

FRESNO IRRIGATION DISTRICT'S THREE-YEAR MAINTENANCE AND FACILITY UPGRADE PLAN

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ABSTRACT

The Fresno Irrigation District (District) is in its third and final year of an ambitious Three-Year Maintenance and Facility Upgrade Plan (Three-Year MFUP). The improvement costs are estimated at \$18.5 million, with \$10.3 million coming from bonds and \$8.2 million coming from outside contributions. These outside contributions include federal and state grants and in-kind District labor. In order to minimize immediate fiscal impacts to landowners, the District decided to bond the initial capital funds and to repay them over time.

The Three-Year MFUP is structured in such a way that it “catches-up” on major infrastructure deficiencies and needs within the District, focusing on deferred maintenance projects and capital improvements. The capital improvements included retrofitting existing weir structures with long crested weirs and automated gates; SCADA and telemetry improvements; improved measurement at lateral headings and selected grower turnouts; regulation and recharge basins; replacement of leaking pipelines; lining problematic portions of open canals; automated trash racks; and improving rights-of-way along open canals. The projects are being constructed by contractors as well as the District’s construction forces. Due to the specialized nature of the majority of the capital improvements the District has been able to minimize costs and construct a greater number of projects by utilizing its construction forces.

INTRODUCTION

The District, and its property owners, approved a supplemental assessment through a Proposition 218 election in December 2005. This was approved after 11 years of no property assessment increase. The majority of District revenues come from property assessments, representing approximately 71 percent of its total budget. The District’s costs are currently allocated to landowners and/or water users through assessments and/or volumetric charges via eight (8) rate services. These eight rate structures represent varying degrees of water service, water supplies, benefits, agreements and legal settlements.

Property assessments had remained fixed since 1994 as a result of Proposition 218 (1996), which limited the District’s ability to increase assessments. The supplemental assessment will help fund repayment obligations for bonds required to complete Three-

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Year MFUP portions of the District's Operations and Maintenance budget, new water right and irrigation-related regulatory fees implemented by the State of California, as well as the annual indexing of supplemental assessment components. Bond or loan obligations will be at actual annual cost and adjusted to the Consumer Price Index (CPI) to account for inflation.

The District plans on constructing \$18.5 million of improvements, with \$10.3 million coming from bonds and \$8.2 million coming from outside contributions including federal and state grants, local agencies, and utilizing District construction labor and equipment by May 2010.

In order to minimize immediate fiscal impacts to the landowners, the District decided to bond the initial capital funds and repay them over time. Listed below is a table showing the eight project categories and their associated estimated costs for the Three-Year MFUP.

Table 1. Project Categories and Estimated Costs for the Three-Year MFUP

<i>N</i>	Structure Type	Total Budget	Contributions by Others	Contributions by FID (Labor & Equipment)	Total Bonding
1	Pipelines	1,279,500	327,500	61,000	891,000
2	Lining and Rodent Barrier	797,702	-	209,595	588,107
3	Regulating Structures and Devices	1,380,914	-	359,000	1,021,914
4	Measuring Structures and Devices	4,445,294	5,000	1,724,275	2,716,019
5	Basins	3,629,709	250,000	199,500	3,180,209
6	Trashrakes	450,000	-	100,000	350,000
7	Misc. Canal Structures	2,580,550	1,066,854	177,575	1,336,121
8	Right of Way Levees and Encroachments	3,918,630	2,993,000	694,000	231,630
	System Construction	18,482,299	4,642,354	3,524,945	10,315,000

DISTRICT BACKGROUND

The District is located in California's San Joaquin Valley and provides service to approximately 245,000 acres. The District is located in the geographic center of Fresno County and its boundary extends from the San Joaquin River to the north, City of Easton

to the south, the Kings River and Friant-Kern Canal to the east and just past the City of Kerman to the west.

Water is delivered to approximately 190,000 acres including the metropolitan areas of Fresno and Clovis. The agricultural lands within the District are predominately permanent crops (about 68 percent). The predominant agricultural crop in the District has been and continues to be grapes, however almonds and citrus have increased over the past 10 years. The conversion of agricultural lands to urban uses in the expanding Fresno-Clovis metropolitan area has significantly increased in recent years. Currently, about 150,000 acres (or 60 percent) of the District remains as farmed agricultural land, while approximate 30 percent is urban and 10 percent is rural residential.

The District was formed in 1920 as a successor to the privately owned Fresno Canal and Irrigation Company (Company). The District purchased all of the rights and property of the Company for the sum of \$1,750,000. The assets of the company consisted of over 600 miles of canals and distribution works, which were constructed between the years 1860 and 1900, as well as extensive water rights on the Kings River. The District currently owns and operates approximately 676 miles of canals with approximately 355 miles being pipelined and 321 being open channel. The District operates and maintains approximately 40 regulating and recharge reservoirs spread across 750 acres, with 4,200 acre-feet of holding capacity. Of the total 750 acres, approximately 220 acres are utilized as a Ground Water Banking Facility which was developed several years ago as a joint project with the City of Clovis. The District also has an additional 2,200 acres of floodrights.

The District diverts an average of 500,000 acre-feet of surface water annually. The primary water supply for the District comes from its Kings River rights administered by the Kings River Water Association. The U.S. Army Corps of Engineers constructed the Pine Flat Dam in 1954, which has a capacity of 1,000,000 acre-feet. Of this, the District is entitled to approximately 26% of the average Kings River runoff. The District also has a small water supply off the San Joaquin River, with a Class II contract for 75,000 acre-feet through the Friant Division of the Central Valley Project (CVP). In addition, the District delivers 60,000 acre-feet of the City of Fresno's Class I contract.

TYPES OF PROJECTS

The Three-Year MFUP was structured to alleviate major deficiencies and needs within the District, focusing on deferred maintenance projects and capital improvements. The capital improvements included retrofitting existing weir structures with long crested weirs and automated gates; Supervisory Control and Data Acquisition (SCADA) and telemetry improvements; improved measurement at lateral headings and selected grower turnouts; regulation and recharge basins; replacement of leaking pipelines; lining problematic portions of open canals; automated trash racks; and improving rights of way along open canals.

The projects listed in the Three-Year MFUP were identified as priorities by the Water Operations and Engineering Departments. The Three-Year MFUP was structured with the following main objectives:

- Address major deficiencies and needs within the District, focusing on deferred maintenance projects and capital improvements.
- Improve landowners' ability to better manage the surface water supply, which will be accomplished by upgrading a portion of the existing turnout gates.
- Implement the Mill-Herndon Canal "Superhighway".

Prioritization of Projects

The District has compiled a lengthy list of master planned projects over the past 15 years, but did not have the necessary funds to construct most of them. The master list included 160 projects which were prioritized by three different criteria: 1) Project Type (e.g. pipelines, lining and rodent barrier, regulating structures and devices, etc.), 2) Priority Number, and 3) Year Constructed. Prior to Proposition 218, the District created a detailed list of projects, with a short summary of each project and a three-year project schedule. The project summaries included a short description, project location and any financial considerations. Project costs were difficult to estimate because a majority of the projects were in very preliminary stages of design and an Engineer's estimate had not been completed. For example, there were numerous check structures identified to be retrofitted, but it was not known if an automated gate valve would be installed or if it would be retrofitted with a less expensive device such as a Irrigation Training and Research Center (ITRC) Flap Gate. The District developed criteria to prioritize the projects below:

1. Efficiency Improvement Projects: Projects that either increase efficiency in operations or decrease maintenance costs.
 - a. *Non-Deferrable Capital Improvement Projects* - Projects that are essential for the continued operation of the canal system. By failing to complete this work, the ability of the District to continue to deliver water at the specified location is in question including:
 - *Maintenance/Operational Improvements (High Concern)* –Issues that cause a canal to be shut down several times per year and/or poor regulation exists, especially in areas which (may) no longer have operational spills. Problem can be addressed with canal lining, rodent barrier, level control gates, retrofitting existing weirs (long crested weirs), pipeline replacement, new or improved regulation basins, lift pumps, telemetry/automation, etc.
 - *Implement the Mill-Herndon Canal "Superhighway"* - Convert existing check structures that could pass changes in flow quickly from one end to the other, while maintaining a fairly constant upstream water level. The Mill-Herndon Canal are large mainlines that accept a wide range of fluctuations and operational canal spills. This will be accomplished by retrofitting existing weirs (long-crested weirs & Langemann Gates).

- b. *Maintenance/Operational Improvements (Medium High Concern)* – Issues that cause a canal to be shut down an average of once per year and also where improved regulation is needed. Problem can be addressed with canal lining, rodent barrier, level control gates, retrofitting existing weirs (long crested weirs), pipeline replacement, regulation basins, lift pumps, telemetry/automation, etc.
 - c. *Turnout Measurement Improvements* - Improve the ability to equitably deliver water to those landowners relying principally upon surface water. Problem can be addressed with retrofitting the existing meter gate, installing an orifice plate or a flow meter.
 - d. *Improve Measurement on Mainlines and Spills* – Improvements will help operations, improve service and limit water leaving the District. Problem can be addressed with Replogle flumes, flow meters, Cipolletti weirs, etc.
 - e. *Improve Existing Basins and Measurement on Smaller Laterals* – Improvements will help operations, improve service and limit water leaving the District. Problem can be addressed with pipelines, lift pumps, long crested weirs, telemetry/automation, Replogle flumes, flow meters, Cipolletti weirs, etc.
 - f. *Preventive Maintenance* – Improve sections of canal where access is lacking, and where repairs are routinely made, but service has not yet been impacted. Problem can be addressed with clearing of rights-of-way (brushing and earthwork), long crested weirs (sediment), lining, rodent barriers, pipeline replacement, etc.
2. Regulatory & Contractual Requirements: Regulatory projects to ensure that facilities are in compliance with all applicable regulations and contractual agreements. Consists of projects with local agencies and improvements to facilities that have mutual benefits.
 3. Landowner, Developer or Agency Participation: Projects requested by a landowner, developer or local agency wanting to improve a District facility for their own benefit. (If a canal is in poor condition and requires a large amount of maintenance it will be listed under a higher priority.) Participation shall be approved by the District’s Board of Directors (BOD) on a case by case basis per Board Policy 102 and 102.1.
 - a. *Adding Water Service* – Projects that will add revenue and improve groundwater conditions by installing a pipeline or constructing a canal. The BOD will decide if the new facility will be maintained by the District or the landowner.
 - b. *Improving Facility* – Landowner requests to improve facility for his own benefit. The facility is in generally good condition.

Although the District developed a good master plan, staff had the flexibility to re-prioritize, add, or delete projects from the approved list, depending on a project’s merit and conditions.

METHODS TO FUND IMPROVEMENTS AND CONTROL COSTS

The District confirmed that the funds acquired would be adequate for approximately five years before additional revenues would need to be developed. In order to minimize immediate fiscal impacts to landowners, the District bonded or borrowed the initial capital funds and will repay them over time. This will help protect the integrity of the District's conveyance system and make sure that water users will continue to receive surface water supplies, when available.

Methods to fund improvements and control costs include:

- Bonding
- Outside grants and contributions
- Utilize district workforce
- Focus improvements on mainlines and laterals
- Retrofit existing weir structures
- Low tech improvements
- Limited automation

Bonding

The District needed additional revenues to maintain the level of service that the property owners have historically been accustomed to receiving, as well as maintain the water rights for future use. The improvement costs are estimated at \$18.5 million, with \$10.3 million of the funding coming from bonds. In order to minimize the immediate fiscal impacts to landowners, the District decided to bond the initial capital funds and repay them over time. The District's Board of Directors and the landowners approved a supplemental assessment that equaled an additional \$1,651,730 in 2006 and indexed annually to approximately \$3,681,511 in 2010.

Outside Grants and Contributions

In addition to the bonding funds, the District expected to receive approximately \$4.6 million through grants and contributions from local agencies. The District expects to receive several grants from federal and state agencies such as the United States Bureau of Reclamation (USBR) and the California Department of Water Resources (DWR). In recent years, the District has been successful in obtaining close to \$6.0 million in grant funding from sources such as the DWR Proposition 13, DWR AB 303, USBR Challenge Grant, USBR Water Efficiency and Water Marketing, among others. The District also planned on receiving funding contributions from local agencies such as the Cities of Fresno and Clovis, the County of Fresno, as well as the Fresno Metropolitan Flood Control District (FMFCD). While \$4.6 million is a large sum to expect, most of the projects were already planned and the contribution percentages were tentatively agreed upon by the agencies. An example of this was the Fancher Flume Replacement/Enterprise Canal Improvement Project that totaled approximately \$900,000. The District received a \$300,000 USBR grant and the remaining project costs were split by four

agencies with a breakdown as follows: District – 31.9 percent, City of Fresno – 26.4 percent, FMFCD – 20.6 percent, City of Clovis – 14.3 percent, and County of Fresno – 6.7 percent.

Utilizing District Workforce

In addition to bond funding, grants, and contributions received, the District expected to receive approximately \$3.5 million by utilizing District forces and equipment. The in-house labor included surveying, engineering, and construction, where possible. Due to the specialized nature of the majority of the capital improvements, the District has been able to minimize costs and construct a greater number of projects by utilizing its construction forces. District staff is planning to utilize in-house forces to construct some of the projects, but will continue to focus its resources primarily on maintenance. The District developed a Project Manager position to oversee the majority of the in-house and contracted projects. The District was able to promote within for this position and the staff member had 15 years of District experience including seven years as its Construction Inspector. Because the District did not want to forego routine maintenance, it hired several temporary laborers to assist with less skilled work such as removing trash from the urban areas, as well as removing trees and vegetation from canals that had been neglected for the past few years. With the addition of the temporary employees, the District was able to shift several of the more experienced FID employees to work on construction crews.

Focus Improvements on Mainlines and Laterals

One of the three goals of the Three-Year MFUP was to improve landowners' ability to better manage the surface water supply, which would be accomplished by upgrading a portion of the existing turnout gates. Although the District had developed an extensive list of projects over the previous seven years, it recognized the need to improve deliveries and to research improved measurement at turnout gates. The District hired the Irrigation Training and Research Center (ITRC) who developed a report on the modernization improvements necessary to attain the goals laid out in the Three-Year MFUP. The District had previously determined to retrofit existing measuring devices that consisted mainly of meter gates, orifice plates and a small number of propeller meters. The District also previously decided to experiment with several flow meters, but installed only 25 due to the unproven technology. Based on the ITRC's report, the District instead focused on better level control in the mainlines and medium laterals. The ITRC also developed the concept of the Mill-Herndon Canal Superhighway, as shown in Figure 1, which would move water more quickly from the east side of the District, through the Fresno-Clovis metropolitan areas, out to the west side of the District, which is primarily rural agricultural land.

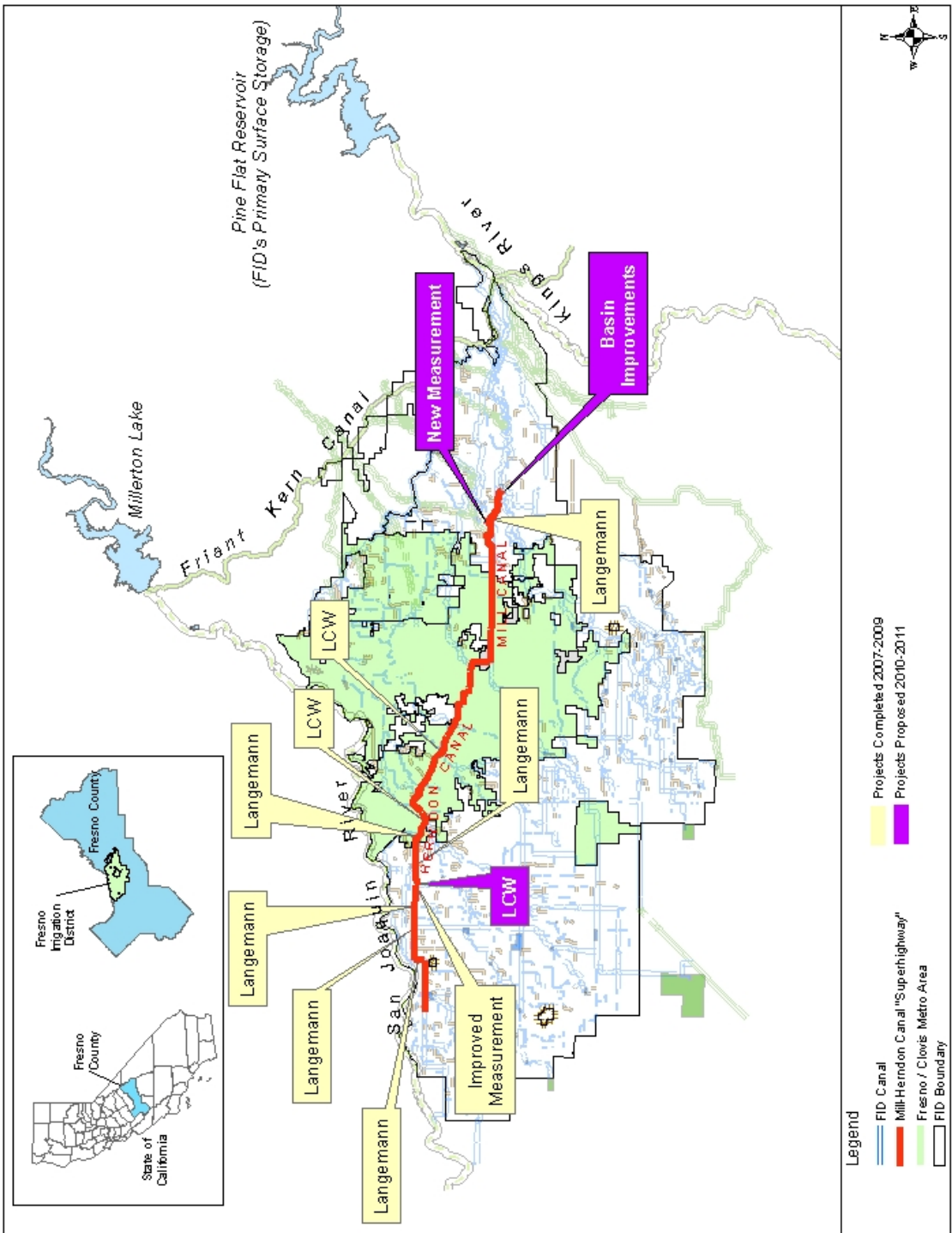


Figure 1. Mill – Herndon Canal “Superhighway”

Retrofit Existing Weir Structures

The District was able to maximize funding and improve additional sites by retrofitting the existing weir structures. A picture of a standard District weir structure is shown in Figure 3. Although most of the District's 2,500 weir structures have not been improved since they were constructed in the late 1800s and early 1900s, it was determined that the majority would last for many more years. The majority of the projects will be retrofitted with either an ITRC Flap Gate or Long Crested Weirs as shown in Figure 2 and Figure 4. It was determined that the ITRC Flap Gates and Long Crested Weirs would not create enough stress or strain to the existing weir structure to warrant a completely new structure. Many of the weir structures were in disrepair and did require some additional repairs and in isolated cases complete replacement. The District will save a considerable amount of money by utilizing the existing structures.



Figure 2. Typical Weir Retrofitted with ITRC Flap Gate

Low Tech Improvements

While the District has added approximately 60 sites to its SCADA system over the past 15 years, only 32 sites are fully automated control sites. This leaves 2,468 standard weir structures remaining. The standard weir has not been improved since they were first constructed in the late 1800s and early 1900s. The District did not intend to fully automate the majority of the sites and instead decided to focus on better level control in the canals, the biggest reason being that the costs are prohibitive. The District has chosen to construct mainly “low tech” structures such as ITRC Flap Gates and Long Crested Weirs, and shown in Figure 2 and Figure 4. It was later determined that the ITRC Flap Gate would not work in most locations due to a lack of head loss across the weir structure. At this point, the District decided to retrofit the majority of the existing

structures with a long crested weirs. At the end of the Three-Year MFUP, the District anticipates constructing approximately 100 long crested weirs and 15-20 ITRC Flap Gates.

In addition to being a cost-effective solution, the long crested weir is a proven technology to control water levels. As stated in ITRC's 2006 report on Long Crested Weirs, they allow the safe passage of a large flow rate with relatively small increase in water surface elevation upstream of the structure. The concept of a long crested weir is simple: Provide more weir length than is possible with typical weirs. A typical weir is installed across the canal with the crest perpendicular to the centerline of the canal. The additional weir length makes it possible to pass the design flow rate with smaller heads. From an operations point of view, this means that large changes in flow rate over the long crested weir will result in smaller changes in head and small changes in flow into the lateral or farm turnouts upstream of the weir. Installation of long crested weirs can result in turnouts that are relatively insensitive to changes in the canal flow. If the turnouts and check structures do not have to be re-regulated each time there is a change in flow rate, it will take less labor to operate the system. Greater flexibility in water deliveries can be accomplished with less labor.

The District worked with the ITRC staff to refine the design and develop a standard design that included a movable weir crest. The movable weir crest consisted of two boards that would slide into weir board guides incorporated into the catwalk for the Ditchtender to easily operate. The design also incorporated sluice gates that sediment could pass through. In some cases, larger sluice gates were installed on canals that conveyed stormwater or laterals that had different routing schedules. Figure 4 illustrates the catwalk/weir board guide design plus small sluice gates.



Figure 3. Typical Weir Structure



Figure 4. Weir Retrofitted with LCW

Limited Automation

As mentioned previously, the District has no immediate plans to fully automate its system and therefore has chosen to incorporate a more “low tech” plan instead. But, there are many places within the District where it does make sense to automate structures, such as major bifurcations or basin locations. Over the past 15 years, the District has automated several sites each year to help improve water management. While the District has added approximately 60 sites to its SCADA system over the past 15 years, only 32 sites are fully automated control sites. The District plans to add another 40 sites to the SCADA system, for a total of 100 sites. Approximately 40 of these sites will be fully automated control sites.

At bifurcations, the District typically fixes the flow down one lateral with undershot sluice gates controlled with an electric actuator. The other canal is not typically automated and will stay as a traditional weir structure with weir boards. The District will typically construct a Replogle Flume on both canals which will provide an accurate measurement. In recent years, the District has installed several Langemann Gate valves that have been utilized for two different reasons. The Langemann Gate shown in Figure 5 serves as the headgate of a fairly large (350 cfs) canal that can change modes from either flow control or monitor only. During the irrigation season, the District will fix the flows down this particular canal and send the fluctuations to another canal where there are regulation basins. During the winter months when the District is routing flood water, the gate will change modes and will accept the fluctuations and route to a Groundwater Banking Facility downstream.



Figure 5. Langemann Gate Used to Automate Headgate

SUMMARY

Prior to the start of the Three-Year MFUP, it was determined that the additional revenue raised through the supplemental assessment would be adequate for approximately five years before FID would need to raise its rates or generate revenue by other means. In order to minimize immediate fiscal impacts to landowners, the District bonded the initial capital funds and will repay them over time.

The Three-Year MFUP was structured in such a way that it “catches-up” major deficiencies and needs within the District, focusing on deferred maintenance projects and capital improvements. The capital improvements included retrofitting existing weir structures with long crested weirs and automated gates; SCADA and telemetry improvements; improved measurement at lateral headings and selected grower turnouts; regulation and recharge basins; replacement of leaking pipelines; lining problematic portions of open canal; automated trash racks; and improving rights-of-way along open canals.

The District goal was to construct \$18.5 million of improvements, with \$10.3 million coming from bonds and \$8.2 million from outside contributions. After 2 ½ years and as of January 1, 2010 the District has spent approximately 65% of the bond funds and the District was granted another 12 months to spend the remaining 35%. Although the

District encountered many challenges throughout the design and construction phase, the program has been considered a success. To date, the highlights include:

- 105 Regulation Structure Retrofits (76 LCW, 13 ITRC Flap Gates and 16 automated gate valves) and 15 sites remaining;
- 25 Measurement Structures and Devices (5 Replogle Flumes, 5 Mace Meters, 10 Sontek Meters, and 5 miscellaneous structures/devices) with 10 more proposed;
- 40 SCADA sites with 10 more proposed;
- Purchase property for 3 Regulation/Recharge Basins with 2 more proposed;
- 1.7 miles of Pipeline Replacement with several more proposed;
- 1 mile of Canal Lining with several more proposed;
- 30 miles of All Weather Road in Conjunction with the City of Fresno and Clovis Surface Water Treatment Facilities;
- 2 Flume Crossings over Creeks; and
- 4 Auto Trashrakes and 2 large trash booms.

The original plan estimated \$8.2 million or 45 percent of the improvements would be funded by outside contributions including federal and state grants, and local agencies. The balance of the funding would utilize in-kind District construction labor and equipment. The original plan estimated that grants and local agency contributions would equal close to \$4.6 million while approximately \$3.5 million would come from District forces and equipment. As of January 1, 2010, the District has received numerous grants and contributions from local agencies and will be receiving additional grants and contributions over the next 15 months. The District expects the total outside contributions will be close to the original estimate. As expected, the majority of the projects were constructed by the District's construction forces. Due to the specialized nature of the capital improvements the District has been able to minimize costs and construct a greater number of projects relying on the District's construction forces. The District hired Contractors to construct the larger, more complex projects. The completion of these projects will protect the integrity of the District's conveyance system and make sure that water users will continue to receive surface water supplies, when available.

REFERENCES

Provost and Pritchard Engineering Group Engineer's Report for a Proposition 218 Election - 2005

ITRC of Cal Poly SLO RAP Report/Modernization Opportunities – 2005

ITRC of Cal Poly SLO Technical Memo of Turnout Flow Measurement - 2006

ITRC of Cal Poly SLO Report on Long Crested Weirs – 2006