

# **MODERNIZATION IMPROVEMENTS — OPTIONS, DECISIONS AND IMPLEMENTATION AT OAKDALE IRRIGATION DISTRICT**

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## **ABSTRACT**

Facing a magnitude of issues including failing infrastructure, water rights challenges, and low water use efficiency, the Oakdale Irrigation District (OID) Board of Directors voted in 2004 to develop a Water Resource Plan (WRP) to guide the District for the next 20 years. The WRP was finalized and adopted by the Board in November 2005 with the five following goals stated:

1. Provide long-term protection to OID's water rights
2. Address federal, state and local water challenges
3. Rebuild/modernize an outdated system to meet changing customer needs
4. Develop affordable ways to finance improvements
5. Involve the public in the planning process

All of the stated goals are interrelated and progress on one has ancillary benefits to others. This paper will predominately focus on the rebuilding and modernizing efforts the OID has implemented since the adoption of the WRP, with major focus on the modernization of the District's diversion structures. This paper will discuss the many options available for modernization, the decision process on the path selected, and the implementation of projects to achieve modernization.

## **INTRODUCTION**

The Oakdale Irrigation District (OID) was organized on November 1, 1909, under the Wright Act. In July 1910, the OID and the South San Joaquin Irrigation District purchased an established ditch system known as the Tulloch System. The Tulloch System had been developed in the 1880s by Charles H. Tulloch, primarily serving the Knights Ferry community with diverted water from the Stanislaus River. Since that time the OID has expanded its service area to encompass approximately 72,345 acres, of which an estimated 55,000 acres are irrigated to produce a variety of agricultural crops, largely pasture, corn (silage), and rice.

The District's development since 1909 can be separated into three distinct chapters. Those three chapters are characterized by significant events that took place that forever changed the Oakdale community and its agricultural development. The first chapter is obviously the organization of the District at the turn of the century, the second chapter was the formation of the Tri-Dam Project, and the third chapter is beginning to be

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written. In the first chapter the District was rapidly expanding the service area and infrastructure needed to meet a growing irrigation demand. In their haste the District failed to invest in the essential infrastructure required to provide reliable irrigation supplies needed to grow more profitable crops in the region. During the early years, most farmers grew oats and other grain crops. Only the most entrepreneurial of farmers tried to grow anything else due to the likelihood that the water supply would dry up by late summer.

The second chapter of the District was aimed at firming up supply reliability and began when the District's Chief Engineer, R.E. Hartley, started expeditions in the Sierra Nevada Mountains along the Stanislaus River. Mr. Hartley spent many years packing into the mountains east of Oakdale looking for ideal reservoir sites to harness the mighty runoff from the Stanislaus River. Three sites were found and soon the District started looking for ways to finance the construction of the "Tri-Dam" Project. The financing came by way of the Pacific Gas and Electric Company whom would pay for the construction of the dams in exchange for a long term contract for the ancillary benefit of the hydropower generated at the sites. The District agreed and the dams were built. However the construction of the dams came at a price. So much effort was placed into the construction and operation of the dams that the District lost sight of the operation and maintenance of the irrigation distribution system.

Nearing the turn of the 21<sup>st</sup> century, the District's delivery system was in a state of disrepair and the District's finances were barely covering operational costs. In conjunction with these shortcomings, turnover at the Board and Managerial level left little room for optimism and certainly didn't contribute to improving the District's financial future. Looking for any way to generate revenues without increasing the all too politically volatile water rates, the Board of Directors approved a water transfer that would supply the much needed revenue stream. Soon after this first water transfer, the District's long term contract with Pacific Gas and Electric was set to expire. The renegotiated hydropower contract would provide additional revenues needed to address myriad infrastructure issues. However, before the District could move forward a plan was needed.

In 2004, with a new Board of Directors and a new General Manager, the District voted to develop a Water Resources Plan (WRP) that would formulate the rebirth of the District and provide guidance for the District over the next 20 years. The WRP was finalized and adopted by the Board in November 2005 with the five following goals stated:

1. Provide long-term protection to OID's water rights
2. Address federal, state and local water challenges
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the OID has implemented since the adoption of the WRP, with major focus on the modernization of the District's diversion structures.

### OPTIONS FOR MODERNIZATION

Infrastructure replacement is a given and is long overdue for the District. However, is infrastructure replacement as simple as just reinstalling the existing facilities or is it as complex as redesigning the entire distribution system? For the Oakdale Irrigation District the answer is somewhere in-between. When the distribution system was originally built in the 1900's it was designed to supply water in large flow rates for large parcels (greater than 160 acres). However, a century's worth of development has occurred and large parcels are no longer the norm. Instead, the District is littered with small parcels (less than 10 acres) and the cropping trends in the District tend to be highly random. So what are the options available to a District looking to replace existing infrastructure with new infrastructure capable of meeting the needs of an ever-changing customer base for at least the next 50 years? For the purpose of this paper, what are the specific options available for diversion structures?

Most of the existing diversion structures in the District utilize a combination of a square shop gate and an afterthought over-pour weir. The square shop gate is an in-house fabricated steel sluice gate with a square opening. The thought behind the installation of these gates was that they were inexpensive, easy to construct, and measurement was easily achieved by using a differential head equation. However as depicted in Figures 1 and 2 presented below, most of the shop gates were undersized or operated infrequently and over topping of the upstream canal section occurred often. The solution was to add over-pour "weirs" as shown in Figures 1 and 2. The result of the non-standard and poorly constructed over-pour weirs negates all of the benefits of the square shop gates.



Figure 1. Upstream View of Typical OID Diversion Structure



Figure 2. Downstream View of Typical OID Diversion Structure

Any option for replacement of these diversion structures needed to meet four basic criteria: 1) Automatic control of the upstream pool elevation; 2) Flow control with flow measurement; 3) Affordability of construction and maintenance; and 4) Flexibility for

future demands and operating scenarios. Based on these criteria the District began to evaluate various options and combinations of the following devices: long crested weirs, Replogle flumes, overshot gates, sluice gates, propeller flow meters, magnetic flow meters, etc. The list of possible designs is vast; however, a few obvious alternatives fell out rather quickly.

**MODERNIZATION DECISIONS**

Obviously there is no quick and easy solution and each option or combination of options has inherent consequences or shortfalls. In order to evaluate the different options available, the District developed a matrix based on the previously stated criteria. The District used the matrix to evaluate four possible configurations. The four selected configurations that could possibly be used to achieve the Districts’ desires are presented below:

1. Long Crested Weir for Upstream Level Control with Automated Sluice gates at the bifurcation. Flow measurement would be achieved downstream with a Replogle Flume.
2. ITRC Flap Gate for Upstream Level Control with Automated Sluice gates at the bifurcation. Flow Measurement would be achieved downstream with a Replogle Flume.
3. A series of Sluice Gates for Upstream Level Control and Flow Control on one of the Canal Headings. Flow measurement would be estimated at the sluice gates.
4. Overshot Drop Leaf Gate for Upstream Level Control and/or Flow Control. Flow measurement would be achieved at the drop leaf gate.

The four configurations were ranked in the matrix that was developed. The configuration that is most favorable for a given category was given a ranking of 1; the least desirable configuration was assigned a ranking of 4. The evaluation and matrix is presented below in Table 1:

Table 1. Configuration Matrix for Evaluation

Configuration	Consistent U/S Level Control	Flow Control & Flow Measurement	Affordability	Flexibility	Average Ranking
Long Crested Weir	1	2	4	3	2.5
ITRC Flap Gate	2	3	1	4	2.5
Sluice Gates	4	4	3	2	3.25
Drop Leaf Gate	2	1	2	1	1.5

As the matrix indicates the Drop Leaf Gate configuration scored the best based on the design criteria for Oakdale Irrigation District. The benefits of the Drop Leaf Gate are numerous but the key element was flexibility and affordability. The Drop Leaf Gate allows the user to configure and operate the gates in a number of modes, such as flow

control, level control, or gate position. This flexibility is essential in order to meet current and future demands.

While all the options could achieve the current or future demands, it is the ability to meet both current and future needs without unreasonable burdens, financial or otherwise that is most important. For example, the District has a particular Lateral Service Area in which the current irrigated acreage is approximately 5,000 acres. During the 20-year planning horizon the District anticipates that the irrigated acreage in this particular service area will increase by 3,500 acres, a 75 percent increase. Consequently, the flow required to meet peak daily evapotranspiration is significantly greater than the current demand. If the District were to select a long crested weir for level control, with its inherent fixed crest elevation, what is the effect on weir length given the two operating scenarios? A longer weir length under reduced flow conditions makes flow control difficult at the canal headings due to the narrow operating range in the upstream pool. The advantage of a drop leaf gate in this scenario is that there is no fixed crest elevation and the gate can be sized for both current and future demand. It is for this flexibility that drop leaf gates are preferable. However, flexibility must always be balanced with affordability.

For Oakdale Irrigation District, like many other irrigation and water districts in the central valley of California, the locations of these diversion structures are often remote and acquisition of a reliable power source to energize a modernization project can be financially unreasonable. Based on unfavorable District experience, DC power for motor actuated slide gates was not a desirable option. With the high cost to bring power to these remote sites and bad experiences with battery powered slide gates, the District was looking for an affordable alternative and the drop leaf gate provided such an alternative.

### **MODERNIZATION IMPLEMENTATION**

Once the District had settled on the drop leaf gate configuration, selection of a manufacturer and specific product needed to occur. The District evaluated the few established products available in the market and selected the Rubicon FlumeGate as the most appropriate for installation. One of the primary reasons for the selection of the FlumeGate was that the product was a turnkey package. Essentially the gates could be dropped into place and functional within a few hours. This is especially true given that the gates are supplied with solar panels; making the remote location power issue null. An example of the modernization efforts are depicted in the before and after photographs from a recently completed project as shown in Figures 3 and 4 below.



Figure 3. OID Diversion Structure Pre-Modernization



Figure 4. OID Diversion Structure - Post Rubicon Gate Installation

Moreover, the Rubicon gates are Supervisory Control and Data Acquisition (SCADA) ready for a variety of protocols. Prior to selecting the Rubicon gates, the District had just recently upgraded the Human Machine Interface package to Control Microsystems ClearSCADA and it was important to ensure that the Drop Leaf Gate that was selected would be capable of working in the modbus environment. Rubicon's predominant protocol is MDLC, however Rubicon was able to supply the modbus drivers and the integration into the District's SCADA system was nearly seamless. The District continues to find small edits that are necessary in the program; however the edits have been cosmetic and not functional issues.

To date the District has installed 18 Rubicon gates with plans for an additional 20 sites to be installed over the next five years. The District has had great success thus far with the Rubicon gate configuration and additional benefits have been realized that were not anticipated. For example, the District utilizes an aquatic herbicide to control vegetation growth in the canals. The District must ensure that while the herbicide is being used that none of the treated water is discharged outside the intended treatment area. Having the ability/flexibility to operate the Rubicon gates in a variety of modes such as flow control or upstream level control makes the herbicide applications easier to manage. Moreover, the ability to accurately measure the flow rates during these applications allows the District to reduce cost by applying the herbicide in exact concentrations dependent upon the stage of vegetative growth. As stated previously, this type of flexibility is vitally important for the District to maintain into the future. Agricultural and economic market conditions are highly variable and the District aims to build in the needed flexibility to meet the needs of a dynamic customer base.

### CONCLUSION

In conclusion, the District spent a lot of time identifying potential alternatives that would meet the needs of the District. The District believes that the selection of the Rubicon gate has served well so far. However, there are some unknowns still looming, specifically long term maintenance and gate longevity. The success of the modernization effort cannot be determined yet. One of the outlying issues is. With that said, the District has been very satisfied with the gate operations and the customer support provided by the manufacturer. The District is hopeful and confident that in time the modernization efforts will be deemed a success.

### REFERENCES

OID Water Resource Plan, November 2005.