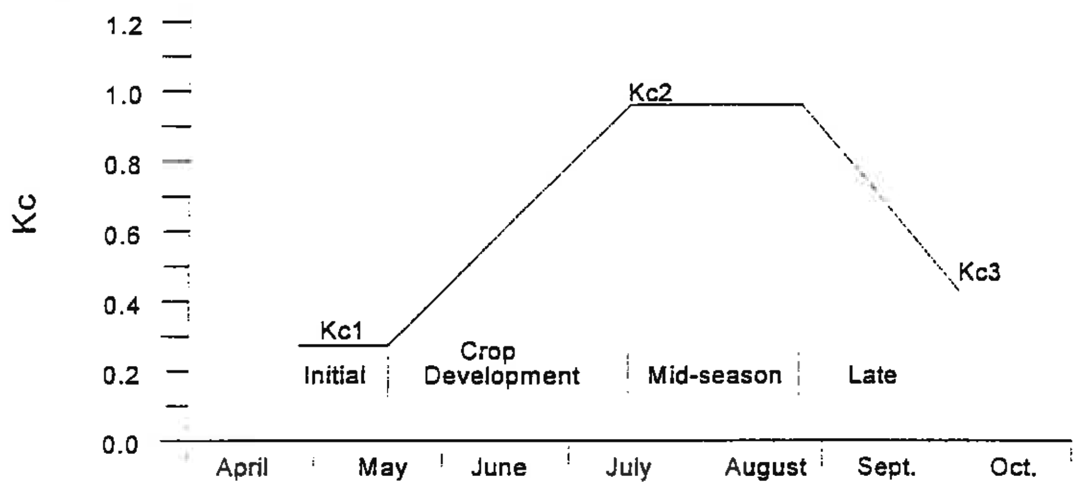

Figure 1. Generalized crop coefficients (Kc) and growth stages.

Table 1. Summary of reference evapotranspiration (ETo)* in the Modesto Irrigation District for 1993 through 1997.

Month	1993	1994	1995	1996	1997
January	0.91	0.68	0.80	0.74	0.66
February	1.59	1.43	1.36	1.22	2.24
March	2.92	3.70	2.61	3.25	3.85
April	5.15	4.92	4.51	5.10	5.95
May	6.25	6.15	5.80	6.49	7.64
June	7.90	8.34	7.21	7.61	7.78
July	8.28	8.09	7.74	8.12	7.99
August	7.20	7.33	7.18	7.09	6.72
September	5.29	4.99	5.04	5.02	5.34
October	2.94	3.45	3.62	3.23	3.38
November	1.81	1.63	1.77	1.26	1.18
December	0.60	0.54	0.56	0.62	0.85
Total	50.81	51.24	48.18	49.71	53.55

* Source: CIMIS weather station, Manteca and Modesto, California.

TABLE 2. Description of crop coefficients (Kc) and crop growth stages.

Kc Value	Growth Stage	Description
Kc1	Initial	The average Kc value from planting to 10% cover
Kc1 to Kc2	Crop development	From 10% cover to about 75% cover or peak water use (whichever occurs first). In orchards/grapes from leafout to full cover.
Kc2	Mid-season	From attainment of full cover to the initiation of maturation or until water use begins to decline due to aging.
Kc2 to Kc3	Late season	From the beginning of Kc decline until harvest or water use ceases or becomes minimum.
Kc3	Harvest	The average value at harvest of the end of the water use season.

NOTE: For deciduous tree crops grown with no cover crop, Kc2 corresponds to approximately 60% to 70% ground shading and Kc3 to leaf drop (mature trees only).

There are eight primary crops or crop categories within the District that comprise as much as 94 percent of the total production. These are alfalfa, almonds, corn, grapes, peaches, pasture, walnuts, and small grains. Specific information pertaining to ETc estimates for certain crops or crop categories is provided as follows:

1. Alfalfa - The ETc estimate is based upon seven (7) cuttings per season and utilizes the Kc values as reported by Snyder et al. (1989a).

2. Irrigated Pasture - The ETc estimate is assumed to be equivalent to the ETo demand between February 1 and November 30.

3. Grain - Hay – Was determined to be oats being grown and dried for hay.

4. Vegetable Crops - The ETc estimate represents an average of all vegetable crops produced in the District.

5. Grain - Other – KC values were obtained by averaging various grain crops.

6. Grapes/Deciduous Orchards - ETc estimates for these crops assume no cover crop. ETc values would be higher where active cover crops are present.

7. Double Crop acres for the crops alfalfa, walnuts, and irrigated pasture were calculated at 50% their ETc and LR totals.

8. Beans, Melons, and Tomatoes - were all calculated using the spring KC values, as no differentiation was made between spring and fall crops.

9. Cling and Freestone Peaches - were combined under "Peaches".

10. Other Fruit and Nut Trees – KC values were obtained by averaging the KC values for all fruit and nut trees.

11. Miscellaneous – The ETc estimate is based upon an average of all crops in the District.

12. Melons - Other – KC values are the same as cantaloupe values.

13. Garden - Other – KC values are the same as vegetable crops.

14. Nursery - Stock – was given an estimated value for ETc and LR totals.

15. Wine Grapes and Table Grapes – were combined under "Grapes".

Estimates of ETc (acre-feet/acre) for various crops produced in the Modesto Irrigation District for 1993 through 1997 are presented in Table 3. In addition, irrigated acres of each crop grown and the corresponding net ETc demand (total acre-feet) are presented in Tables 4 and 5, respectively. Acreage values were obtained from crop census reports, which are compiled by the District.

Determination of Leaching Fraction and Leaching Requirement

Drainage of irrigated cropland is essential to remove excess soluble salts from the soil and to maintain optimum crop productivity. Increases in soil salinity levels primarily occur as a result of salt importation from irrigation water and, to a lesser extent, from other sources such as fertilizers and soil amendments (Hanson et al., 1993). Water diverted into the Modesto Irrigation District from the Tuolumne River contains very little soluble salt. The quality of groundwater pumped within the District is also good. Over time, however, salt accumulation will occur in the crop root zone if an appropriate leaching fraction is not provided. Since effective rainfall is often lacking or inconsistent in the region (see subsequent discussion), leaching of salts out of the crop root zone must be accomplished through the application of additional irrigation water.

The leaching fraction (LF) is defined in this analysis as the incremental portion of infiltrated water, beyond that required for crop evapotranspiration (ETc), that must pass through the root zone to maintain the soil solution at a salinity level compatible with the particular crop being grown (U.S. Salinity Laboratory Staff, 1954; Hanson et al., 1993). The LF is dependent upon the salinity of the irrigation water and the salinity tolerance of the crop. It may be calculated as follows:

$$LF = \frac{ECw}{5\,(ECe) - ECw}$$

where,

ECw = the electrical conductivity of the irrigation water.

ECe = the maximum electrical conductivity of the saturated soil paste extract at which 100 percent crop yield is maintained (Doorenbos and Pruitt, 1977). This is also described as the crop salinity threshold (Maas, 1990).

Table 3. **Calculated evapotranspiration demand (ETc) for various crops grown in Modesto Irrigation District for 1993 through 1997.**

Crop	1993	1994	1995	1996	1997
			Acre-feet / acre		
Alfalfa Hay	3.91	3.97	3.70	3.87	4.15
Almonds	2.92	2.96	2.76	2.89	3.08
Apples	3.45	3.49	3.31	3.41	3.56
Apricots	2.92	2.96	2.76	2.89	3.08
Beans - Dry	1.73	1.75	1.62	1.69	1.70
Berries - Bush	3.28	3.31	3.11	3.25	3.39
Cherries	3.45	3.49	3.31	3.41	3.56
Garden - Other	1.91	1.93	1.77	1.88	1.95
Grain - Barley	1.54	1.58	1.39	1.55	1.82
Grain - Corn	2.24	2.25	2.11	2.19	2.22
Grain - Hay	1.25	1.28	1.12	1.27	1.53
Grain - Milo	1.47	1.47	1.45	1.44	1.44
Grain - Oats	1.54	1.58	1.39	1.55	1.82
Grain - Other	1.54	1.58	1.39	1.55	1.82
Grain - Rye	1.54	1.58	1.39	1.55	1.82
Grain - Wheat	1.54	1.58	1.39	1.55	1.82
Grapes - Table	2.40	2.42	2.28	2.37	2.46
Grapes - Wine	2.40	2.42	2.28	2.37	2.46
Kiwi	3.24	3.27	3.11	3.20	3.30
Lawn - Garden	3.42	3.47	3.24	3.38	3.64
Melons - Other	1.63	1.65	1.51	1.60	1.64
Melons - Watermelon	1.69	1.71	1.55	1.67	1.80
Miscellaneous	2.51	2.58	2.52	2.64	2.79
Nursery Stock	2.20	2.20	2.20	2.20	2.20
Other Fruit & Nut Trees	2.98	3.02	2.84	2.95	3.10
Pasture - Irrigated	4.11	4.17	3.90	4.03	4.34
Peaches	2.84	2.89	2.70	2.83	2.98
Pumpkins	1.53	1.52	1.48	1.56	1.48
Rice	3.34	3.35	3.16	3.29	3.39
Silage - Corn	2.07	2.08	1.95	2.03	2.05
Strawberries	1.67	1.67	1.56	1.64	1.91
Sudan	1.89	1.91	1.77	1.85	1.87
Trees - Christmas	4.39	4.42	4.16	4.29	4.62
Vegetables - Misc.	1.91	1.93	1.77	1.88	1.95
Walnuts	3.00	3.03	2.89	2.96	3.06

Table 4. **Irrigated acreage of various crops grown in Modesto Irrigation District for 1993 through 1997.**

Crop	1993	1994	1995	1996	1997
			Acres		
Alfalfa Hay	3,899	3,516	3,486	3,379	3,300
Almonds	17,451	17,705	18,200	18,143	18,182
Apples	103	119	161	177	219
Apricots	14	16	16	16	21
Beans - Dry	838	1,980	1,327	1,145	907
Berries - Bush	74	74	72	71	83
Cherries	92	126	161	116	145
Garden - Other	38	25	29	27	39
Grain – Barley	848	754	562	581	370
Grain – Corn	465	473	611	603	562
Grain – Hay	3,869	5,170	5,320	5,200	6,235
Grain – Milo	0	125	125	0	0
Grain – Oats	1,910	1,645	1,538	1,443	1,197
Grain – Other	0	282	120	91	110
Grain – Rye	0	0	0	0	0
Grain – Wheat	287	103	6	6	1
Grapes – Table	10	10	10	10	10
Grapes – Wine	3,880	3,932	3,816	3,583	3,478
Kiwi	8	8	6	6	6
Lawn – Garden	105	91	89	87	89
Melons – Other	0	70	40	50	10
Melons – Watermelon	195	106	35	25	25
Miscellaneous	777	723	777	635	718
Nursery Stock	67	72	152	183	120
Other Fruit & Nut Trees	236	185	207	208	263
Pasture – Irrigated	12,824	12,452	12,497	12,304	11,968
Peaches	5,191	4,553	4,056	3,899	3,842
Pumpkins	46	0	0	9	9
Rice	973	973	973	974	975
Silage – Corn	8,781	8,961	8,608	8,993	8,898
Strawberries	13	26	12	0	0
Sudan	28	65	144	260	325
Trees – Christmas	48	32	69	32	48
Vegetables – Misc.	306	350	371	520	512
Walnuts	8,425	8,185	8,178	8,238	8,141
Total	71,801	72,907	71,774	71,014	70,808

Table 5. **Total ETc demand of various crops grown in Modesto Irrigation District for 1993 through 1997.**

Crop	1993	1994	1995	1996	1997
			Acre-feet		
Alfalfa Hay	15,244	13,971	12,900	13,087	13.684
Almonds	50,891	52,487	50,152	52,518	56.073
Apples	356	416	532	604	781
Apricots	41	47	44	46	65
Beans – Dry	1,449	3,463	2,146	1,938	1,543
Berries – Bush	243	245	224	231	282
Cherries	318	440	532	396	517
Garden – Other	73	48	51	51	76
Grain – Barley	1,308	1,192	780	901	675
Grain – Corn	1,041	1,066	1,291	1,324	1,245
Grain – Hay	4,853	6,618	5,984	6,607	9.530
Grain – Milo	0	184	182	0	0
Grain – Oats	2.946	2,601	2,135	2,239	2.182
Grain – Other	0	446	167	141	201
Grain – Rye	0	0	0	0	0
Grain – Wheat	443	163	8	9	2
Grapes – Table	24	24	23	24	25
Grapes – Wine	9,314	9,526	8,710	8,501	8,561
Kiwi	26	26	19	19	20
Lawn – Garden	359	316	288	294	324
Melons – Other	0	115	61	80	16
Melons – Watermelon	329	182	54	42	45
Miscellaneous	1,950	1,865	1,958	1,676	2,003
Nursery Stock	147	158	334	403	264
Other Fruit & Nut Trees	703	558	587	614	815
Pasture – Irrigated	52,691	51,904	48,754	49,585	51,911
Peaches	14,754	13,165	10,943	11,033	11,459
Pumpkins	70	0	0	14	13
Rice	3,255	3,257	3,074	3,203	3,303
Silage – Corn	18,164	18,683	16,775	18,246	18,228
Strawberries	22	43	19	0	0
Sudan	53	124	255	481	608
Trees – Christmas	211	142	287	137	222
Vegetables - Misc.	585	676	658	979	997
Walnuts	25,240	24,764	23,598	24,357	24,911
Total	207,102	208,915	193,526	199,779	210.581

Accordingly, the leaching requirement (LR) is defined as the incremental portion of water necessary to satisfy the required leaching fraction. It is dependent upon the crop ET demand (ETc) and is expressed as a depth of water in inches, feet, acre-inches, or acre-feet per acre. The LR may be calculated as follows:

$$LR = \frac{ETc \times LF}{1 - LF}$$

where,

ETc = the net crop evapotranspiration requirement.

LF = the leaching fraction.

It is important to note that the terms LF and LR are sometimes used interchangeably. Both terms refer to the portion of irrigation water that should pass through the root zone to maintain salts at a desired level. As indicated in the equations above, however, LR should be considered as a specified volume of water, which is dependent upon the crop ET requirement (ETc), whereas LF is expressed only as a fraction or percentage.

Water sources within the Modesto Irrigation District include both river and groundwater supplies. River water is acquired primarily from the natural runoff of Tuolumne River. The annual surface water allocation is supplemented by pumped groundwater based on irrigation demands within the District.

Water quality measurements are compiled periodically along the Modesto Irrigation District canal system. These measurements provide a good indication of the salinity of the water that is delivered for irrigation use throughout the crop season. To calculate an appropriate LR for each crop, water salinity was determined by averaging the reported water quality. The water quality from the Tuolumne River had an average ECw of 0.14 dS/m.

The surface water source contains fewer salts than groundwater sources, which effectively reduces the required LR. However, the relatively low salt content also contributes to soil-water infiltration problems. By contrast, the salinity contents of the groundwater supplies are often within a more desirable range (e.g., ECw = 0.50 to 0.75 dS/m). The salinity of the groundwater sampled by M.I.D. averaged 0.53dS/m. The combined weighted average of the two sources ranged from 0.16 to 0.17 dS/m.

Based upon salinity thresholds for specific crops, as documented in the literature (Maas, 1990; Rhodes and Loveday, 1990; Hanson et al., 1993) and presented in Table 6, an appropriate LF[1] for

[1]Ec values based upon average TDS stated in Water Quality Tests Various Sites at MID, 1996 and Irrigation Water Analysis Report, MID 1994.

each crop grown in the Modesto Irrigation District for 1993 through 1997 was determined using the equation shown above. The LF values (not shown) together with the total ETc demands (Table 5) were then used to determine the LR for each crop (Table 7). Lastly, the total ETc and LR demand for crops grown in the District for 1993 through 1997 are presented in Table 8.

Effective Precipitation

Considering the variance in yearly rainfall not only from year to year, but also within the District, the collected rainfall provides only a portion of the total precipitation contributing to crop evapotranspiration. The effective or utilizable precipitation that is reported in this analysis was determined using the same formula applied by the USBR for preparation of annual water supply reports for water district/users within the Friant Division (personal communication with USBR, Fresno, California office). The formula for utilizable precipitation is:

$$\text{Utilizable Precipitation} = \frac{0.8 \times (\text{Annual Rainfall} - 4)}{12} - 0.07$$

The annual rainfall amount in the equation is reported as inches and the divisor (12) converts the result into feet. The final value is then multiplied times the net cropped acres (i.e., actual acres not including double crops) to determine the total acre-feet of utilizable precipitation for the entire District.

Rainfall amounts were recorded at Modesto and Manteca CIMIS weather stations and at the MID headquarters. By averaging the rainfall totals of these three stations, and using the net cropped acreage within the District each year the utilizable precipitation was estimated as follows:

Year	Average Rainfall (Inches)	Effective Rainfall (Feet)	Net Cropped Acres	Utilizable Precipitation (Acre Feet)
1992-93	17.47	0.83	66,164	54,916
1993-94	10.00	0.33	65,069	21,473
1994-95	16.50	0.76	65,035	49,427
1995-96	14.96	0.66	64,039	42,266
1996-97	13.28	0.55	63,437	34,890

The amount of utilizable precipitation in each year was subtracted from estimates of ETc + LR (see Table 9) to determine the net irrigation requirement of the District.

Table 6. **Crop salinity thresholds and expected rate of decline in yield for various crops grown in Modesto Irrigation District.**

Crop	Salinity Threshold (dS/m)	Rate of Yield Decline* (% per dS/m)	Rating**
Alfalfa Hay	2.0	7.3	MS
Almonds	1.5	19.0	S
Apples	1.7	N/A	S
Apricots	1.6	24.0	S
Beans – Dry	1.0	19.0	S
Berries	1.5	22.0	S
Cherries	N/A	N/A	S
Garden – other	2.2	N/A	N/A
Grain – Barley	8.0	5.0	T
Grain – Corn	1.7	12.0	MS
Grain - Milo	6.8	16.0	S
Grain – Oats	6.0	N/A	MT
Grain – Rye	11.4	10.8	T
Grain – Wheat	6.0	7.1	MT
Grapes	1.5	9.6	S
Irrigated Pasture #	4.0	N/A	MT
Kiwi	1.5	N/A	N/A
Lawn - Garden	4.0	N/A	N/A
Melons - Other	2.2	N/A	MT
Melons - Watermelons	N/A	N/A	MS
Misc. Trees	1.7	N/A	S
Misc. Vegetables	1.2	N/A	N/A
Nursery #	2.3	N/A	S
Peaches	1.7	21.0	S
Pumpkins	2.2	N/A	MS
Rice	3.0	12.0	S
Sudan	2.8	4.3	MT
Trees - Christmas	1.5	N/A	N/A

* % yield decline expected for each 1 unit increase in ECe above the crop salinity threshold.

** Ratings defined as S=sensitive, MS=moderately sensitive, MT=moderately tolerant, T=tolerant.

Estimated salinity threshold.

Source: Maas, E.V., 1990.

Table 7. **Leaching requirement (LR) for various crops grown in Modesto Irrigation District for 1993 through 1997.**

Crop	1993	1994	1995	1996	1997
			Acre-Feet		
Alfalfa Hay	268.3	230.9	213.2	230.3	226.2
Almonds	1,208.3	1,169.6	1,117.6	1,246.9	1,168.2
Apples	8.4	9.3	11.9	14.3	17.4
Apricots	0.9	1.0	0.9	1.0	1.3
Beans - Dry	52.9	118.4	73.4	70.7	52.8
Berries - Bush	5.8	5.5	5.0	5.5	6.3
Cherries	7.5	9.8	11.9	9.4	11.5
Garden - Other	2.2	1.4	1.4	1.5	2.1
Grain - Barley	5.6	4.8	3.1	3.9	2.7
Grain - Corn	21.7	20.9	25.2	27.6	24.4
Grain - Hay	27.8	35.7	32.3	37.9	44.0
Grain - Milo	0.0	1.0	0.9	0.0	0.0
Grain - Oats	16.9	14.0	11.5	12.8	11.8
Grain - Other	0.0	2.1	0.9	0.8	0.9
Grain - Rye	0.0	0.0	0.0	0.0	0.0
Grain - Wheat	2.5	0.9	0.0	0.1	0.0
Grapes - Table	0.6	0.5	0.5	0.6	0.5
Grapes - Wine	221.1	212.3	194.1	201.8	190.8
Kiwi	0.6	0.6	0.4	0.5	0.4
Lawn - Garden	3.1	2.6	2.3	2.5	2.6
Melons - Other	0.0	1.7	0.9	1.3	0.2
Melons - Watermelon	5.2	2.7	0.8	0.7	0.7
Miscellaneous	34.2	31.1	35.0	32.4	35.9
Nursery Stock	4.6	4.8	9.3	12.6	7.7
Other Fruit & Nut Trees	14.6	10.9	11.5	12.8	16.0
Pasture - Irrigated	455.6	422.0	396.4	428.8	422.0
Peaches	307.4	257.5	214.0	229.9	224.1
Pumpkins	1.1	0.0	0.0	0.2	0.2
Rice	37.7	35.5	33.5	37.1	36.0
Silage - Corn	91.7	88.8	79.7	92.1	86.6
Strawberries	0.8	1.5	0.6	0.0	0.0
Sudan	0.7	1.4	3.0	6.0	7.1
Trees - Christmas	0.9	0.6	6.4	3.3	4.9
Vegetables - Misc.	17.6	19.0	18.5	29.4	28.1
Walnuts	525.8	484.4	461.6	507.4	487.3
Total	3,352.3	3,203.0	2,977.8	3,262.0	3,120.8

Table 8. **Total of ETc and LR demand for crops grown in Modesto Irrigation District for 1993 through 1997.**

Crop	1993	1994	1995	1996	1997
			Acre-Feet		
Alfalfa Hay	15,513	14,202	13,113	13,317	13,910
Almonds	52,100	53,656	51,269	53,765	57,241
Apples	364	425	544	618	798
Apricots	42	48	45	47	66
Beans - Dry	1,502	3,582	2,219	2,008	1,596
Berries - Bush	249	251	229	236	288
Cherries	325	450	544	405	528
Garden - Other	75	50	53	52	78
Grain - Barley	1,314	1,197	783	905	677
Grain - Corn	1,063	1,087	1,316	1,351	1,270
Grain - Hay	4,881	6,653	6,016	6,645	9,574
Grain - Milo	0	185	183	0	0
Grain - Oats	2,963	2,615	2,147	2,252	2,194
Grain - Other	0	448	168	142	201
Grain - Rye	0	0	0	0	0
Grain - Wheat	445	164	8	9	2
Grapes - Table	25	25	23	24	25
Grapes - Wine	9,535	9,738	8,904	8,703	8,752
Kiwi	27	27	19	20	20
Lawn - Garden	362	318	291	297	327
Melons - Other	0	117	61	81	17
Melons - Watermelon	334	184	55	42	46
Miscellaneous	1,984	1,896	1,993	1,709	2,039
Nursery Stock	152	163	344	415	272
Other Fruit & Nut Trees	718	569	599	627	831
Pasture - Irrigated	53,146	52,326	49,150	50,014	52,333
Peaches	15,061	13,422	11,157	11,263	11,683
Pumpkins	71	0	0	14	14
Rice	3,292	3,292	3,107	3,240	3,339
Silage - Corn	18,255	18,772	16,855	18,338	18,314
Strawberries	22	45	19	0	0
Sudan	54	126	258	487	615
Trees - Christmas	212	142	294	141	227
Vegetables - Misc.	603	695	676	1,008	1,025
Walnuts	25,765	25,248	24,060	24,864	25,398
Total	210,454	212,118	196,504	203,041	213,701

Other Reasonable Uses of Water

As indicated previously, it is necessary to include an operational component in any water-needs analysis to allow for reasonable and unavoidable losses. It is impossible to apply irrigation water at all times throughout an entire crop season with 100 percent effectiveness. This occurs due to several factors including soil variability, wind, evaporation, changes in system flow rates, irrigation system constraints, etc. To alleviate this problem, additional water than required for ETc and LR, must be applied. If additional water is not provided, crop production will be reduced and the negative effects due to factors such as salt accumulation in the crop root zone will increase.

Irrigation efficiency and water application uniformity are key parameters that influence water-use effectiveness. Research studies evaluating various irrigation methods (i.e., surface, sprinkler, drip, etc.) indicate system efficiencies of 60 to 90 percent may be achieved depending upon soil and design factors (Goldhamer and Snyder, 1989). Higher values are generally associated with pressurized systems such as drip or microsprinklers. Several studies conducted in the San Joaquin Valley in recent years have evaluated irrigation efficiencies in various water districts. Burt (1988) reported an average irrigation efficiency of 66% among all fields tested in a technical study conducted for the Westside Resource Conservation District (WRCD). The maximum attainable efficiency without under-irrigating the crop was considered to be 80%. In another study (Burt et al., 1991), irrigation efficiency was evaluated in several districts on the west side of the San Joaquin Valley. These studies reported maximum on-farm irrigation efficiencies of about 80% and concluded that any value greater than this would be accompanied by under-irrigation and increases in soil salinity. In the Westlands Water District, a two-year study of irrigation performance on 75 farms, consisting of 335 fields and 44,686 acres, indicated an average annual irrigation efficiency of 71% for all fields in the program (Westlands Water District Staff, 1989). A goal of 75% was considered attainable if recommended changes and improvements were adopted.

Based on the information above and experience with similar crop production systems in nearby regions, an operational component of 20 percent (i.e., 80 percent efficient) was applied in this analysis. This amount represents the amount of water required, in addition to net ETc and LR, to allow for reasonable and unavoidable losses as described above. The operational component is added to the net irrigation requirement (Etc + LR - effective rainfall) to obtain the total District irrigation water requirement.

In addition to the District irrigation water requirements, other reasonable uses of irrigation water may occur. These may include water applications for weed germination (prior to planting crop), leaching salts in fallow and/or reclaimed land, and frost protection. Water used to apply pesticide or foliar fertilizer sprays is also considered reasonable and necessary for optimum crop production. Quantifying the amount of water used for these various practices is difficult and in some cases (such as frost protection), the need for these practices may be inconsistent. For this reason, estimates pertaining to these practices have not been included in this analysis. It should be noted, however, that these practices are essential components of successful farming operations and are considered by informed sources as "beneficial uses." Amounts of water utilized for these purposes would effectively increase the estimate for reasonable irrigation water requirements as provided in this analysis.

$$\text{Total Demand} = \frac{ETc + LR}{IE} - ER$$

where,

ETc = Crop Evapotranspiration

LR = Leaching Requirement

IE = Management Component

ER = Effective Rainfall

SUMMARY OF ANALYSIS

Table 9 presents a summary of the available water supply to the Modesto Irrigation District for 1993 through 1997. Water diverted to the District from the Tuolumne River is delivered to the Modesto Reservoir or delivered directly for irrigation through the Waterford area distribution system. From Modesto Reservoir water is delivered through lined canals to the end users. As Table 10 indicates, the amount of return flows to the Tuolumne River in any given year can be highly variable and is dependent upon through flows required for environmental mitigation.

Although leaching requirements are relatively low within the District, the total amount does vary each year depending upon the quality and quantity of irrigation water delivered. Based on the analysis presented here, the required leaching component in the Modesto Irrigation District averaged approximately 2 percent of the irrigation requirement (ETc ÷ LR) during the period evaluated.

Table 9 presents a summary of reasonable irrigation water requirements for the Modesto Irrigation District for 1993 through 1997. The sum of ETc, LR, and the operational component represents an estimate of beneficial use of irrigation water within the District. This amount has been adjusted downward for effective rainfall. An estimate of the total District irrigation water requirement is indicated in Column 5. When surface water is available Modesto Irrigation District also supplies growers with additional water for groundwater recharge, thus helping to maintain the groundwater table. This additional water supplied to growers by the District for the purpose of groundwater recharge is not taken into account for the water requirement indicated in Column 5.

Growers receiving District surface water avoid groundwater pumping which, in turn, reduces groundwater overdraft and provides for the remaining land to be irrigated with a more stable groundwater source. Values in Table 9 indicate the total amount of water available to the District, the portion allocated as return flows to rivers, and the net amount of water delivered to water users.

The difference between supply and demand is attributable to factors such as evaporation, seepage, metering inaccuracies and operational spills. On average, this amount represents about 25 percent of the total available water supply each year.

The analysis provided in this report, together with the historical observations on groundwater pumping, strongly underscores the need for full District water allocations in the future.

Table 9. Summary of reasonable water requirements for the Modesto Irrigation District for 1993 through 1997.

Year	ETc+LR (1)	Effective Rainfall (2)	Net Irrigation Requirement (3)	Operational Component (4)	Total District Water Requirement (5)
			Acre-Feet		
1993	210,454	54,916	155,538	38,885	194,423
1994	212,118	21,473	190,645	47,661	238,306
1995	196,504	49,427	147,077	36,769	183,846
1996	203,041	42,266	160,775	40,194	200,969
1997	213,701	34,890	178,811	44,703	223,514
Average	207,164	40,594	166,569	41,642	208,212

(1) From Table 8.

(2) Calculated using USBR formula for utilizable precipitation (see Page 1). Annual precipitation amounts were the combined average values compiled from the Modesto and Manteca weather stations located within the Modesto Irrigation District boundaries.

(3) Columns (1) - (2).

(4) Reasonable and unavoidable loss due to irrigation system non-uniformity, soil variation, wind, evaporation, management constraints, economics, etc. Assumes an 80% District wide water management efficiency.

(5) Columns (3) + (4). Values in Column (5) do not include water for various other practices that are considered beneficial, or water required for Municipal and Industrial uses.

Table 10. Summary of District Water Supplies for 1993 through 1997

Water Source	1993	1994	1995	1996	1997
Surface Supply					
Releases Below Modesto Reservoir	208.345	201,655	208,432	208,950	222.032
Waterford Diversions	35,978	37,002	35,296	43,202	50,356
Total Surface Supply	244,323	238,657	243,728	252,152	272.388
Groundwater Supply					
District Irrigation Wells	1,395	4,458	718	719	2,952
District Drainage Wells	13.234	13,548	12,725	14,819	17,904
Total Groundwater Supply	14,629	18,006	13,443	15,538	20.856
Total Water Supply	258,952	256,663	257,171	267,690	293,244
Deliveries to Water Users	154,835	170,730	148,827	155,885	185,797
Return Flows to Rivers	41,302	25,782	41,081	40,554	38,591
Operational Losses	62,815	60,151	67,263	71,251	68,856

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Modesto Irrigation District

Water and Power

Irrigation Line

June 1999 Issue

MID Irrigation Line

Modesto Irrigation District June 1999

Mobile lab evaluation maximizes irrigation system performance

Is your irrigation system performing as well as it should? Irrigation systems that perform at peak efficiency can help lower your operating costs and increase crop yields.

To help growers get the most from their irrigation systems, the Modesto Irrigation District (MID) has partnered with the East Stanislaus Resource Conservation District to finance a mobile irrigation lab service. The mobile lab, operated by Power Hydrodynamics of Modesto, is now available to conduct complete, on–farm evaluations of your irrigation system.

What does an irrigation evaluation include?

An irrigation evaluation field tests the efficiency of your irrigation system and the effectiveness of your water management practices. The evaluation focuses on two key questions:

- Are the trees, vines or other crops receiving the right amount of water for optimal yield?
- Is the water being applied uniformly throughout the field?

If the crop is receiving inadequate water, it will stress, reducing the potential yield. If too much water is being applied, fertilizer may be leaching below the rootzone where it is not usable by the crop. If your system is applying the right amount of water but not distributing it evenly across the field, the crop could be too wet or too dry. Either way, the consequences are lower yields and wasted fertilizer.

How long does an evaluation take?

The evaluator will need a few minutes of your time to ask questions about the configuration of your irrigation system. Examining the system and collecting flow and/or pressure data will take three to eight hours. After the data is analyzed, the evaluator will meet with you again to discuss the results of the evaluation and recommend how to improve your system for more effective water and chemical application. If a pressure pump is being used for irrigation, the evaluation will also recommend optimal pump pressures for greater efficiency and power savings. A written report and system evaluation is provided.

What is the cost of an evaluation?

MID will pay 75 percent of the evaluation costs for qualifying irrigation water users. Your cost may vary depending on your operation.

What are the results of mobile evaluations conducted so far?

Several MID customers, including an almond grower and a producer of vineyard nursery stock, have been pleased with the results of their evaluations. We hope to report some interesting case studies in coming issues of this newsletter.

How can I schedule an evaluation?

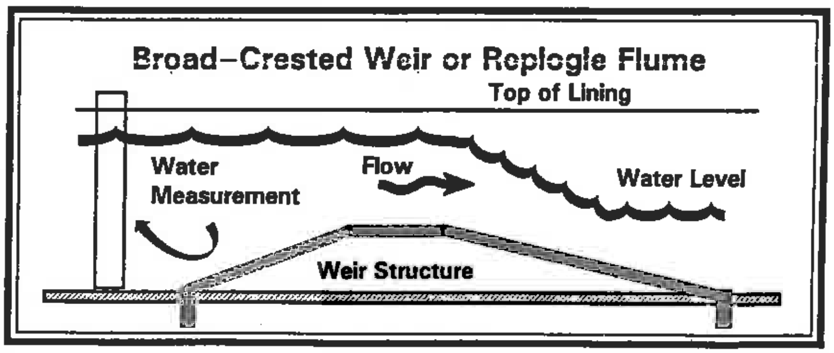
MID irrigation water users may schedule an evaluation by calling Bill Power, Power Hydrodynamics, 527-2908 or Joe Lima, MID Water Use Manager, 526-7562.

Inside This Issue

Maintenance improves water deliveries

Maintenance to keep the irrigation system in top condition is a winter tradition at MID. During 1998–'99, three broad–crested weirs, also known as "replogle flumes," were installed by MID crews. Because of their ability to accurately measure open canal flows, the new weirs will improve the accuracy with which we move water to specific sites. The weirs can be remotely monitored from the District office and are linked into a larger canal monitoring and control system. This automation will provide greater flexibility in irrigation water deliveries and reduce the likelihood of operational spills. Locations of the new flumes are:

- the Main Canal directly below the Modesto Reservoir outlet
- the Main Canal above Wellsford Road, and
- Lateral 5 above Maze Boulevard.



Pumps on Lateral 5 and the Main Canal were also automated during the winter to improve the reliability of our water deliveries to growers. Finally, portions of the Highline and Coffee-Davis concrete pipelines were replaced with plastic. This change will more than double the pipelines' useful lifetime and increase their ability to handle pressure and water changes.

Irrigators' frequently asked questions

Q: How do I calculate the inches of water applied per acre on my parcel?

A: Here's an example for a 27-acre parcel to which 7.88 acre-feet is applied (your ditchtender can tell you the number of acre-feet):

1. Calculate the number of acre-feet per acre:

   $\frac{\text{acre-feet}}{\text{acres}} = \text{acre-feet/acre}$

   $\frac{7.88 \text{ acre-feet}}{27 \text{ acres}} = 0.29 \text{ acre-feet/acre}$

2. Multiply acre-feet/acre by 12 inches/foot:

   $0.29 \times 12 = 3.5 \text{ inches/acre}$

Q: How do I calculate how many hours are needed to apply 3.5 inches of water?

A: First you need to know the acreage to which you are applying water and the flow rate of the water.

Example: I have 35 acres, and my flow is 15 cubic feet per second (cfs).

$\frac{\text{depth required in inches} \times \text{acres irrigated}}{\text{flow rate in cfs}} = \text{hours}$

$\frac{3.5 \text{ inches} \times 35 \text{ acres}}{15 \text{ cfs}} = 8.17 \text{ hours}$

Q: Who do I call about vandalism along canals?

A: To reduce these problems, MID has installed Unauthorized Motor Vehicle and No Trespassing signs wherever roads and canal banks intersect. If you notice problems, please contact the Sheriff or other local law enforcement for action. MID has no authority to make arrests or issue citations. Important telephone numbers: Stanislaus County Sheriff: 525-7916, Modesto Police: 524-4721.

Q: Who do I call about a flooding incident?

A: Call your ditchtender first. If you cannot reach your ditchtender, call the MID Irrigation Department 24–hour emergency number, 526-5222.

Modesto Irrigation District
Water and Power

1997 Irrigation Water Allocation

MODESTO IRRIGATION DISTRICT

Irrigation Water Allocation Policy for 1997

1. The base irrigation water allocation is 42-inches (3.5 acre-feet) per acre which is included in the $10.10 water charge. *(The minimum irrigation service charge per account regardless of acreage is $50.50).*

2. Six inches of water for groundwater recharge will be included in the $10.10 water charge.

3. An additional 24 - inches of irrigation water (from 48 to 72 - inches) is available at a cost of $8.75 per acre foot.

4. In special circumstances where crops need extra water, and upon written application and approval by the District, supplementary pump groundwater **may** be available at a cost of $ 20.14 per acre-foot.

5. The "facilities maintenance charge" cost is $5.05 per acre. *(The minimum "facilities maintenance charge" cost per account regardless of acreage is $25.25).*

6. If the State of California levies fees or other charges upon the District, the District reserves the option to pass the cost on to the water consumer.

7. Continuing the water transfer policy of past years, a landowner may transfer water from an owned or rented parcel to another parcel which landowner owns or rents, provided that the rented parcel from which water is to be transferred, was rented to the same landowner during the prior year's irrigation season. The water can only be transferred to and from lands within the boundaries of the District. Please contact the District for details.