Yolo County Flood Control & WCD
Flow Monitoring Network

2004 Water Use Efficiency Proposal Solicitation Package

Project Information Form

Applying for: ☐ Urban ☒ Agricultural

1. (Section A) **Urban or Agricultural Water Use Efficiency Implementation Project**
   - ☐ (a) implementation of Urban Best Management Practice, #_____
   - ☒ (b) implementation of Agricultural Efficient Water Management Practice, # 10 Water Measurement
   - ☒ (c) implementation of other projects to meet California Bay-Delta Program objectives, Targeted Benefit # or Quantifiable Objective #, if applicable TB#s 24,26,50,51
   - ☐ (d) Specify other: _____

2. (Section B) **Urban or Agricultural Research and Development; Feasibility Studies, Pilot, or Demonstration Projects; Training, Education or Public Information; Technical Assistance**
   - ☐ (e) research and development, feasibility studies, pilot, or demonstration projects
   - ☐ (f) training, education or public information programs with statewide application
   - ☐ (g) technical assistance
   - ☐ (h) other

3. Principal applicant (Organization or affiliation): Yolo County Flood Control and Water Conservation District

4. Project Title: Yolo County Flow Monitoring Network

5. Person authorized to sign and submit proposal and contract:

Name, title	Chris Barton, Assistant General Manager
Mailing address	34274 State Hwy 16
	Woodland, CA 95695
Telephone	530-662-0265
Fax.	530-662-4982
E-mail	cbarton@YCFCWCD.org

6. Contact person (if different):	Name, title.	Max Stevenson, Water Resources Associate
	Mailing address.	34274 State Hwy 16
		Woodland, CA 95695
	Telephone	530-662-0265
	Fax.	530-662-4982
	E-mail	mstevenson@YCFCWCD.org

7. Grant funds requested (dollar amount): *(from Table C-1, column VI)*	**$272,000**
8. Applicant funds pledged (dollar amount):	**$327,144**
9. Total project costs (dollar amount): *(from Table C-1, column IV, row n)*	**$599,144**
10. Percent of State share requested (%) *(from Table C-1)*	45%
11. Percent of local share as match (%) *(from Table C-1)*	55%
12. Is your project locally cost effective? *Locally cost effective means that the benefits to an entity (in dollar terms) of implementing a program exceed the costs of that program within the boundaries of that entity.* *(If yes, provide information that the project in addition to Bay-Delta benefit meets one of the following conditions: broad transferable benefits, overcome implementation barriers, or accelerate implementation.)*	☐ (a) yes ☒ (b) no

11. Is your project required by regulation, law or contract?
If no, your project is eligible.

If yes, your project may be eligible only if there will be accelerated implementation to fulfill a future requirement and is not currently required.

Provide a description of the regulation, law or contract and an explanation of why the project is not currently required.

- ☐ (a) yes
- ☒ (b) no

12. Duration of project (month/year to month/year):	Aug 2005 to Sept 2007 (depends on contract start date)
13. State Assembly District where the project is to be conducted:	08
14. State Senate District where the project is to be conducted:	05
15. Congressional district(s) where the project is to be conducted:	2
16. County where the project is to be conducted:	Yolo
17. Location of project (longitude and latitude)	38.75 North 122.0 West
18. How many service connections in your service area (urban)?	n/a
19. How many acre-feet of water per year does your agency serve?	~190,000 af/year

20. Type of applicant (select one):

- ☐ (a) City
- ☐ (b) County
- ☐ (c) City and County
- ☐ (d) Joint Powers Authority
- ☒ (e) Public Water District
- ☐ (f) Tribe
- ☐ (g) Non Profit Organization
- ☐ (h) University, College
- ☐ (i) State Agency
- ☐ (j) Federal Agency

❑ (k) Other

❑ (i) Investor-Owned Utility

❑ (ii) Incorporated Mutual Water Co.

❑ (iii) Specify _____

21. Is applicant a disadvantaged community? If 'yes' include annual median household income.

(Provide supporting documentation.)

❑ (a) yes, _____ median household income

☒ (b) no

2004 Water Use Efficiency Proposal Solicitation Package
Signature Page

By signing below, the official declares the following:

The truthfulness of all representations in the proposal;

The individual signing the form has the legal authority to submit the proposal on behalf of the applicant;

There is no pending litigation that may impact the financial condition of the applicant or its ability to complete the proposed project;

The individual signing the form read and understood the conflict of interest and confidentiality section and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant;

The applicant will comply with all terms and conditions identified in this PSP if selected for funding; and

The applicant has legal authority to enter into a contract with the State.

_____	Christy Barton, Assistant General Manager	1/11/05
Signature	Name and title	Date

Yolo County Flood Control & WCD
Flow Monitoring Network

Statement of Work
Section 1: Relevance and Importance (A-15c)

The Yolo County Flood Control and Water Conservation District (the District) proposes to modernize its flow measurement system through a network of electronic sensors. With average annual deliveries of 190,000 acre feet of water delivered through 200 miles of canals, many are 100-years old. The potential for increased water use efficiency, delivery flexibility and reliability is great. Yolo County produces approximately $300 million dollars of crops annually.

Currently, during the irrigation season, manual flow measurements are taken on a daily basis at 300 canal sites (from a possible 800 sites) in the District. Paper chart recorders, with a design first introduced in the 1930's, are used for continuous flow monitoring at five sites. Additionally, a 150 mile drainage network of sloughs, used as regional tail water return system, go essentially unmeasured.

The District proposes to create a modular network of 26 ultrasonic flow measurement stations that can be deployed at key canal and slough/drainage sites. These stations will be interchangeable and movable, enhancing flexibility, reliability, and cost efficiency. The flow data will be transmitted wirelessly to the central office through a long range Wi-Fi network. Parts of the regional Wi-Fi communications backbone are already complete and operational.

Currently, almost no flow measurements are taken during the winter months. With the Flow Monitoring Network, measurements at Network sites can be made continuously and year round, greatly increasing the accuracy of total flow and flood season measurements. Drain water flowing into the system during the irrigation season, also currently unmeasured, can be quantified. Carriage water, lost to District users, can also be quantified and better managed. According to USGS measurements on a main drainage slough, between 5,000 and 20,000 acre feet of water leave the District each irrigation season (in that location).

The District requests $272,000 to purchase electronics, power supplies, and enclosures for up to 26 flow measurement sites. The total project cost is approximately $599,144. Flow site installation, maintenance, data management, and data quality control will be paid for by the district. The cost share of this project by the District will be approximately 55 percent.

In addition to indirect effects on CALFED Targeted Benefits # 20, 24, 26, 50, and 51, this project will implement components of Efficient Water Management Practices (EWMP), namely Flow Measurement, as described by CALFED's Independent Panel on Appropriate Measurement of Agricultural Water Use (Sept. 2003)

Consistency with local or regional water management plans.
The District currently uses a Water Management Plan (WMP2000) developed in the year 2000. The District is in the process of updating the WMP2000, with significant expansion of the workplan.

The measurement of flow in the sloughs/drains is a workplan item in the WMP2000, partially implemented by a contract with the USGS. The USGS is measuring flows once per week in three slough/drain areas. However, it is not known how much of that water is carriage water from District canals, runoff from fields supplied by district water, runoff from fields supplied by wells, and/or natural flows from groundwater or other sources. With the proposed electronic flow monitoring, we can begin to answer these questions. Additionally, instantaneous weekly measurements by the USGS cannot give accurate total flows due the wide variability in flow rates. With this project we can continuously monitor flows in the slough/drain areas, along with the rest of the District's system.

Relationship to existing water management activities or initiate new ones.
Four new District initiatives are directly related to the proposed Flow Monitoring Network. They include: upgrading and expanding the District's data management system, developing an Integrated Ground and Surface Water Model for the Cache Creek region (with built-in expansion abilities for the entire County), an ambitious Conjunctive Use Plan to provide in-lieu groundwater recharge, and the development of a District-wide water balance model. Each of these initiatives requires good flow data, which the proposed Flow Monitoring Network can begin to provide.

Water demand management activities.
The District provides information to water users and the community at large through the following activities:

1. Quarterly newsletter
2. Annual water users meetings
3. Presentations at outreach field meetings (2-3x per year)
4. Direct monetary support for the local Resource Conservation District and in-kind support for the Mobile Irrigation Lab testing service.
5. California Irrigation Institute support (staff is on the board)

Statement of Work
Section 2: Technical/Scientific Merit (A-15d)

Existing Flow Measurement Program
Current District operations include *manual* flow measurements taken at more than 800 sites, with up to 300 visited each day. Many of these sites are farm turnouts and measurements are taken for billing purposes. We do not plan to automate the measurement of farm level turnouts. We do plan to automate and upgrade the measurement of flow in our main canals and sloughs/drains.

All flow measurements and gate changes are recorded on laptop computers in the field by District ditchtenders. At the end of each day, data is downloaded ("synched") at the District's office. All data is recorded into a data management system called STORM. The main purpose of "synching" data is to record water deliveries for billing purposes, and to give each ditchtender the following day's water orders. Estimates of drainage water returning to the delivery system are recorded. These estimates are used when

reporting for water rights reuse and conservation and are an important component of District operations.

Map of flow measurement locations
On the attached folded map, all structures with measurement capabilities are labeled. The black smaller symbols are farm turnouts, which will not be automated.

The red colored symbols represent priority measurement sites for automation and fall into 3 categories:

1. Canal headings
2. Spills (at canal termini)
3. Sloughs/drains

Measurements at canal headings represent the amount of water flowing into and through the District's delivery system. Measurement at spills represents extra (or carriage) water delivered to the system, but not delivered to farms and "spilled" at the end of each canal. Some spill is an intentional part of current system design and operation. Flow in sloughs/drains represents mostly runoff from on-farm irrigation, with additional contributions from District spill.

By measuring flow at these three areas (canal headings, spill, and sloughs/drains), a mass balance approach can answer the following questions:

1. How much water is lost to District users through operational spills?
2. How much water enters the District delivery system as runoff from farm fields (drains into the canals)?
3. How much water is lost in each canal reach (through seepage and spill)?
4. Conversely, how much water is gained in each canal reach (from drainage inflow and from groundwater?)
5. How much water is sent to downstream users through the slough/drain system?
6. How much water is lost to seepage (and therefore recoverable as groundwater recharge) in the upper reaches of the canal system?
7. On an hourly basis, how much water is entering the canal system, and how does this input compare to expected water deliveries for that day (daily O&M)?

The map shows all of the District's priority sites for flow measurement. However, we are only asking for funding for 26 sites. These 26 sites are the first phase of automation, with many more sites planned in the years to come.

Why measure flow now?
It seems as though the District should already be able to answer the preceding basic questions regarding gains and losses to the system. However, the District deliveries have been in equilibrium with losses and gains from inflow drainage (and other sources) for many decades. Measurements of deliveries for billing purposes, and measurement of diversions for storage management have been the priority. Flow measurement in the sloughs/drains, and continuous flow measurements in canal headings and spills have not been needed.

But today and in the future, we must manage water resources more efficiently: for on-farm water users, for indirect users of District through groundwater recharge, and for environmental uses of water. The proposed flow monitoring network can begin to accurately quantify the uses, losses, and gains of District water.

Converting existing structures to automated flow measurement

Most of the manual measurements currently performed on the canals can be retrofitted to automated measurements by duplicating the manual measurements a person would make. With the use of a non-contact ultrasonic water level sensor connected to a small computer, power supply, solar panel, battery, radio, and antennae, water level data can be automatically collected, and then converted to flow. The relationship between flow and water level depends on the type of canal structure being used; however, all water level/ flow relationships have already been completed for all structures in the District. We may recreate some of these relationships if old equations are found to be inaccurate. In some cases, two sensors will be needed to record the water level difference between the opposite sides of a structure. In other cases, the degree of opening or closing of a structure will also need to be recorded. The measurement of the opening or closing may be automated with a sensor, but in some cases that data will be taken from the District's data management system (called STORM), where all gate changes and adjustments are manually recorded when the changes are made.

Non-contact ultrasonic sensors are important, as the non-contact aspect reduces fouling from algae growth, sedimentation, and floating trash, significantly reducing maintenance costs.

Typical Retrofit Installations

Photo 2 shows some typical structures found in our District, and mounting locations of a typical water level sensor. The sensor is bolted onto the side of a structure with a metal bracket, as shown in the bracket and sensor schematic in Figure 1. These sensors are rugged, industry tested units with an excellent track record for reliability and accuracy.

Wireless transmission of data

Flow data will be wirelessly transmitted directly to the District office. This wireless data transmission system will be in the 900Mhz band, using the WiFi-max (also called Wi-max) protocol (IEEE 802.16) and will use standard Ethernet and TCP/IP. The maximum range of this technology is about 30 miles.

Our currently installed WiFi-max system will be used for dam control and remote video surveillance. The data transmission backbone for our new flow monitoring network will be integrated into the current dam and video surveillance system. Off-the-shelf technology can bridge the two systems (for example, the MDS iNet 900 unit).

Hardware and installation details

The District requests funding to purchase the hardware for 26 flow measurement sites. The District will pay for installation, maintenance, the wireless data transmission backbone, data processing, and quality control.

The core components of a flow measurement site include water level sensor, computer/processor, radio, and power supply. These core components are outlined in Table 1. and depicted in the Photo . A detailed list of all parts needed for a flow measurement site is included in Table 2.

Table 1. Basic component list for a flow monitoring site, the photo below, monitoring in a pond, shows all basic components in use.

Name	Model	Use
Ultrasonic water level sensor	Milltronics “Probe” standard and extended range, two wire versions	Measure water level (then convert to flow with known relationship)
WiFi internet radio	MDS iNET 900	Wireless communication with network
Solar Panel	BP 380	To charge battery
Computer/Controller	Momentum M1E series with Modicon modules	To collect and send data
Battery	~50 ah 12V sealed lead acid deep cycle battery	Power for low light conditions
Antennae	Small form factor directional Yagi	To transmit data
Mast	Stock metal pipe (8-10 feet)	To hold solar panel and antennae

Photo 1. This photo features at typical measurement station, that is measuring water level in a pond in Australia. All basic components are shown: ultrasonic transducer/sensor (on left of structure aiming at water), enclosure with computer, radio, and battery (box halfway up mast), and mast supporting solar panel and antennae. Unlike this station, which has its own dedicated structure, proposed flow measurement stations will be mounted on existing structures, as depicted in Photo 1.

Photo 2. Three typical District canal structures that can be retrofit with ultrasonic transducer water level measurement devices. Approximate mounting positions of the transducer/sensor are shown.

TYPICAL TRANSDUCER
INSTALLATION LOCATIONS

Photo 1

Figure 1. Schematic of the bracket and ultrasonic transducer/sensor for measuring water levels.

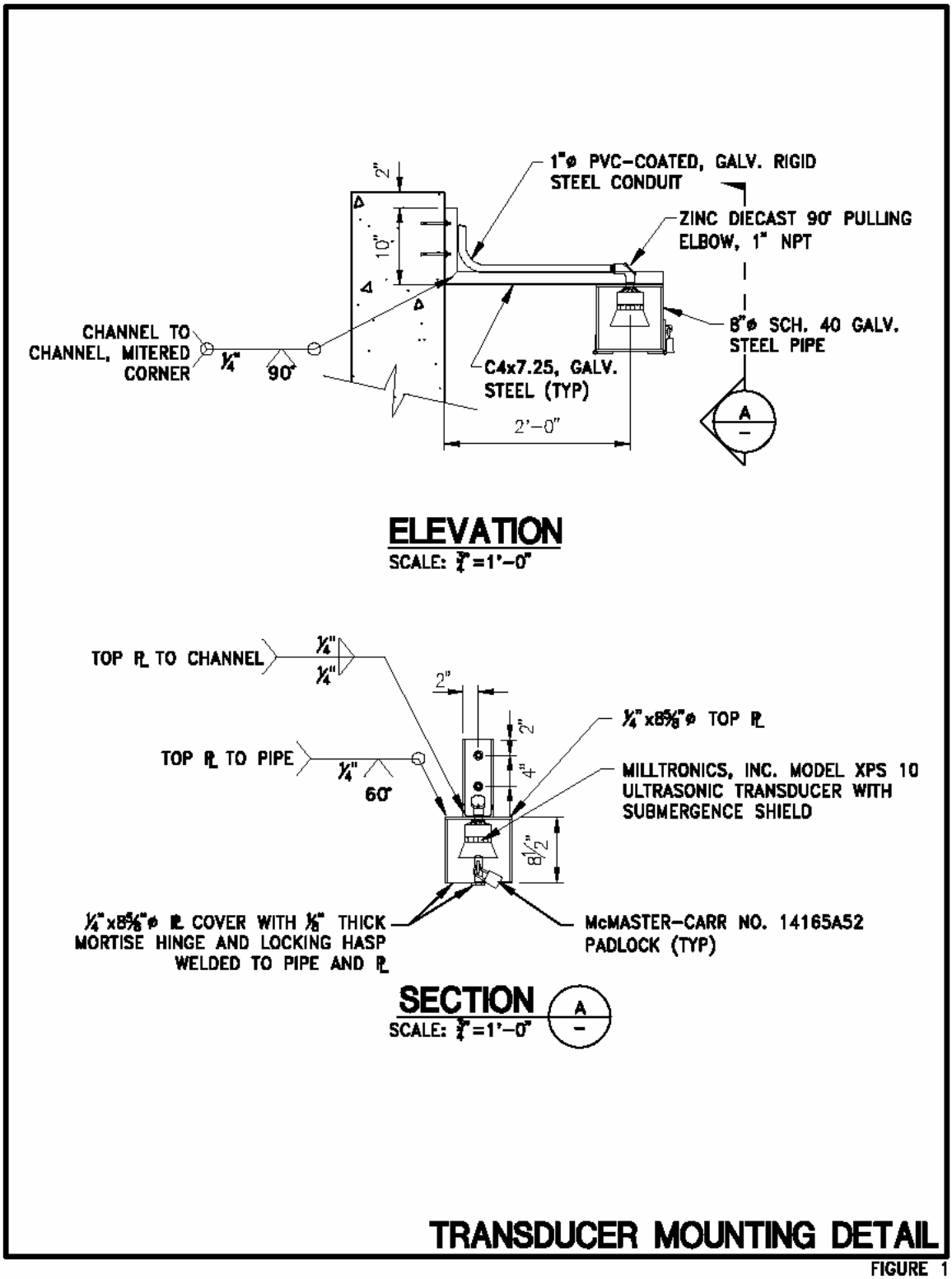


Table 2. Detailed parts specification for a flow monitoring site.

	Monitoring Panel Components			
Item	**Description**	**Qty**	**Per Unit**	**Extended**
1	Nema 4 Enclosure, Hoffman 36" x 30" x 8"	1	$1,130.00	$1,130.00
2	Enclosure backplate, Hoffman	1	$ 112.00	$ 112.00
3	Processor , Modicon 171 CCC 760 10	1	$ 575.00	$ 575.00
4	Communication adapter, Modicon 170 JNN 210 32	1	$ 160.00	$ 160.00
5	Momentum Base, 4 AI, 2 AO, 4 DI, 2 Do, Modicon 170 AMM 090 00	1	$ 620.00	$ 620.00
6	Module screw terminals, Modicon 170 XTS 001 00	1	$ 35.00	$ 35.00
7	Solar panels, 83 W, 12 VDC, Solarex MXS-83	2	$ 420.00	$ 840.00
8	Solar voltage regulator, SCI ASC 12/8A	2	$ 55.00	$ 110.00
9	Gell cell battery 54 amp-hour, Dynasty	1	$ 165.00	$ 165.00
10	12 VDC/24 VDC converter, Vicor	1	$ 175.00	$ 175.00
11	Low Voltage Disconnect, Time Mark Corp.	1	$ 95.00	$ 95.00
12	Low Voltage Disconnect Base, Time Mark Corp.	1	$ 7.50	$ 7.50
13	Fuse terminals, Allen Bradley	20	$ 9.38	$ 187.50
14	Fuse terminals end plate , Allen Bradley	3	$ 0.88	$ 2.63
15	Fuse terminals jumper bar, Allen Bradley	2	$ 3.75	$ 7.50
16	Feed through terminals, Allen Bradley	40	$ 2.13	$ 85.00
17	Feed thru terminals end plate , Allen Bradley	5	$ 0.88	$ 4.38
18	Feed thru terminals jumper bar , Allen Bradley	3	$ 7.13	$ 21.38
19	Feed thru terminals jumper bar , Allen Bradley	8	$ 1.81	$ 14.50
20	Disconnect terminals, Allen Bradley	3	$ 5.63	$ 16.88
21	Ground terminals, Allen Bradley	5	$ 6.38	$ 31.88
22	Terminal strip, Allen Bradley	1	$ 8.75	$ 8.75
23	Terminal end barrier, Allen Bradley	6	$ 1.19	$ 7.13
24	Wire duct, Panduit	0.5	$ 200.00	$ 100.00
25	Wire duct cover, Panduit	0.5	$ 50.00	$ 25.00
26	Panel ground bar	1	$ 12.50	$ 12.50
27	Analog surge protector, Weidmuller	2	$ 115.88	$ 231.75
28	Precision resistors, Dale RS-2B 3w 250 ohms, 0.1%	3	$ 3.75	$ 11.25
29	Precision resistors, Dale RS-2B 3w 30k ohms, 0.1%	1	$ 3.75	$ 3.75
30	Precision resistors, Dale RS-2B 3w 10k ohms, 0.1%	1	$ 3.75	$ 3.75
31	Panel door switch, Allen Bradley	1	$ 100.00	$ 100.00
32	Field junction box, Hoffman	1	$ 50.00	$ 50.00
33	Field junction box back plate , Hoffman	1	$ 2.50	$ 2.50
34	Wire as illustrated on the drawings	1	$ 200.00	$ 200.00
35	Panel Construction	24	$ 50.00	$1,200.00
			Subtotal	$ 6,352.50

Table 2. continued...

	Radio Communication Components			
Item	**Description**	**Qty**	**Per Unit**	**Extended**
1	900 MHz Ethernet remote radio, MDS iNet	1	$1,654.00	$1,654.00
2	Superflex jumper cable, Andrews	1	$ 70.00	$ 70.00
3	Lightning protector, Polyphaser	1	$ 75.00	$ 75.00
4	Superflex 1/2" cable, Andrews	30	$ 2.55	$ 76.50
5	Yagi antenna, Scala	1	$ 150.00	$ 150.00
6	Antenna pole mount	1	$ 47.00	$ 47.00
			Subtotal	$ 2,072.50
	Level Transmitter			
Item	**Description**	**Qty**	**Per Unit**	**Extended**
1	Ultrasonic level transmitter, with bracket, Milltronics	1	$1,125.00	$1,125.00
			Subtotal	$ 1,125.00
	Miscellaneous			
Item	**Description**	**Qty**	**Per Unit**	**Extended**
1	Solar panel pole mounting hardware	2	$ 85.00	$ 170.00
2	Bird spike kit	2	$ 47.00	$ 94.00
			Subtotal	$ 264.00
	Installation			
Item	**Description**	**Qty**	**Per Unit**	**Extended**
1	Outer security/vandalism enclosure for control panel	0	$ -	$ -
2	PLC program development costs	0	$ -	$ -
3	Site monitoring application development costs	0	$ -	$ -
4	Site commissioning/configuration costs	0	$ -	$ -
5	Pole/Mast for solar panels and antenna	0	$ -	$ -
6	Installation of control panel, mast, antenna, solar panels	0	$ -	$ -
7	Taxes	0	$ -	$ -
8	Shipping	0	$ -	$ -
			Subtotal	$ -
			TOTAL ESTIMATE	$ 9,814.00

Task List and Schedule

The implementation schedule for this project has been divided into two phases. During the first phase, one half the sites will be installed. Information gained from installing the first sites will be used to guide the installation of the final sites. A task list and schedule is included in Table 3 below. The project will span 2 years.

Table 3. Task list and schedule.

Task	Begin date	End date
1. Survey first 13 sites and prepare for installation of flow measurement units (cost: $8450 or $650/site)	Within one week of contract signing	Within one month of start
2. Purchase materials and equipment for all 26 sites (cost: $255,000 or $9,800 per site)	Within one month of contract signing	Within 24 months of contract signing
3. Hire contractors to install instrumentation	Within one month of contract signing	n/a
4. Install first set of 13 sites (cost: $104,000 or $8,000 per site)	Within 2 months of contract signing	Within 10 months of contract signing
5. Write and submit quarterly progress reports (cost $1075 each)	Quarterly	Quarterly
6. Test and evaluate data collected for first set of sites (cost: $3,000)	Within one month of installation	Within 2 months of installation
7. Survey second set of 13 sites and prepare for installation of flow measurement units (cost: $8450 or $650/site)	Within 12 months of contract signing	Within 14 months of contract signing
8. Install second set of 13 sites (cost: $104,000 or $8,000 per site)	Within 6 months of contract signing	Within 20 months of contract signing
9. Test and evaluate data collected for second set of sites (cost: $2,500)	Within one month of installation	Within 2 months of installation
10. Compare old manual data to new automated data (cost: $4,000)	Within 6 months of signing of contract	Within 24 months of signing of contract
11. Write and submit final report (cost: $6,000)	Within 11 months of signing of contract	Within 24 months of signing of contract
12. Write and submit annual reports for 5 years post project (4 reports total cost: $6,000 or $1,500/report)	Annually	Annually

Future Automated Water Quality Measurements
Each flow measurement site will have the ability to add additional sensors to the monitoring panel. Two or three sensors can be added in the future, such as temperature, EC (electrical conductivity), and turbidity. Temperature is important as it is related to dissolved oxygen, a critical fish parameter. EC can give an indication of the percentage of drainage water entering the delivery system; and turbidity can indicate sediment load, also critical for habitat and canal system maintenance. Sediment monitoring may also be critical for future conjunctive use, groundwater recharge, and mercury studies.

Certification Statements
Certification statements for plans are not included as this proposal is not a construction project. All flow measurement equipment will be retrofit to existing structures.

Environmental Documentation
A completed (CEQA) Environmental Impact Checklist has been attached.
The proposed work is not a "project" under CEQA. Please see the CEQA checklist for details.

Statement of Work
Section 3: Monitoring and Assessment (A-15e)

Baseline data on flow conditions consists mostly of daily manual on-farm level water delivery measurements. Quantities of water reused in the District system, used by downstream users, and used by the environment are currently not regularly quantified.

Current algorithms are used to calculate customer delivery totals. These algorithms will be modified to calculate flow totals as described in table 4.

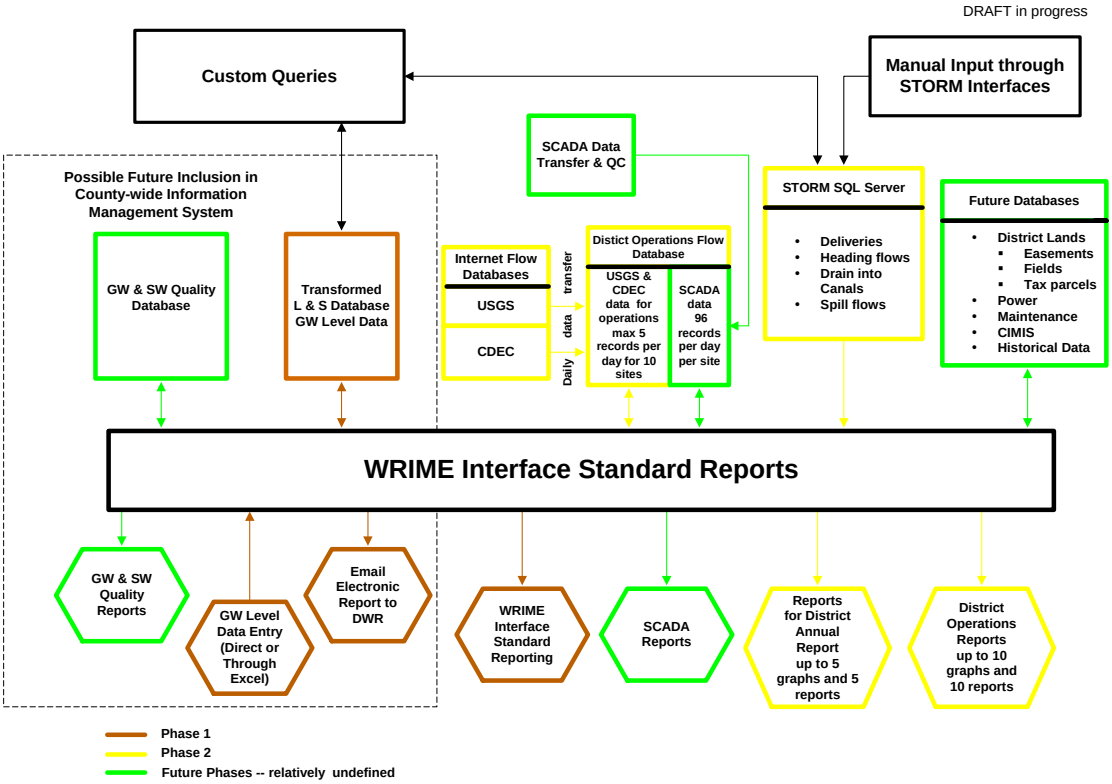
Table 4. Baseline versus proposed data collection.

Calculated value	Currently calculated/measured?	Proposed to calculated/measured?
Total water delivered to lateral canal headings	Measured once per day, assumed constant	Measure continuously
Total water entering canals (delivered and drainage flows)	Currently not measured	Measure continuously
Water leaving District canals as spill	Currently measured daily	Measure continuously
Water leaving District in sloughs/drains	Measured weekly by USGS	Measure continuously
Total water reused in the system (amount of drain water delivered back to users)	Currently estimated	Measure continuously and calculate amount of water reused
Timing and quantity of flows in the sloughs/drains (for both on-farm and environmental uses)	Currently not measured or calculated (except as included by weekly USGS measurements)	Measure continuously to characterize slough/drain flow in specific areas
Total water lost to seepage	Currently not measured or calculated	Calculated losses in the first 4 to 8 miles of main canal

Monitoring methodologies, data collection, and public access to data

The District is currently upgrading its data management system. The District has hired a consultant to integrate current in-house databases, including Access and STORM files, into one SQL based interface. Custom data input forms and reports will be included with this work. Data from the proposed Flow Monitoring Network, along with reporting to DWR, will be incorporated into the new database management system. The District is devoting considerable resources toward this effort, but the workplan is not yet complete. A schematic of the proposed data structure is below in Figure 2.

Figure 2. Preliminary Information Management Structure for YCFC&WCD



Evaluation of project goal and objectives

Project goals, objectives, and implementation will be tracked by number of flow monitoring sites installed and the number of questions answered from Table 4, page 17.

The most important goal of the project is how the flow data will be used. The Costs and Benefits section best describes how the data will be used. Please refer to the Costs and Benefits section to evaluate project goals and objectives.

External factors

In some drought years the District restricts or allocates water and may not have adequate supplies for all crops or fields needing surface water. This occurs every 10 to 15 years. During these drought years, local farmers pump groundwater for irrigation. Additionally, there are many farmers not adjacent to District who utilize groundwater

pumping for irrigation. Therefore, there will still be some flows in the slough/drain system from farm runoff, even during drought. Since each flow monitoring station is standardized, idle stations can be moved, as needed, to better use at measuring slough/drain flows more completely.

Costs of evaluation plan
The estimated costs associated with the implementation of the monitoring and evaluation plan are listed in Table C-1.

Qualifications of the Applicants and Cooperators

The project manager will be Max Stevenson, Water Resources Associate for the District. He has more than 10 years experience in automated data collection devices and database management. His resume is attached. Project guidance will also be provided by the District's General Manager, Tim O'Halloran, an engineer with over 20 years experience in the irrigation field. His resume is also attached.

The Yolo Resource Conservation District's Mobile Lab irrigation testing service will conduct 5-10 interviews of slough/drain water users. This information will help the District characterize slough/drain water use. The District knows that this slough/drain water is important on many farms, but has few details on the user's needs for quality, reliability, and quantity of slough/drain water. When the Mobile Lab service visits farms that use slough/drain water, a questionnaire will be used to answer these questions. This questionnaire will be developed jointly by District and RCD staff.

The Yolo RCD Mobile Lab irrigation testing service is also applying for Prop 50 WUE funds.

Additional external cooperators and interested public are described in the next section.

Outreach, Community Involvement, and Acceptance (A-15g)

Water Management Plan Update
The proposed Flow Monitoring Network will be an integral part of District activities. As mentioned previously, the District is in the process of updating its WMP2000. The intent is to be compliant with both AB3030 and SB1938. For purposes of the District's Water Management Plan Update, the overall public involvement and outreach program would include discrete outreach elements. In view of the composition of the District and interested stakeholders, the services of a professional facilitator are deemed appropriate for some elements of the program. The program would, of necessity, have to be carefully designed to accommodate the following:

a) Public Hearings
b) Public Meetings
c) Sub-basin Meetings
d) Technical Advisory Committee Meetings

Integrated Regional Water Management Plan (IRWMP)
Additionally, the District is a participant in the Water Resources Association of Yolo County (WRA). This regional planning group is a non-profit mutual benefit corporation. The WRA Board of Directors consists of representatives from the cities of Davis, Woodland, and Winters; the University of California at Davis; County of Yolo; Dunnigan Water District and the Yolo County Flood Control and Water Conservation District. The WRA was organized to coordinate implementation of the Water Resources Management Program as identified in the Yolo County Water Plan Update (1992).

Currently, the WRA is preparing an updated Integrated Regional Water Management Plan (IRWMP), funded in part by the California Department of Water Resources (DWR). The District's Water Management Plan Update is a major component of the IRWMP. District plans and activities are known by WRA members and the made available to interested public. Activities and plans made by the District are openly made and consider all stakeholders. Input from all parties is actively solicited through the WRA, at District Board meetings, and in the future through outreach meetings as mentioned previously.

Innovation (A-15h)

Wi-Fi Max
The Wi-Fi Max wireless data communications network we propose to use is fast becoming an industry standard for factories, refineries, and rural ISPs (internet service providers). However, to our knowledge, this technology has not yet been used extensively for monitoring surface water deliveries and drainage of an irrigation district. Because of the standard interfaces used (Ethernet/IP) and the infinite scalability of the system, we believe the Wi-Fi Max system to be an ideal solution for irrigation districts throughout California.

Flow monitoring station standardization
We propose to standardize the components of our flow monitoring stations. In this regard, we can move expensive electronic components to new sites, if an older site is already characterized, or for some reason the site becomes inappropriate for measurement. For example, in the sloughs/drains of the District, more than 100 miles of sloughs/drains are still in the process of being mapped. Farmer made diversions are installed or removed. Beavers, vegetative growth, and natural erosion or other changes in channel morphology dramatically alter flow patterns. Since these changes cannot be known (they are always changing) it is logical to create measurement devices that can be moved to areas of best use. We believe the standardization of a modular, movable system of wireless measurement devices can be of benefit to other irrigation and drainage districts. Currently there is no standard of this type.

Benefits and Costs (A-15i)

Bay-Delta Benefits

The focus of the proposed Flow Monitoring Network is to provide flow data to address indirect in-stream flow and timing, and water quality benefits to the Bay-Delta System. These benefits include Targeted Benefits # 20, 24, 26, 50 and 51.

Although Target Benefits are a main focus of the project, CALFED's goals of appropriate measurement, as described by CALFED's Independent Panel on Appropriate Measurement of Agricultural Water Use (Sept. 2003) will also be specifically addressed by the proposed Flow Monitoring Network.

Indirect Benefit to TB #20

TB #20	Sacramento River below Keswick	Provide flow to improve ecosystem conditions

In 1994 the District applied for the appropriation of 45,000 acre feet of Sacramento River water on behalf of the District and cities within Yolo County. With the proposed Flow Monitoring Network, greater water use efficiency can be achieved, reducing future demands on Sacramento River Water.

Indirect Benefit to TB# 24

TB #24	Colusa Basin	Reduce salinity to improve water quality for Ag and M&I

Also in 1994, the District studied the feasibility of appropriating winter flows in the Colusa Basin Drain. Recently (2002) The District has completed a comprehensive feasibility study for Conjunctive Water Use to the Yolo-Zamora areas north of the District boundary and south of the Colusa Basin Drain. One alternative studied includes the surface storage of winter Colusa Basin Drain water. This water could be re-released into the Drain, to reduce salinity and improve water quality for M&I uses. This could only be done with increased efficiency of current water supplies. The proposed Flow Monitoring Network can help increase efficiency and reduce demands on developing new water supplies. This would leave water available to "freshen" the Colusa basin Drain water.

Indirect Benefit to TB# 26 and # 51

TB # 26 and TB # 51	All suitable lands	Provide long-term water management flexibility to increase the water supply for beneficial uses (Eco, Ag, M&I) Enhance the effectiveness of potential conjunctive use programs by reducing flows to groundwater during periods of shortage; and increasing flows to groundwater during periods of excess.

The District has recently implemented a comprehensive AB303 groundwater monitoring program for Yolo County. Additionally, we are developing an Integrated Ground Water

and Surface Water Model (IGSM) for the Cache Creek region. By complimenting these efforts with surface flow data from the proposed Flow Monitoring Network, potential conjunctive use programs can be enhanced as described in TB # 26 and #51. For example, our unlined canals could be filled with water, even when deliveries are not ordered, in order to recharge the aquifer. We would need accurate flow measurements to determine the effectiveness of this operation.

Indirect Benefit to TB # 50

TB # 50	Cache & Putah Creeks	Provide flow to improve ecosystem conditions More closely emulate natural seasonal patterns in Cache and Putah Creeks by providing additional flows, when available from existing water supplies. Flows in the Yolo Bypass would be supplemented, as needed, by the Colusa basin drain through the Knights Landing Ridge Cut Canal, extending the Tehama-Colusa Canal, and the Sacramento River through the Fremont weir. Supplemental flows may be needed in fall if water temperature and flow in the lower Yolo Bypass are insufficient for passage from Cache Slough to upstream areas in the Sacramento River. Supplemental flows may be needed in winter and spring to sustain downstream migrating juvenile salmon and steelhead on their journey through the Yolo Bypass to the Delta. Supplemental flows would be needed along with irrigation water from spring to fall to sustain native fish, wetlands, and riparian habitats in channel sloughs of the Yolo Bypass.

One of the main purposes of the Flow Monitoring Network is to characterize District operations, so that future changes in operation can be best used to benefit water users and the environment. For example, during the summer time Cache Creek is usually dry below our Capay Diversion Dam. However, one of our canals actually crosses the dry creek bed about 11 miles downstream of the diversion dam. It may be possible to use the creek bed itself for conveyance to the canal crossing. This would provide an additional 11 miles of riparian habitat along Cache Creek. However, without knowing exactly how much water is needed for this operation, we cannot plan for it. The proposed Flow Monitoring Network could eventually provide data to answer this type of question. Other uses of the Flow Monitoring Network include managing winter flows, currently not measured, for the best use in Cache Creek and the Yolo Bypass.

Local benefits

The local benefits are divided into two types: quantifiable (Table 5) and non-quantifiable (Table 6).

Table 5. Local, quantifiable benefits

#	**Local Quantifiable Benefits**
1.	**Water savings from reduced spill.** Although no changes in District operations are planned, by measuring flows more accurately in the delivery canals, it is possible to reduce excess spill. We estimate that these savings could be up to 1,900 acre feet per year (or 1% of total deliveries). Dollar value of this amount of water is approximately $26,600. However, no changes in District operations will be made without further study.
2.	**Water savings from reduced runoff.** The USGS measurements in the sloughs/drains shows that 4,000 to 20,000 acre feet are lost to District users each irrigation season. This represents a large potential savings. However, more accurate and complete data must be collected before any changes to District operations can be made. Effects on downstream users within and outside the District, effects on riparian habitat, and effects on groundwater must all be considered. A conservative estimate of savings at

	$14/af totals $56,000. This value is not included in table C-5 as no changes to District operation will be made at this time.
3.	**Remote synching of ditchtender data**. At the end of each day, ditchtenders must return to the office to download, or synch, their laptops with the central office database. With the proposed flow monitoring network, remote synching may be possible in the field, saving approximately one hour per day. This may sum to $17,360 per year.

Table 6. Local, non-quantifiable benefits

#	**Local non-Quantifiable Benefits**
1.	**Information on slough and tailwater** used both for environmental uses and by downstream water users can assist in planning operational changes to increase efficiency and reliability of water supplies.
2.	**Provide baseline data** for the planned and funded development of a Cache Creek Integrated Ground and Surface Water Model (IGSM)
3.	**Possible use in flood control operations**. With knowledge of real time flows, some flows can be redirected into neighboring canals, distributing flows more evenly and lessening local flooding
4.	Excess bandwidth form the WiFi-Max network can be used **to provide rural ISP service**
5.	Flow measurement devices can be set to detect and give **alarms in the case of catastrophic failure**, such as a canal break. This can provide greater safety for neighboring rural residents and can save spilled water by reducing reaction time.
6.	**Spills onto local highways** can be more quickly and easily detected, increasing responsiveness to problems on local roads.

Relative balance between Bay-Delta system and local benefits

As expressed in the PSP, it is difficult to assign local versus Statewide benefits to any project, yet especially so for our proposed Flow Monitoring Network. Although the Network will implement updated flow measurement technologies, that will become part of the District's infrastructure, the project is designed to collect data that has never been collected before. Therefore, we do not know all, or any, of the possible benefits to in-stream flow, timing, water quality to the Bay-Delta system.

The quantifiable local benefits amount to only 11% of project costs (Table C-7), but we feel this is an unrealistic description of the local benefits. Therefore, we have taken a more realistic approach of 55/45 cost share for this project. The District will pay for 55% of the project, while asking the State for 45%. We feel that this more closely approximates local versus Bay-Delta system benefits.

Project Costs (Budget)

Table C-1 explanations

(a) Salaries and fringe benefits- are for 25% time of the Water Resources Associate, who will manage installation of the network, and analyze data collected by the Network.

(b) Planning- costs are to cover site visits.

(d) Materials and Installation- will cover the equipment purchases and installation for the 26 flow monitoring sites. This is the major cost category for this project.

(e) Implementation Verification- costs will cover additional work on analyzing data.

(l) Monitoring and Assessment- costs will cover development of automated data reports from our data management system.

(m) Report Preparation- costs will cover project reporting costs.

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Section A projects must complete Life of investment, column VII and Capital Recovery Factor Column VIII. Do not use 0.

Table C-1: Project Costs (Budget) in Dollars)

	Category (I)	Project Costs $ (II)	Contingency % (ex. 5 or 10) (III)	Project Cost + Contingency $ (IV)	Applicant Share $ (V)	State Share Grant $ (VI)	Life of investment (years) (VII	Capital Recovery Factor (VIII)	Annualized Costs $ (IX)
	Administration[1]								
	Salaries, wages	$16,600	0	$16,600	$16,600	$0	1	1.0600	$17,596
	Fringe benefits	$4,980	0	$4,980	$4,980	$0	1	1.0600	$5,279
	Supplies	$0	0	$0	$0	$0	0	0.0000	$0
	Equipment	$0	0	$0	$0	$0	0	0.0000	$0
	Consulting services	$0	0	$0	$0	$0	0	0.0000	$0
	Travel	$0	0	$0	$0	$0	0	0.0000	$0
	Other	$0	0	$0	$0	$0	0	0.0000	$0
(a)	Total Administration Costs	$21,580		$21,580	$21,580	$0			$22,875
(b)	Planning/Design/Engineering	$8,632	0	$8,632	$8,632	$0	0	0.0000	$0
(c)	Equipment Purchases/Rentals/Rebates/Vouchers	$0	0	$0	$0	$0	10	0.0000	$0
(d)	Materials/Installation/Implementation	$544,000	0	$544,000	$272,000	$272,000	10	0.1359	$73,930
(e)	Implementation Verification	$8,632	0	$8,632	$8,632	$0	0	0.0000	$0
(f)	Project Legal/License Fees	$0	0	$0	$0	$0	0	0.0000	$0
(g)	Structures	$0	0	$0	$0	$0	0	0.0000	$0
(h)	Land Purchase/Easement	$0	0	$0	$0	$0	0	0.0000	$0
(i)	Environmental Compliance/Mitigation/Enhancement	$0	0	$0	$0	$0	0	0.0000	$0
(j)	Construction	$0	0	$0	$0	$0	0	0.0000	$0
(k)	Other (Specify)	$0	0	$0	$0	$0	0	0.0000	$0
(l)	Monitoring and Assessment	$10,000	0	$10,000	$10,000	$0	1	1.0600	$10,600
(m)	Report Preparation	$6,000	5	$6,300	$6,300	$0	1	1.0600	$6,678
(n)	**TOTAL**	$598,844		$599,144	$327,144	$272,000			$114,082
(o)	Cost Share -Percentage				55	45			

1- excludes administration O&M.

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Table C-2: Annual Operations and Maintenance Costs

Operations (1) (I)	Maintenance (II)	Other (III)	Total (IV) (I + II + II)
$25,000	$19,000	$0	$44,000

(1) Include annual O & M administration costs here.

Table C-3: Total Annual Project Costs

Annual Project Costs (1) (I)	Annual O&M Costs (2) (II)	Total Annual Project Costs (III) (I + II)
$114,082	$44,000	$158,082

(1) From Table C-1, row (n) column (IX)
(2) From Table C-2, column (IV)

Table C- 4: Capital Recovery Table (1)

Life of Project (in years)	Capital Recovery Factor
1	1.0600
2	0.5454
3	0.3741
4	0.2886
5	0.2374
6	0.2034
7	0.1791
8	0.1610
9	0.1470
10	0.1359
11	0.1268
12	0.1193
13	0.1130
14	0.1076
15	0.1030
16	0.0990
17	0.0954
18	0.0924
19	0.0896
20	0.0872
21	0.0850
22	0.0830
23	0.0813
24	0.0797
25	0.0782
26	0.0769
27	0.0757
28	0.0746
29	0.0736
30	0.0726
31	0.0718
32	0.0710
33	0.0703
34	0.0696
35	0.0690
36	0.0684
37	0.0679
38	0.0674
39	0.0669
40	0.0665
41	0.0661
42	0.0657
43	0.0653
44	0.0650
45	0.0647
46	0.0644
47	0.0641
48	0.0639
49	0.0637
50	0.0634

(1) Based on 6% discount rate.

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Table C-5 Project Annual Physical Benefits (Quantitative and Qualitative Description of Benefits)

	Qualitative Description - Required of all applicants[1]				**Quantitative Benefits - where data are available [2]**
	Description of physical benefits (in-stream flow and timing, water quantity and water quality) for:	Time pattern and Location of Benefit	Project Life: Duration of Benefits	State Why Project Bay Delta benefit is Direct[3] Indirect [4] or Both	Quantified Benefits (in-stream flow and timing, water quantity and water quality)
Bay Delta	Targeted Benefits # 26 and 51	All suitable lands	undetermined, but long term	indirect, benefits in the future	The proposed project (Flow Monitoring Network) will collect data to further refine estimates of groundwater recharge due to District activites.
Bay Delta	Targeted Benefits # 20, 24 and 50	Sacramento River, Colusa Basin and Cache and Putah Creeks	undetermined, but possibly long term	indirect, benefits in the future	The purpose of the proposed project is to measure current diversion and return flows for future determination of benefits to the Bay-Delta system
Local	Local benefits include increased flexibility and reliabilty in the Ditrict's water delivery system to farms. Please see text of Cost Benefits section for more details.	Timing: During the summer irrigation season. Location: Within District boundries in Yolo County.	long term	**Not applicable.**	

[1] The qualitative benefits should be provided in a narrative description. Use additional sheet.

[2] Direct benefits are project outcomes that contribute to a CALFED objective within the Bay-Delta system during the life of the project.

[3] Indirect benefits are project outcomes that help to reduce dependency on the Bay-Delta system. Indirect benefits may be realized over time.

[4] The project benefits that can be quantified (i.e. volume of water saved or mass of constituents reduced) should be provided.