DEALING WITH AN UNCERTAIN WATER SUPPLY IN JAMES IRRIGATION DISTRICT

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ABSTRACT

Based on the ongoing drought conditions and pumping restrictions from the Sacramento-San Joaquin River Delta (Delta), the James Irrigation District (District) made the decision to analyze their water resources to understand if the District could sustain its current agricultural practices without a Delta supply. The result of the analysis is that the District can continue to farm at its current capacity, but it will require changes to both District infrastructure and operations. Groundwater supplies can meet the overall demand of the District, but wells alone lack the instantaneous capacity to meet peak demand during summer months. Because of this, storage will be required to meet peak demands. Many options were developed and considered by the District. The final decision consisted of drilling additional wells, utilization of three large existing basins at the upstream end of the District for short-term storage, and system automation. Since the District does not rely on computerized controls, it is proposed that this design utilize simple robust structures, and minimal computerized automation, to provide a simple "automatic" control system to meet demands.

Other than design and engineering, significant project issues consisting of environmental concerns, cultural resources, and funding have arisen.

When completed, this project will provide for continued sustainable farming, remove the art of system control by implementing simple control systems in canal and reservoir modernization, and allow the District to provide the large amount of flexibility growers are accustomed to.

INTRODUCTION AND BACKGROUND

The James Irrigation District (James ID, JID, or District) is located in western Fresno County in proximity to the cities of Mendota and San Joaquin. The District was organized in 1920 under the California Water Code. Currently the District consists of approximately 23,000 acres, and annually supplies from roughly 80,000 AF. In a normal year the District would receive 45,000 AF in surface water from the Central Valley Project (CVP). Of this 45,000 AF of CVP water, 9,700 AF is developed from the Districts historic right to San Joaquin River water (Schedule 2). The remainder of the

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grower demand is met by the 59 groundwater wells and unpredictable water supplies from the Kings River by way of the Fresno Slough Bypass. Provided below is a map of the District (**Figure 1**). The yellow area of **Figure 1** represents the boundary of the District, while the tan area represents to Eastside Well Field for which the District possesses groundwater rights.

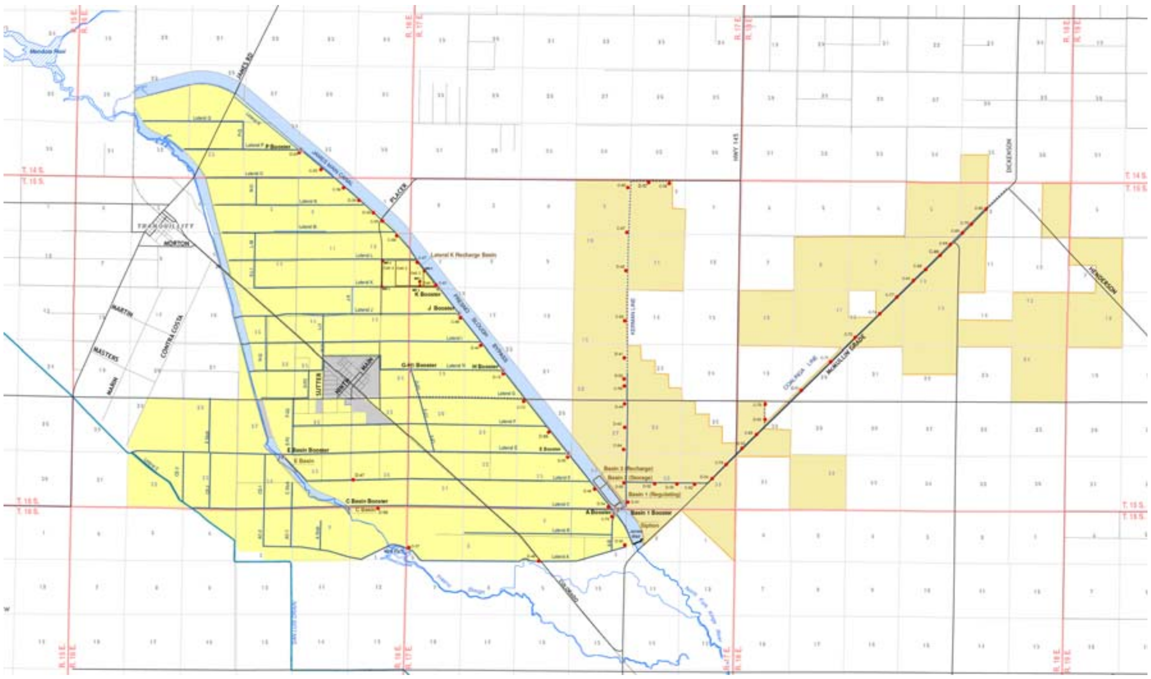

Figure 1. District Map

The CVP water is pumped from the Mendota Pool, whose backwater is adjacent to the eastern side of the northern quarter of the District. As the natural gradient of the District is south to north, the water received from the Mendota Pool must be pumped in reverse flow to be delivered to the District's distribution system. The water in the Main Canal is checked at four points, Laterals E, H, J, and P. These checks are also the location of the reverse flow pumps.

Groundwater pumped from the Eastside Well Field flows by gravity down the Main Canal. Of the 59 wells owned by the District, 35 are located in the Eastside Well Field. This water is delivered to the Main Canal at its highest point, allowing water to gravity flow down the District's Main Canal.

Recently the District has been concerned on the reliability of their 35,300 AF surface water supply available through the Central Valley Project. This concern is based upon water supply issues such as climate change, San Joaquin River restoration initiative, and pumping restrictions from the San Joaquin-Sacramento River Delta due to endangered species, foremost the Delta Smelt. These uncertainties have caused the District to reevaluate their water resources and determine if it would be possible to sustain their operations of providing agricultural water to users if the 35,300 AF of CVP water were not available.

ANALYSIS

To begin the analysis, the District measured daily system demand for the 2007 year (**Figure 2**). This was the most recent data and thought to be representative of a typical year by the District. To this data, the secured water sources (Schedule 2 and groundwater) were added (**Figure 3**). The District has a contract for 9,700 AF of Schedule 2 water, and has 59 groundwater wells. What was determined is that the District can acquire enough water from these two sources to sustain their practices, but cannot provide enough water to meet the instantaneous summer demand while maintaining the current level of grower flexibility.

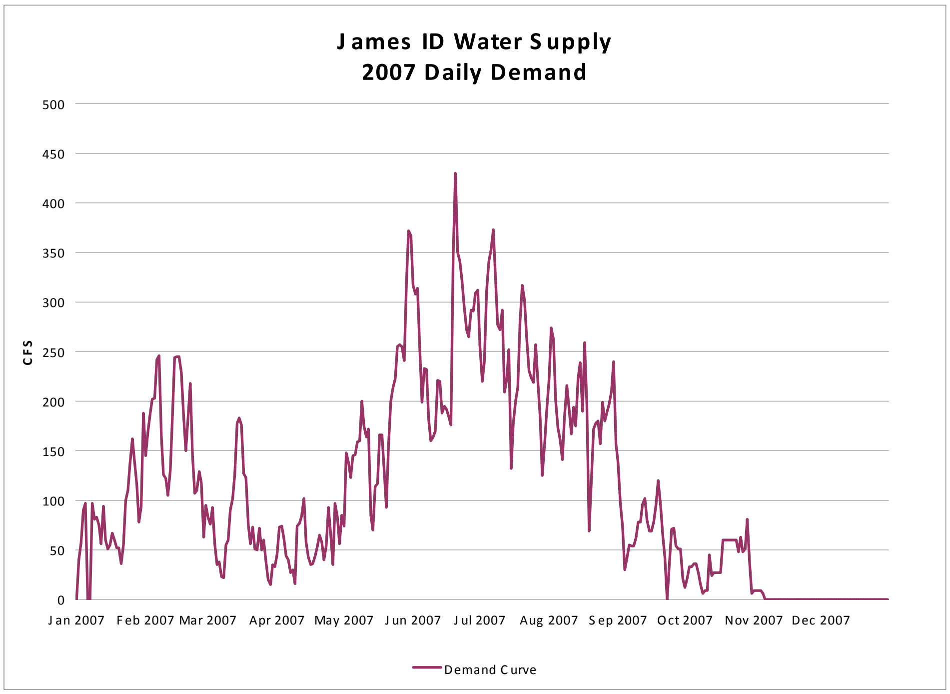

Figure 2. Daily Demand Representative of a Normal Year

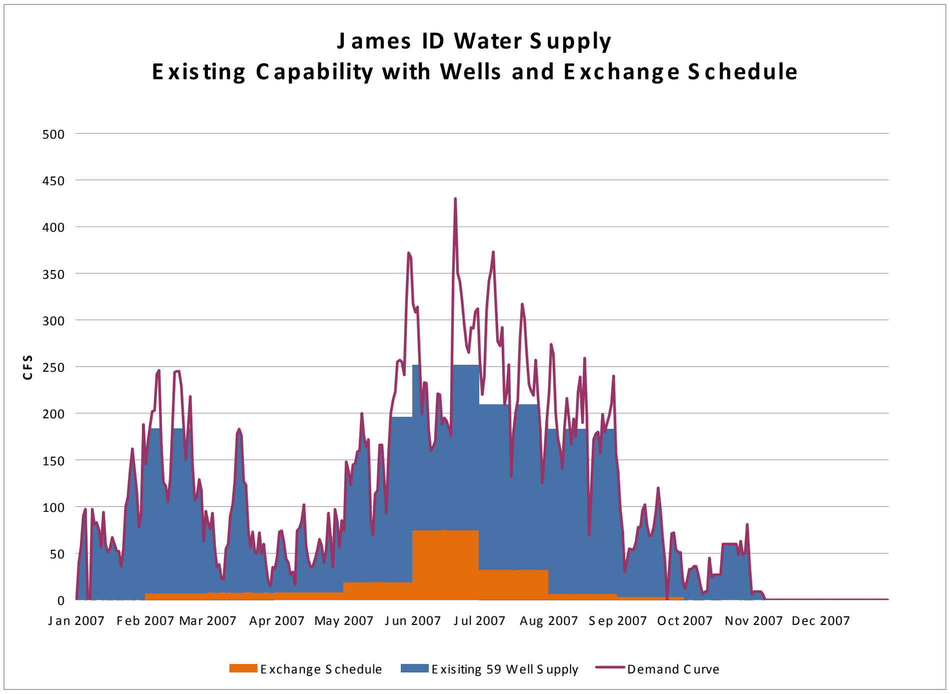

Figure 3. Secured Supply Inability to meet Current Demand

This left the District with one of three options; 1) switch from an on-request delivery method to a rotation type delivery, 2) increase surface storage capabilities, or 3) drill new wells. The District's decision was a combination of the final two; additional storage and wells. Although switching delivery methods could have helped balance out high daily flow rate demands, the District still wanted to provide water to growers as requested.

The next step was to investigate locations for these new facilities. There were many sites to choose from, each with their own pros and cons. Some options included providing additional storage behind a dam, modifications to a recharge site, and purchasing bankrupted land in another District. It was ultimately determined that three existing basins near the head of the James ID Main Canal would be the most ideal site for obtaining additional storage. One basin was currently being used as storage and the other basins were only utilized when flood waters were available off of the Kings River. The advantage to using this site was its proximity to the James ID Main Canal. The Basins were adjacent to the Main Canal, and located at the most upstream end. The drawback however, was that these basins are separated from the Main Canal by the Fresno Slough Bypass Channel. Connection of these facilities requires the construction of siphon pipes to pass flow underneath the bypass channel to connect the basins and the Main Canal.

With an additional 16 wells the new storage and regulation site needed to store approximately 3,000 AF. Based on the timing of water needs and the ability of the storage basins to fill and refill, the amount of storage needed to meet all demands was reduced to 1, 500 AF.

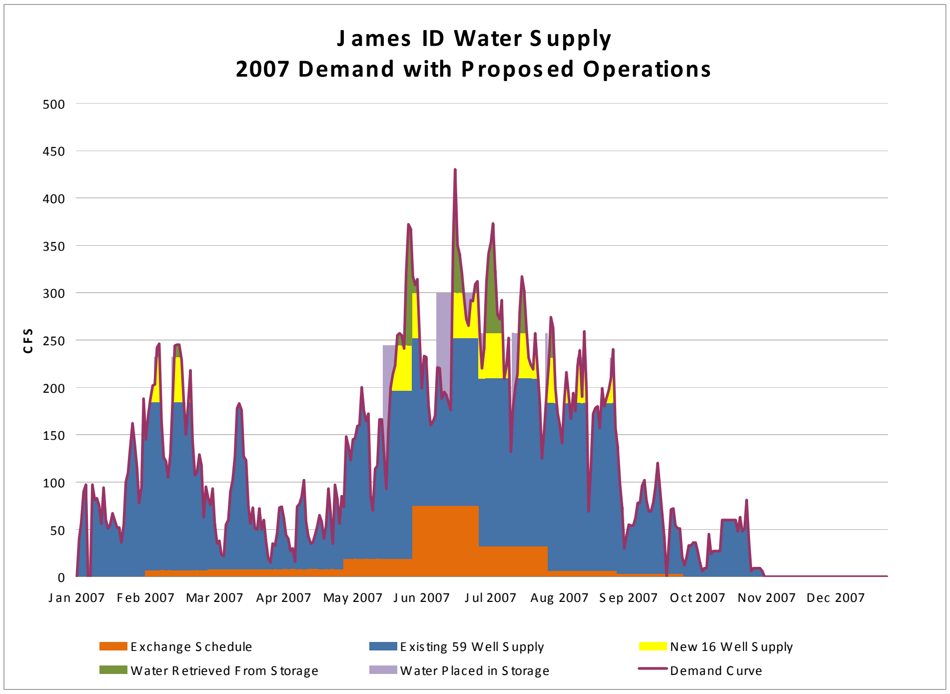

Figure 4. Future Operation of District

Figure 4 represents the planned operation of District facilities to meet system demand. From the graph in **Figure 4** it was also possible to interpret other necessary design information. The most significant design consideration is the maximum flow rates for filling and recovery. It was determined that 130 CFS could be required for recovery to the Main Canal. The other was how often these basins could be filled and the time it would take to fill them. Based off of the data from 2007, these basins are expected to be filled and refilled four times during the irrigation season.

PROPOSED DESIGN

<u>Fresno Slough Bypass</u>

Since the District had limited experience using automation, the goal of this project is to make this project operate as easily as possible with simple robust structures, while minimizing the amount of computerized controls required for operation. This is not to say it will not be modernized, as it is proposed to include long crested weirs, ITRC Flap gates, a Langemann gate, some localized controls, and flow measurement devices.

Currently when CVP water is available and the District is pumping contract water from Mendota Pool, the District uses lift pumps to force water upstream into each pool of the Main Canal. Since this project is being done assuming an absence of CVP supply the operation of the Main Canal will reverse. In essence, the system is being reconfigured so that it can operate in either direction.

Once the proposed modifications are made, the Main Canal will operate as historically operated, flowing downhill as it did when its sole source was water from the Kings River.

The new basins will store excess water supply, and then discharge the stored water into this most upstream pool of the Main Canal.

The proposed operation of the off-channel storage facility consists of storing excess pumped groundwater from the Eastside Well Field. The supply will enter the most upstream pool, the “E-Pool”. The “E Pool” will be maintained by flow control. An automated flow control device will be operated at the E-Check Structure, where the ditchtender will have the ability of setting the flow rate to be maintained by the device.

When there is excess flow from the Eastside Well Field, the gate will close and force water through the siphon and into the basins. The design flow from the Eastside Well Field is 120 CFS. Flow into the siphon will be regulated by level control. When the gate closes, the water level will rise and spill over a level regulation structure in the Main Canal. It is proposed that this structure consist of both ITRC Flap Gates and a weir section.

Once the water passes through the siphon it will reach a distribution structure. It is proposed that this structure have the ability to deliver water to the different cells on a predetermined arrangement. Distribution of water will be determined by weir sill settings. Once Basin 3 fills to set level, enough head can then be built to spill water into Basin 2.

Retrieval of water will be in reverse order. Since Basin 2 is so large and flat, it is likely that this water would infiltrate or evaporate before it could be retrieved, if left for an extended period of time. This is why water will be retrieved from Basin 2 first. Retrieval of water will be accomplished by a pumping structure which will be plumbed to pull water from either basin, depending on the position of gates. It is intended that initially this control will be manual, but could be easily modified for automation in the future. If automated, the pumps would be operated off of level control in the Main Canal.

Water will be conveyed from the pump station into a separate pipeline and siphon that parallels the spill siphon and pipeline flowing toward the basins, and discharged into the Main Canal.

All work to be performed in the Fresno Slough Bypass is capitally intensive. For this reason, structures in the project will serve multiple purposes. The first example is the pump structure. This is plumbed into both basins so that water can be retrieved from either basin by the operation of a single gate. This will save the District from installing a pump structure in each basin that would be capable of supplying the needed flow. The second example is that the pump structure also acts as the delivery structure into Basin 2. Since the pump inlet needed to be set at the invert of the Basin 2, it was fairly easy to incorporate this to deliver flow back to the basin through this same pipeline. The third example is the regulation structure in the Main Canal. Both the outflow and inflow lines will be built into the same head wall. The fourth and final example is that the pipeline that normally conveys flow to the Main Canal can also be utilized to send flow to the basins in periods of extremely high flows.

Recharge area

To reach the required 1,500 AF of storage, the basins will need to be further excavated, and the excavated earth will become an issue. After a topographic survey, it was confirmed that the lands lying north of the storage basins were low enough to capture Main Canal spill and flood waters released from Pine Flat Lake via the Kings River. It was decided that the excavated earth of the basins could be used to construct levees in this area to maximize storage and provide areas for intentional recharge. It is proposed that four cells be constructed based on the fall of the land, each cell storing water to a depth of 2 to 3 feet. This will also increase the utility of this area. **Figure 5** illustrates the proposed facilities of the Fresno Slough Bypass.

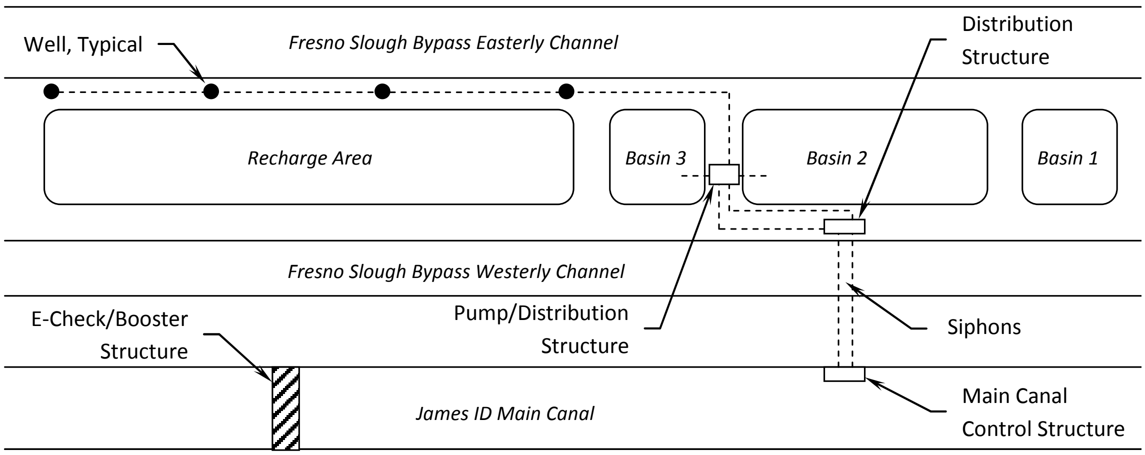

Figure 5. Overall Proposed Features in Fresno Slough Bypass Channel

Well locations

Well locations were based on many considerations. These included system limitations, water quality, and site availability. Overall, four locations were determined for well locations; 1) four in the Eastside Well Field, 2) four west of Colorado Ave, 3) four at the K Basin Recharge Facility, and 4) four at the proposed recharge facility (**Figure 6**).

Figure 6. Proposed Well Locations

The Eastside Well Field was chosen because the District has a right to pump water from this area at a flow rate of which they have not met yet; there was still enough available capacity to add the four wells. Another reason was that a utility company was installing a gas line through this area, causing the District to act quickly to get their needed infrastructure in place.

The area west of Colorado Avenue was chosen because of the fact that the District is limited to the amount of water that can be forced under the upstream highway. By placing wells here, more flexibility is provided to growers in this region.

The wells at K-Basin and the proposed recharge area in the Fresno Slough Bypass were chosen for the same reason; their location to a recharge facility. Water retrieved from here will be of better quality, require less energy to pump, and allow for banking opportunities in the future.

ENVIRONMENTAL AND CULTURAL ISSUES

With the majority of construction being in an environmentally friendly area, one of the first steps conducted by the District was a biological reconnaissance survey. Endangered species of note in this area consists of; San Joaquin Kit Fox, the Burrowing Owl, and the Fresno Kangaroo Rat. Once the survey was conducted, it was determined that the San Joaquin Kit Fox and the Burrowing Owl were present on site in the proposed recharge area. In addition to this, it was determined that wetlands existed on the site as well. Mitigation measures must be taken not to disturb any of these sensitive items.

Beyond the biological survey, a cultural survey was conducted as well. According to the database, the proposed site encompassed three artifact locations. Two of the three sites were found, and must also be mitigated for. Below (**Table 1**) is a summary of mitigation measures for both environmental and cultural issues.

Table 1. Summary of Issues with Mitigation Measures

Issue	**Mitigation Measure**
San Joaquin Kit Fox	Perform survey before construction, and check dens prior to flooding recharge area
Burrowing Owl	Cannot disturb during nesting period
Wetland	Replace any disturbed at a 3:1 ratio
Cultural Site	Cannot disturb with construction, but can flood site for groundwater recharge

Based on the California Environmental Quality Act (CEQA), environmental issues will be disclosed through the State Clearing House to obtain comments from agencies and other interested parties. It is proposed that a Mitigated Negative Declaration be used. Once circulated and comments are received, it is anticipated that numerous permits will be required. These permits consists of; the Army Corp 404 permit, the Department of Fish and Game 1600 Streambed Alteration Permit, and a Reclamation Board Encroachment Permit.

FUNDING

With the total cost of this project being nearly $10 million dollars, the District is searching for and utilizing grants and low interest loans to fund the construction. Thus far, the U.S. Bureau of Reclamation (USBR) has awarded to District $300,000 in their Water 2025 Challenge Grant Program, and is considering another $25,000 through the Water Conservation Field Services Program. In addition, funds from California Department of Water Resources (DWR) in the form of Local Groundwater Assistance Grants (AB303), and Proposition 82 loans will be used. **Table 2** provides a summary of present and future funding the District intends to pursue to fund portions of the overall project.

Table 2. Summary of Funding Opportunities Utilized by District

Funding Source	Project	Status
Water 2025 Challenge Grant	Turnout, Pipeline, Pumps and Basin Excavation	Awarded
Water Conservation Field Services Program Grant	Flow Control Gate at E-Check	Pending
Proposition 82 Loan	Well Construction and Equipping	Pending
Water for America Challenge Grant	Banking Expansion	Future
Local Groundwater Assistance Grant (AB303)	Well Location Investigation on Westside of District	Awarded

The grants alone have already provided nearly $400,000 to the project. While this is small compared to the overall cost, the District views the time applying for these grants as time well spent. The District plans to obtain the rest of the money for this project by increasing water rates and land assessments.

CURRENT STATUS AND CONCLUSION

As of early 2009, the project is making steady progress. Before the project can proceed much further, the funding issues must be resolved. James ID is in the process of outreach, educating growers, and getting feedback on the project. The CEQA process is being prepared, and is planned for circulation in the summer of 2009.

It is the goal of the District to start construction of the Fresno Slough Bypass Facilities next year. James Irrigation District anticipates that all facilities described in the proposed paper are operational prior to the 2011 irrigation season.

It is the opinion of the District that they are fortunate the water resources available to the District can be utilized to meet the irrigation demands of the District absent CVP supplies. By incorporating recharge facilities, the District can intentionally recharge flood waters so that mitigation of installing 16 new wells and the associated groundwater pumping is addressed. It should be noted that for long term sustainability, importation of surface supplies and CVP supplies is necessary. In this case it is expected that CVP supplies will be diverted only in wet years, and during drought years the system will be operated as described above.