Las Virgenes – Triunfo Joint Powers Authority
4232 Las Virgenes Road, Calabasas, CA 91302
818.251.2100

Call and Notice of Special Meeting of the Governing Board of the
Las Virgenes – Triunfo Joint Powers Authority

A Special Meeting of the Governing Board of the Las Virgenes – Triunfo Joint Powers Authority (JPA) is hereby called, and notice of said Special Meeting is hereby given for **5:00 p.m. on Wednesday, July 11, 2018**, at Las Virgenes Municipal Water District, 4232 Las Virgenes Road, Calabasas, California 91302, to consider the following:

PLEDGE OF ALLEGIANCE

1. Call to Order and Roll Call
2. Special Meeting of July 11, 2018 (Agenda attached)
3. Adjourn

By Order of the Board of Directors
GLEN PETERSON, Chair

David W. Pedersen, P.E.
Deputy Secretary

Dated: July 5, 2018

c: Each Director

LAS VIRGENES - TRIUNFO
JOINT POWERS AUTHORITY
AGENDA

4232 Las Virgenes Road, Calabasas, CA 91302

CLOSING TIME FOR AGENDA IS 8:30 A.M. ON THE TUESDAY PRECEDING THE MEETING. GOVERNMENT CODE SECTION 54954.2 PROHIBITS TAKING ACTION ON ITEMS NOT ON POSTED AGENDA UNLESS AN EMERGENCY, AS DEFINED IN GOVERNMENT CODE SECTION 54956.5 EXISTS OR UNLESS OTHER REQUIREMENTS OF GOVERNMENT CODE SECTION 54954.2(B) ARE MET.

5:00 PM July 11, 2018

PLEDGE OF ALLEGIANCE

1 CALL TO ORDER AND ROLL CALL

2 APPROVAL OF AGENDA

3 PUBLIC COMMENTS

Members of the public may now address the Board of Directors **ON MATTERS NOT APPEARING ON THE AGENDA**, but within the jurisdiction of the Board. No action shall be taken on any matter not appearing on the agenda unless authorized by Subdivision (b) of Government Code Section 54954.2

4 CONSENT CALENDAR

A Minutes: Regular Meeting of June 4, 2018 (Pg. 3)

Approve.

5 ILLUSTRATIVE AND/OR VERBAL PRESENTATION AGENDA ITEMS

A Pure Water Demonstration Project: Refined Configuration and Layout (Pg. 7)

Provide staff with feedback and direction on the refined configuration and layout of the Pure Water Demonstration Project.

6 ACTION ITEMS

A Rancho Amendment Bin and Conveyance Modifications Project: Construction Award (Pg. 9)

Approve an additional appropriation, in the amount of $381,868; award a construction contract to Pacific Hydrotech Corporation, in the amount of $1,408,700; and reject all remaining bids upon receipt of duly executed contract documents for the Rancho Amendment Bin and Conveyance Modifications Project.

B Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project: Construction Award (Pg. 12)

Award a construction contract to GSE Construction Company, Inc., in the amount of $1,369,000, and reject all remaining bids upon receipt of duly executed contract documents for the Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project.

C Tapia Process Air Improvements Project: Call for Bids (Pg. 15)

Authorize the issuance of a Call for Bids for the Tapia Process Air Improvements Project.

7 BOARD COMMENTS

8 ADMINISTERING AGENT/GENERAL MANAGER REPORT

9 FUTURE AGENDA ITEMS

10 INFORMATION ITEMS

A State and Federal Legislative Update (Pg. 19)

B Flow Augmentation to Malibu Creek: Cost and Economic Impact (Pg. 30)

C Pure Water Demonstration Project: Equipment Procurement (Pg. 37)

D Tapia SCADA System Upgrade: Request for Proposals (Pg. 40)

11 PUBLIC COMMENTS

Members of the public may now address the Board of Directors **ON MATTERS NOT APPEARING ON THE AGENDA**, but within the jurisdiction of the Board. No action shall be taken on any matter not appearing on the agenda unless authorized by Subdivision (b) of Government Code Section 54954.2

12 CLOSED SESSION

A Conference with Legal Counsel – Existing Litigation (Government Code Section 54956.9(a)):

Zusser Construction, Inc. v. Las Virgenes Municipal Water District

13 ADJOURNMENT

Pursuant to Section 202 of the Americans with Disabilities Act of 1990 (42 U.S.C. Sec. 12132), and applicable federal rules and regulations, requests for a disability-related modification or accommodation, including auxiliary aids or services, in order to attend or participate in a meeting, should be made to the Executive Assistant/Clerk of the Board in advance of the meeting to ensure availability of the requested service or accommodation. Notices, agendas, and public documents related to the Board meetings can be made available in appropriate alternative format upon request.

LAS VIRGENES – TRIUNFO
JOINT POWERS AUTHORITY
MINUTES
REGULAR MEETING

5:00 PM June 4, 2018

PLEDGE OF ALLEGIANCE

The Pledge of Allegiance to the Flag was led by Susan Pan.

1. CALL TO ORDER AND ROLL CALL

The meeting was called to order at **5:00 p.m.** by Chair Peterson in the Board Room at Las Virgenes Municipal Water District headquarters at 4232 Las Virgenes Road in Calabasas, California. Josie Guzman, Clerk of the Board, conducted the roll call.

Present: Director(s): Caspary, Lewitt, Pan, Paule, Peterson, Polan, Renger, Tjulander, and Wall
Absent: Director Orkney

2. APPROVAL OF AGENDA

Chair Peterson noted that Closed Session Item 12A was not needed and could be removed from the agenda.

Director Paule moved to approve the agenda as amended. Motion seconded by Director Caspary. Motion carried by the following vote:

AYES: Caspary, Lewitt, Pan, Paule, Peterson Polan, Renger, Tjulander, Wall,
NOES: None
ABSTAIN: None
ABSENT: Orkney

3. PUBLIC COMMENTS

None.

4. CONSENT CALENDAR

A Minutes: Regular Meeting of May 7, 2018

Director Caspary moved to approve the Consent Calendar. Motion seconded by Director Paule. Motion carried by the following vote:

AYES: Caspary, Lewitt, Pan, Paule, Peterson Polan, Renger, Wall,
NOES: None
ABSTAIN: Tjulander
ABSENT: Orkney

5. ILLUSTRATIVE AND/OR VERBAL PRESENTATION AGENDA ITEMS

A Pure Water Project Las Virgenes-Triunfo: Update

Public Outreach: Recent public outreach events included a presentation during the Quarterly Tour on May 12th with 40 people in attendance, and a presentation to the Thousand Oaks Kiwanis Club on May 30th.

Demonstration Project: Design work is moving forward, and a conceptual design will be presented at the July 11th JPA meeting.

6. ACTION ITEMS

A Proposed Two-Year JPA Budget Plan for Fiscal Years 2018-20

Approve the proposed Two-Year JPA Budget Plan for Fiscal Years 2018-20 and adopt the Fiscal Year 2018-19 JPA Budget

Angela Saccareccia, Finance Manager, provided a PowerPoint presentation. She responded to a question regarding the difference between the FY 17-18 budget and the FY 17-18 estimated actual budget for Net Operating Expenses by stating that the difference was due to salary savings from vacant positons and budgeting as though these positions were filled.

Acting Administering Agent/General Manager David Lippman responded to a question regarding the appropriation for Capital Improvement Project No. 10619 Summer Season 2013 TMDL Compliance by stating that the cost estimate would be decreased because it would be based on a nitrogen removal process rather than membrane technology. He also responded to a question regarding the amount in grants received for the Pure Water Project Las Virgenes-Triunfo by stating that a total of $450,000 has been received.

Director Renger moved to approve Item 6A. Motion seconded by Director Caspary. Motion carried by the following vote:

AYES: Caspary, Lewitt, Pan, Paule, Peterson Polan, Renger, Tjulander, Wall,
NOES: None
ABSTAIN: None

ABSENT: Orkney

7. BOARD COMMENTS

None.

8. ADMINISTERING AGENT/GENERAL MANAGER REPORT

Acting Administering Agent/General Manager David Lippman reminded the Board that the next JPA Board meeting would be held on July 11th. He noted that former JPA Board Member Hal Helsley passed away in April, and his memorial service would be held on June 9th at the Peter Strauss Ranch.

9. FUTURE AGENDA ITEMS

None.

10. INFORMATION ITEMS

A State and Federal Legislative Update

B Tank Rehabilitation Priority Summary and Requests for Proposals for Cordillera Tank Rehabilitation

11. PUBLIC COMMENTS

None.

12. CLOSED SESSION - (This item was removed from the agenda)

A Conference with Legal Counsel – Pending Litigation (Government Code Section 54956.9(d)(1)):

Zusser Construction, Inc. v. Las Virgenes Municipal Water District

13. ADJOURNMENT

Seeing no further business to come before the Board, the meeting was duly adjourned at **5:12 p.m**., in memory of former Director Hal Helsley.

Glen Peterson, Chair

ATTEST:

Michael Paule, Vice Chair

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Pure Water Demonstration Project: Refined Configuration and Layout

SUMMARY:

On April 17, 2018, a workshop was held with the JPA Board to solicit input on the purpose, configuration and layout of the proposed Pure Water Demonstration Project. Carollo Engineers; El Dorado, their architectural sub-consultant; and New Water Resources provided the Board with preliminary concepts at the workshop. Based on the feedback received during the workshop and at subsequent JPA Board meetings, Carollo and staff refined the configuration and layout of the demonstration project.

Key feedback from the Board included starting and ending the tour in the existing Boardroom; making modest building improvements to accommodate the facility; focusing on the goals of public outreach, research, and staff training; and including a California-friendly demonstration garden. The configuration and layout of the demonstration project is also intended to accommodate future modification or expansion if the Board choses to consider such options at a later date.

Staff and Carollo will present the Board with the refined configuration and layout of the demonstration project at the meeting.

RECOMMENDATION(S):

Provide staff with feedback and direction on the refined configuration and layout of the Pure Water Demonstration Project.

FISCAL IMPACT:

No

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

There is no financial impact associated with providing feedback and direction.

Prepared by: David R. Lippman, P.E., Director of Facilities and Operations

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Rancho Amendment Bin and Conveyance Modifications Project: Construction Award

SUMMARY:

On May 7, 2018, the JPA Board authorized a Call for Bids for the Rancho Amendment Bin and Conveyance Modifications Project and determined that the proposed amendment bin and conveyance equipment be designated by specific trade name to match the existing equipment at the facility.

A mandatory pre-bid meeting and job walk was held on May 24, 2018. Two bids were submitted and publicly opened on June 18, 2018. The lowest responsive bid was submitted by Pacific Hydrotech Corporation, in the amount of $1,408,700, which is approximately 6% lower than the Engineer's Estimate of $1,500,000.

RECOMMENDATION(S):

Approve an additional appropriation, in the amount of $381,868; award a construction contract to Pacific Hydrotech Corporation, in the amount of $1,408,700; and reject all remaining bids upon receipt of duly executed contract documents for the Rancho Amendment Bin and Conveyance Modifications Project.

FISCAL IMPACT:

Yes

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

The total project cost is estimated to be $1,829,442. The adopted Fiscal year 2018-19 JPA Budget provides funding for CIP Job No. 10608 in the amount of $1,447,574. An additional appropriation of $381,868 is recommended to allow for the award of the construction contract, a 10% contingency and professional services and administrative costs for the project.

Following is a summary of the estimated total project cost:

Description	**Cost**
Design Services	
Stantec	$124,915
Construction	
Construction Award	$1,408,700
Construction Contingency (10%)	$140,870
Administrative	
District Labor (4%)	$56,348
G&A (7%)	$98,609
Total Project Cost	**$1,829,442**
Existing Appropriation	$1,447,574
Additional Appropriation (Proposed)	$381,868

The costs for the project will be allocated 70.6% to LVMWD and 29.4% to Triunfo Sanitation District.

DISCUSSION:

The amendment storage bin at the Rancho Las Virgenes Composting Facility is oversized, highly complex, deteriorating and has reached the end of its useful life. The bin was designed to receive and store up to 370 cubic yards of amendment, anticipating a 16 MGD build-out at the Tapia Water Reclamation Facility. However, due to lower flows at Tapia and a revised capacity of 12 MGD, a smaller amendment bin is needed. Due to the bin's large size, the amendment stored within it is not being turned over properly, resulting in corrosion and heavy pitting on the sides of the bin. The perforated grate, through which blowers send air to reduce the moisture content of the amendment, has become clogged and no longer functions efficiently. The bin itself is difficult and costly to maintain and takes up a large amount of space. In addition, the amendment has a tendency to build up at the front of the bin, requiring operators to open hatches and distribute the amendment manually using shovels. The manual handling of the amendment near mechanical equipment poses a safety concern.

The proposed project consists of removing and replacing the existing bin with a smaller version and extending the amendment delivery conveyor to the new bin. The new bin includes live-bottom screws along with leveling screws to better control the handling of the amendment and reduce bridging of material within the bin. The bin will maintain the existing dust control and fire suppression systems, which were included in the original design of the facility for safety. The equipment and controls will be integrated into the facility's existing control system. Due to the complexity of the equipment and the need for a comprehensive, fully-functional system, designation of the equipment by trade name was recommended to match the existing equipment at the facility.

During removal and installation of the new bin, the composting and cure process will be temporarily shut down and the dewatered cake will be hauled off for disposal. This will result in

additional costs for hauling the cake, but it also results in a cost-savings from reduced amendment purchases as well as energy savings. Amendment will not be purchased during the 6-month shutdown period, which will translate to a savings of approximately $52,800. Additionally, since the blowers and fans in the reactor building will not need to be operation, a cost-savings for reduced electrical usage is expected. The temporary shutdown also creates an opportunity to perform maintenance tasks in reactor and cure buildings that cannot be performed with the system in operation. Some of these tasks include completing the Rancho Lighting Efficiency Upgrade Project, electrical and instrumentation inspection and clean-up as well as inspection, maintenance and repair of many of the critical mechanical equipment supporting the facility. These ancillary tasks will be funded from the maintenance and operations business units and will not be applied to the overall cost of the project.

On May 1, 2017, the Board determined that the work is categorically exempt from the California Environmental Quality Act (CEQA), pursuant to Section 15301(b) of the CEQA Guidelines, because it involves only minor alterations to an existing facility with no expansion of use.

Pacific Hydrotech Corporation submitted the lowest responsive bid, in the amount of $1,408,700, and has successfully completed several other projects at the Rancho Las Virgenes Composting Facility including, but not limited to, the Sludge Recirculation Project, Digester No. 1 Rehabilitation Project and construction of Digester No. 3. In addition to Pacific Hydrotech's familiarity with JPA facilities, the pre-selection of the equipment allowed for fixed pricing of equipment, which is the largest material cost for the project. This process assures the best value to the JPA by encouraging a competitive bidding environment for the installation of the equipment.

Following is a summary of the bids received:

Bidder	Bid Total	Percentage Above/Below Estimate
Pacific Hydrotech Corporation	$1,408,700	-6%
MMC, Inc.	$1,964,000	+31%

Prepared by: Eric Schlageter, P.E., Senior Engineer

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project: Construction Award

SUMMARY:

On May 7, 2018, the JPA Board authorized a Call for Bids for the Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project. A mandatory pre-bid walk was conducted on May 30, 2018. Five bids were received and publically opened on June 14, 2018. Staff evaluated the bids and determined that the lowest responsive bid was submitted by GSE Construction Company, Inc., in the amount of $1,369,000, which is approximately 28% lower than the Engineer's Estimate of $1,894,500.

RECOMMENDATION(S):

Award a construction contract to GSE Construction Company, Inc., in the amount of $1,369,000, and reject all remaining bids upon receipt of duly executed contract documents for the Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project.

FISCAL IMPACT:

Yes

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

The total project cost is estimated to be $1,739,494. The adopted Fiscal Year 2018-19 JPA Budget provides sufficient funding for the work under CIP Job No. 10653. The costs for the project will be allocated 70.6% to LVMWD and 29.4% to Triunfo Sanitation District.

Following is a summary of the estimated total project cost:

Description	Cost
Design Services	
Cannon Corp. (Design)	$60,204
Construction	
Construction Award	$1,369,000
Construction Contingency (10%)	$136,900
CSI Services Inc. (Coatings Inspection)	$22,800
Administrative	
District Labor and G&A (estimated)	$150,590
Total Project Cost	$1,739,494
Existing Appropriation	$2,105,700

DISCUSSION:

The Tapia Water Reclamation Facility Fiscal Year 2017-18 Rehabilitation Project involves replacement or rehabilitation of equipment in three different areas of Tapia: (1) rehabilitation of Primary Clarifier Nos. 4 and 5, (2) replacement of grit and skimmings piping, and (3) replacement of slide gates for Channel No. 4 of the secondary sedimentation basins. These three work items were originally planned and budgeted as three separate capital improvement projects; however, combing the work into one project provides cost-savings in design, bidding and construction. In addition, the work will require carefully phased construction to avoid impacting on-going treatment operations. By having one contractor complete all of the work, staff can better control and specify the phasing of work.

Because the project requires the application of a specialized epoxy coating to concrete surfaces of the primary tanks, the Administering Agent/General Manager will execute a professional services agreement for coating inspection.
The work is categorically exempt from the California Environmental Quality Act (CEQA), pursuant to Section 15301(b) of the CEQA Guidelines because it involves only minor alterations to an existing facility with no expansion of use.

GSE Construction Company, Inc., submitted the lowest responsive bid, in the amount of $1,369,000, which was approximately 28% lower than the Engineer's Estimate. The average of all bids submitted was approximately 13% lower than the Engineer's Estimate, likely due to a contingency placed on the estimate to account for a recent increase in construction costs experienced both regionally and nationally. Several of the lowest bidders, including GSE Construction Company, Inc., have performed prior work at Tapia and utilized the same coating sub-contractor that performed the work for the previous clarifier rehabilitation project, indicating that familiarity with the site may have contributed to the lower bids.

GSE Construction Company, Inc., has successfully completed several other recent projects at Tapia. Upon reviewing the submitted bids, staff contacted GSE Construction Company representatives who indicated that they were comfortable and confident with their ability to complete the project as bid.

Following is a summary of the bids:

Bidder	Bid Total	Percentage Above/Below Estimate
GSE Construction Company, Inc	$ 1,369,000	-28%
Pacific Hydrotech Corporation	$ 1,434,420	-24%
Mehta Mechanical Company, Inc. dba MMC Inc	$ 1,674,400	-12%
Abhe & Svoboda, Inc.	$ 1,719,982	-9%
Green Building Corporation	$ 2,029,520	+7%

Prepared by: Coleman Olinger, P.E., Associate Engineer

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Tapia Process Air Improvements Project: Call for Bids

SUMMARY:

On October 5, 2016, the JPA Board accepted a proposal from Pacific Advanced Civil Engineering, Inc. (PACE), and authorized the Administrating Agent/General Manager to execute a professional services agreement, in the amount of $215,216, for the environmental review and design of the Tapia Water Reclamation Facility (WRF) Process Air Improvements Project. The scope of work consists of replacing the existing blowers and aeration basin air diffusers, which have reached the end of their useful life. Process air is used at the Tapia WRF to support the treatment processes, which require air for mixing, oxygen transfer for biological treatment and filter backwashing.

On December 4, 2017, the JPA Board approved the selection of Sulzer ABS process air blowers and OTT North America air diffusers based on a competitive process and determined that the selected equipment be designated by specific trade name in order to obtain a necessary item that is only available from one source. The design, which incorporates the selected equipment, is now complete, and staff recommends issuance of a Call for Bids for the project.

RECOMMENDATION(S):

Authorize the issuance of a Call for Bids for the Tapia Process Air Improvements Project.

FISCAL IMPACT:

No

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

There is no financial impact associated with a Call for Bids.

DISCUSSION:

There are six blowers at the Tapia WRF: three 250-horsepower Hoffman blowers (4,500 cubic feet per minute each) and three 900-horsepower Roots blowers (22,500 cubic feet per minute each). The Hoffman blowers were installed in the early 1970s, and the Roots blowers were installed in the late 1970s and early 1980s. The blowers were designed for the complete nitrification of the wastewater at an average daily flow of 16.1 MGD.

The current operation at Tapia WRF requires less air than the original design because the treatment process now includes partial denitrification, which requires anoxic conditions, at a design flow of 12 MGD. The existing blowers do not have the "turndown" capability to operate efficiently with the lower air demand. Also, the swing arm air diffusers in the aeration tanks introduce air on one side of the tank, causing a spiral roll of mixing and aeration. This type of aeration is inefficient for oxygen transfer (50% lower than comparable water reclamation facilities). By replacing the blowers and diffusers, a Southern California Edison (SCE) Project Feasibility Study prepared by Lincus Inc., concluded that the total energy and demand savings would equates to an annual cost-savings of $138,405. In addition, a SCE rebate of $137,719 was reserved for the project.

Design of the project is now complete, and staff recommends issuance of a Call for Bids. On May 1, 2017, the JPA Board determined that the project was exempt from the provisions of the California Environmental Quality Act.

Following is a summary of the proposed bid schedule:

Call for Bids	July 11, 2018
1st Advertisement	July 19, 2018
2nd Advertisement	July 26, 2018
Pre-Bid Meeting	Aug 8, 2018
Bids Open	September 5, 2018
Award of Contract	October 1, 2018

Prepared by: Eric Schlageter, P.E., Senior Engineer

ATTACHMENTS:

Notice Inviting Bids

NOTICE INVITING SEALED PROPOSALS (BIDS)
Tapia Process Air Improvements Project

NOTICE IS HEREBY GIVEN that the Board of Directors of Las Virgenes – Triunfo Joint Powers Authority (JPA) invites and will receive sealed proposals (bids) up to the hour of 3:00PM on September 5 , 2018, for furnishing the work described in the contract documents. Bids received after the time stated in the Call for Bids will not be accepted and will be returned, unopened, to the bidder. The time shall be determined by the time on the receptionist telephone console in our Headquarters lobby. Proposals will be publicly opened and read aloud at the office of the JPA, 4232 Las Virgenes Road, Calabasas, California 91302. Said bids shall conform to and be responsive to the Specifications and Contract Documents for said work as heretofore approved by the JPA.

*A **mandatory** pre-bid tour will be conducted on August 8, 2018 at 10:00 a.m.. The meeting will begin at the JPA headquarters at 4232 Las Virgenes Road, Calabasas, CA 91302. Attendance at the pre-bid conference is a condition precedent to submittal of the bid and the JPA will not consider a bid from any bidder not represented at the pre-bid conference. Questions regarding the project may be directed to Project Manager, Eric Schlageter at (818) 251- 2142.*

Bidders are notified that the JPA Board has found the need that selected equipment must be designated by specific trade name in order to obtain necessary items that are each only available from one source pursuant to Public Contracts Code Section 3400. Bidders, in submitting a bid, acknowledge and consent to accept the equipment supplier listed for the project as noted within the contract documents and specifications.

Sets of contract documents may be downloaded for free by going to http://www.LVMWD.com/Ebidboard and following the links to this project.

In order to be placed on the plan holder's list, contractors shall register for free as a document holder for this project on Ebidboard by going to www.LVMWD.com/Ebidboard and following the links to this project. Addendum notifications will be issued through Ebidboard.com, but may also be provided by calling the District's Project Manager. Although Ebidboard will fax and/or email all notifications to registered plan holders after the District uploads the information, Bidders are responsible for obtaining all addenda and updated contract documents.

Each bid must be on the JPA bid form and shall be sealed and filed with the secretary of the JPA at or before the time stated in the Notice.

No Contractor or Subcontractor may be listed on a bid proposal for a public works project submitted on or after March 1, 2015 unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5. No Contractor or Subcontractor may be awarded a contract for public work on a public works project awarded on or after April 1, 2015 unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5. Effective January 1, 2016, no Contractor or Subcontractor may perform on

a contract for public work on a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5. This project is subject to compliance monitoring and enforcement by the DIR.

All terms and conditions contained in the Specifications and Contract Documents shall become part of the contract. The Board of Directors of the JPA reserves the right to reject any and all bids and to waive any and all irregularities in any bid. No bidder may withdraw his bid after the said time for bid openings until 60-days thereafter or until the JPA has made a final award to the successful bidder or has rejected all bids, whichever event first occurs.

The Board of Directors of the JPA reserves the right to select the schedule(s) under which the bids are to be compared and contract(s) awarded.

BY ORDER OF THE GOVERNING BODY OF
LAS VIRGENES – TRIUNFO JOINT POWERS
AUTHORITY

_____ _____

Dated *Glen Peterson, Chair*

BEST BEST & KRIEGER LLP
ATTORNEYS AT LAW

Memorandum

To: Las Virgenes-Triunfo Joint Powers Authority
From: Syrus Devers, Best Best & Krieger
Date: June 22, 2018
Re: Monthly State Political Report

Administrative Report

The State Budget signed just before the deadline did increase some of the items the Governor proposed in the May Revise despite his resistance to increasing long-term funding obligations, but both sides also lost a few pet projects. The big winner was education. Governor Brown tried to hold the U.C. system to a 3% increase, or $92 million, but that got bumped to $120 million along with significant one-funding to address enrollment pressure. The Legislature also added $140 million to the Governor's proposal to address homelessness which brought the total to $500 million. The big loser was healthcare. Universal healthcare proposals got nixed as did demands to increase MediCal funding.

Legislative Report

The next major deadline is June 29th. A bill must make it to a fiscal committee by then to stay alive, and if it does it has until July 6th to make it to the floor. After that the Legislature takes a break for a month.

Tax on Water: Ignore the headlines—it's not dead. Newspapers reported on the Budget Conference Committee closing without passing the Governor's language. In fact, the water tax language had been removed from the committee two weeks ago. This only means that the administration saw it didn't have the votes and smartly chose to avoid getting a bad vote on record. To be sure, this is a very good outcome for the opposition. It was debated in the Conference Committee and ran into opposition from both sides. This is the second pathway to a new tax that opponents have blocked, the first being SB 623—which is still technically alive. The Governor, however, has more than two options. Since it can be done without a budget appropriation, it could still appear in a trailer bill in August. But at least opponents can enjoy the summer.

SB 606 (Hertzberg, previously Skinner)/AB 1668 (Friedman) Water efficiency bill package: The long march is over. The Governor signed both bills on May 31st to surprisingly little fanfare. To BB&K staff it feels like a child has left for college.

SB 2050 (Caballero-Small district consolidation): The water industry's answer to the water tax and the problems of disadvantaged water districts. The good news is that amendments taken in May were relatively minor and the bill passed the Assembly with 56 votes. The less good news is that it's passing on an almost entirely party line vote. It looked like a few Republicans considered going up on the floor vote but in the end only Assemblyman Frank Bigelow (Placerville) stayed on. It passed the Sen. Environmental Quality Committee, but the author agreed to "work with the committee" on amendments. The SWRCB was advocating to remove the requirement to comply with Cortese-Knox district formation provisions in favor of the Board's existing authority to dissolve water districts—which it has almost never used.

SB 998 (Dodd-Water shut off prohibitions): Opponents were disappointed with the floor vote in the Senate. All but one Democrat voted in support, and the one that stayed off is no longer in office. There was no question that the bill would be sent to the Assembly, but it was hoped that the long list of problems with the bill highlighted by the committees would have caused some of the Democrats to layoff. The bill will be heard in the Assembly Environmental Safety and Toxics Committee on the 26th. With the tax on water being pushed to the backburner for a few weeks this will now become the top priority.

BEST BEST & KRIEGER LLP
ATTORNEYS AT LAW

To: Las Virgenes Board of Directors
From: John Freshman and Ana Schwab
Date: June 20, 2018
RE: Federal Report

Federal Budget

While Congress passed the appropriations for FY2018 this past March, both chambers are well underway with the FY2019 appropriations.

The House passed its first package of appropriations bills on June 8, 2018 – included in this package was the Energy and Water Appropriations. The Senate is considering the House "mini-bus" package this week, however it is hitting some political road bumps. The controversial amendments include an amendment that would check of the President's use of national security-related tariffs. For FY2019 appropriations for the Bureau of Reclamation the President requested a budget of $1.05 billion. The House bill includes $1.54 billion and the Senate bill includes $1.48 billion for the Bureau. For FY2019 appropriations for the Army Corps of Engineers, the President requested a budget of $4.78 billion. The House bill includes $7.48 billion and the Senate bill includes $6.93 billion for the Corps.

The House Appropriations Committee has approved the Interior and Environment Appropriations for FY2019, this measure has not been taken up by the full House to date. The Senate Interior Appropriations Subcommittee has approved the Interior and Environment Appropriations for FY2019, this measure has not been taken up by the full committee to date. For FY2019 appropriations for the Environmental Protection Agency the President requested a budget of $5.4 billion. The House bill includes $7.96 billion and the Senate bill includes $8.06 billion for the EPA.

Senate Majority Leader Mitch McConnell has indicated that he would like a return to regular order and a move away from omnibuses and continuing resolutions, to further his commitment to this, the Leader has cancelled three weeks of district time in August. More appropriations developments are expected throughout the summer.

Water Resources Development Act (WRDA)

The Water Resources Development Act is done by Congress every two years. It provides direction to the Army Corps of Engineers for improvements of rivers and harbors in the United States and to provide for conservation and development of water and related resources. Since Chairman Bill Shuster took over the Chairmanship of the House Transportation and Infrastructure Committee, he has worked hard, and succeeded, at passing WRDA every two years. The House passed its version of WRDA on June 6th of this year. The Senate is expected to take up its version the last week of June. After it has passed out of both chambers there will be a

conference committee to agree to a joint version of the bill. This is all expected to be completed prior to the August work period.

Legislation Recently Introduced
Please let us know if you would like us to track any of the below, or anything in the Legislative Matrix for you

H.R. 5596 – Water Infrastructure Resiliency and Sustainability Act of 2018
To authorize the Administrator of the Environmental Protection Agency to establish a program of awarding grants to owners or operators of water systems to increase resiliency or adaptability of the systems to any ongoing or forecasted changes to the hydrologic conditions of a region of the United States.

H.R. 5609 – Water Affordability, Transparency, Equity, and Reliability Act of 2018
To establish a trust fund to provide for adequate funding for water and sewer infrastructure, and for other purposes.

S. 2771 – Residential Decentralized Wastewater System Improvement Act
To amend the Federal Water Pollution Control Act to require the Administrator of the Environmental Protection Agency to provide grants for the construction, refurbishing, and servicing of individual household decentralized wastewater systems to individuals with low or moderate income.

S. 2772 – A bill to amend the Consolidated Farm and Rural Development Act to modify provisions relating to the household water well system grant program.
To amend the Consolidated Farm and Rural Development Act to modify provisions relating to the household water well system grant program.

H.R. 2510 –Water Quality Protection and Job Creation Act of 2017
To amend the Federal Water Pollution Control Act to authorize appropriations for State water pollution control revolving funds, and for other purposes.

S. 2800 – America's Water Infrastructure Act of 2018
To provide for the conservation and development of water and related resources, to authorize the Secretary of the Army to construct various projects for improvements to rivers and harbors of the United States, and for other purposes.

H.R. 8 –Water Resources Development Act of 2018
To provide for improvements to the rivers and harbors of the United States, to provide for the conservation and development of water and related resources, and for other purposes.

S. 2969 – Rural Water Infrastructure Improvement Act of 2019
To amend the Consolidated Farm and Rural Development Act to improve water or waste disposal grants or direct or guaranteed loans, and for other purposes.

H.Res. 923 – Providing for further consideration of the bill (H.R. 5895)
Providing for further consideration of the bill (H.R. 5895) making appropriations for energy and water development and related agencies for the fiscal year ending September 30, 2019, and for other purposes, and providing for consideration of the bill (H.R. 3) to rescind certain budget authority proposed to be rescinded in special messages transmitted to the Congress by the President on May 8, 2018, in accordance with title X of the Congressional Budget and Impoundment Control Act 1974.

S. 3012 – Water Technology Acceleration Act
To establish an innovative water technology grant program and to amend the Safe Drinking Water Act and the Federal Water Pollution Control Act to encourage the use of innovative water technology, and for other purposes.

S. 3015 – Water Affordability Act
To amend the Federal Water Pollution Control Act to establish a low-income sewer and drinking water assistance pilot program, and for other purposes.

S. 3001 –Contra Costa Canal Transfer Act
To authorize the Secretary of the Interior to convey certain land and facilities of the Central Valley Project.

H.R. 6040 – Contra Costa Canal Transfer Act
To authorize the Secretary of the Interior to convey certain land and facilities of the Central Valley Project.

LAS VIRGENES - HIGH PRIORITY LEGISLATION IN THE 115TH CONGRESS
JUNE 2018

Legislation	Summary	Status	Position
H.R. 23 – Gaining Responsibility on Water Act of 2017	This legislation will allow for more water conveyance while protecting the water rights of users, as well. Additionally, the legislation reforms the Central Valley Project Improvement Act and the San Joaquin River Restoration Settlement Act. This legislation would reduce the cost of water delivery contracts and would give users more authority over how restoration funds are spent. The bill purports to expand on a compromise reached between Sen. Dianne Feinstein (D-CA) and House Majority Leader Kevin McCarthy (R-CA) during last year's Water Infrastructure Improvements for the Nation Act discussion. The compromise directed more water to farms by tweaking the way rules meant to protect endangered fish are interpreted when operating the State's waterways.	Introduced by Rep. David Valadao – January 3, 2017 Passed the House of Representatives on July 12, 2017. This measure has not been taken up in the Senate yet.	
H.R. 434 – New Water Available to Every Reclamation State Act or the New WATER Act	This legislation authorizes the Department of the Interior to provide financial assistance, such as loans and guarantees, to entities that contract under federal reclamation law to carry out water projects within the 17 western states served by the Bureau of Reclamation, and Alaska and Hawaii. Eligible Projects include: • non-federal water infrastructure projects that would contribute to a safe, adequate water supply for domestic, agricultural, environmental, or municipal and industrial use; • projects for enhanced energy efficiency in the operation of a water system; • projects for accelerated repair and replacement of aging water distribution facilities; • brackish or sea water desalination projects; and • the acquisition of real property or an interest therein for water storage, reclaimed or recycled water, or wastewater that is integral to such a project.	Introduced by Rep. Jeff Denham – January 11, 2017	

Legislation-con't	Summary-con't	Status-con't	Position-con't
H.R. 448 – Water Conservation Rebate Tax Parity Act	This bill amends the Internal Revenue Code to expand the tax exclusion for energy conservation subsidies provided by public utilities to exclude from gross income subsidies provided (directly or indirectly): (1) by a public utility to a customer, or by a state or local government to a resident of such state or locality, for the purchase or installation of any water conservation or efficiency measure; and (2) by a storm water management provider to a customer, or by a state or local government to a resident of such state or locality, for the purchase or installation of any storm water management measure.	Introduced by Rep. Jared Huffman and Rep. Dana Rohrabacher – January 11, 2017	
S. 32 – California Desert Protection and Recreation Act of 2017	This bill amends the California Desert Protection Act of 1994 to, among other things: • establish or designate wilderness areas, a special management area, off-highway vehicle recreation areas, and a national scenic area; • release specified wilderness study areas; • adjust national park and preserve boundaries; and • specify land withdrawals and conveyances. Specified federal land shall be taken into trust for the Lone Pine Paiute-Shoshone Tribe. Lands and interests in land, including improvements, outside the boundary of Joshua Tree National Park in California may be acquired for the purpose of operating a visitor center. The bill makes amendments to the California Desert Protection Act of 1994 regarding the California State School lands. The bill amends the Wild and Scenic Rivers Act to designate specified segments of rivers and creeks as components of the National Wild and Scenic Rivers System. The bill establishes the Renewable Energy Resource Conservation Fund for use in regions impacted by the development of wind or solar energy.	Introduced by Sen. Dianne Feinstein – January 5, 2017 Committee on Energy and Natural Resources held a hearing on the legislation on July 26, 2017	

Legislation-con't	Summary-con't	Status-con't	Position-con't
S. 692 – Water Infrastructure Flexibility Act	To provide for integrated plan permits, to establish an Office of the Municipal Ombudsman, to promote green infrastructure, and to require the revision of financial capability guidance.	Introduced by Sen. Deb Fischer – March 21, 2017 Passed the Senate on October 5, 2017 This action has not yet been taken up by the House	
H.R. 5596 – Water Infrastructure Resiliency and Sustainability Act of 2018	To authorize the Administrator of the Environmental Protection Agency to establish a program of awarding grants to owners or operators of water systems to increase resiliency or adaptability of the systems to any ongoing or forecasted changes to the hydrologic conditions of a region of the United States.	Introduced by Rep. Salud Carbajal – April 24, 2018	
H.R. 5609 – Water Affordability, Transparency, Equity, and Reliability Act of 2018	To establish a trust fund to provide for adequate funding for water and sewer infrastructure, and for other purposes.	Introduced by Rep. Keith Ellison – April 25, 2018	
S. 2771 – Residential Decentralized Wastewater System Improvement Act	To amend the Federal Water Pollution Control Act to require the Administrator of the Environmental Protection Agency to provide grants for the construction, refurbishing, and servicing of individual household decentralized wastewater systems to individuals with low or moderate income.	Introduced by Sen. Cory Booker – April 26, 2018	

Legislation-con't	Summary-con't	Status-con't	Position-con't
S. 2772 – A bill to amend the Consolidated Farm and Rural Development Act to modify provisions relating to the household water well system grant program.	To amend the Consolidated Farm and Rural Development Act to modify provisions relating to the household water well system grant program.	Introduced by Sen. Cory Booker – April 26, 2018	
H.R. 2510 – Water Quality Protection and Job Creation Act of 2017	To amend the Federal Water Pollution Control Act to authorize appropriations for State water pollution control revolving funds, and for other purposes.	Introduced by Rep. Peter DeFazio – May 18, 2017	
S. 2800 – America's Water Infrastructure Act of 2018	To provide for the conservation and development of water and related resources, to authorize the Secretary of the Army to construct various projects for improvements to rivers and harbors of the United States, and for other purposes.	Introduced by Sen. John Barrasso – May 8, 2018 Passed the Senate Environment and Public Works Committee on May 22, 2018	
H.R. 8 – Water Resources Development Act of 2018	To provide for improvements to the rivers and harbors of the United States, to provide for the conservation and development of water and related resources, and for other purposes.	Introduced by Rep. Bill Shuster – May 18, 2018 Passed the House on June 6, 2018	

Legislation-con't	Summary-con't	Status-con't	Position-con't
S. 2969 – Rural Water Infrastructure Improvement Act of 2019	To amend the Consolidated Farm and Rural Development Act to improve water or waste disposal grants or direct or guaranteed loans, and for other purposes.	Introduced by Sen. Tammy Baldwin – May 24, 2018	
H.Res. 923 – Providing for further consideration of the bill (H.R. 5895)	Providing for further consideration of the bill (H.R. 5895) making appropriations for energy and water development and related agencies for the fiscal year ending September 30, 2019, and for other purposes, and providing for consideration of the bill (H.R. 3) to rescind certain budget authority proposed to be rescinded in special messages transmitted to the Congress by the President on May 8, 2018, in accordance with title X of the Congressional Budget and Impoundment Control Act 1974.	Introduced by Rep. Michael Burgess – June 6, 2018 Passed the House on June 7, 2018	
S. 3012 – Water Technology Acceleration Act	To establish an innovative water technology grant program and to amend the Safe Drinking Water Act and the Federal Water Pollution Control Act to encourage the use of innovative water technology, and for other purposes.	Introduced by Sen. Tammy Baldwin – June 6, 2018	
S. 3015 – Water Affordability Act	To amend the Federal Water Pollution Control Act to establish a low-income sewer and drinking water assistance pilot program, and for other purposes.	Introduced by Sen. Kamala Harris – June 6, 2018	
S. 3001 – Contra Costa Canal Transfer Act	To authorize the Secretary of the Interior to convey certain land and facilities of the Central Valley Project.	Introduced by Sen. Diane Feinstein – June 6, 2018	
H.R. 6040 – Contra Costa Canal Transfer Act	To authorize the Secretary of the Interior to convey certain land and facilities of the Central Valley Project.	Introduced by Rep. Mark DeSaulnier – June 7, 2018	

FY2019 Appropriations

Legislation	Summary	Status	Position
H.R. 5895 – Energy and Water Development and Related Agencies Appropriations Act, 2019	Funding for the Army Corps of Engineers , the Department of the Interior – Bureau of Reclamation, and the Department of Energy	Introduced by Rep. Michael Simpson – May 21, 2018 Passed the House on June 8, 2018	
S. 2975 – Energy and Water Development and Related Agencies Appropriations Act, 2019	Funding for the Army Corps of Engineers , the Department of the Interior – Bureau of Reclamation, and the Department of Energy	Introduced by Sen. Lamar Alexander – May 24, 2018	
House Interior, Environment, and Related Agencies Appropriations Act, 2019	Funding for the Department of the Interior, the Environmental Protection Agency, the Forest Service, the Indian Health Service, and various independent and related agencies.	Introduced by Rep. Ken Calvert Passed the House Appropriations Committee on June 6, 2018	
Senate Interior, Environment, and Related Agencies Appropriations Act, 2019	Funding for the Department of the Interior, the Environmental Protection Agency, the Forest Service, the Indian Health Service, and various independent and related agencies.	Introduced by Sen. Lisa Murkowski Passed the Senate Interior Appropriations Subcommittee on June 12, 2018	

ITEM 10B

INFORMATION ONLY

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Flow Augmentation to Malibu Creek: Cost and Economic Impact

---

SUMMARY:

This item provides an update on the cost and economic impact of flow augmentation to Malibu Creek. The attached memorandum provides historical data on the quantity and economic impact of the flow augmentation.

FISCAL IMPACT:

Yes

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

The financial impact of flow augmentation to Malibu Creek for calendar year 2017 is estimated to be $525,000. The economic impact to the JPA consists of both from a loss of revenue from the decreased sale of wholesale recycled water and the additional cost related to water quality monitoring during flow augmentation.

DISCUSSION:

Beginning in 2005, the JPA has been required by its NPDES Permit for the Tapia Water Reclamation Facility to augment flow in Malibu Creek such that 2.5 cubic feet per second of flow is measured at the Los Angeles County gauging station to sustain steelhead trout habitat. During dry years, the volume and economic impact of the flow augmentation can be significant.

Prepared by: Doug Anders, Administrative Services Coordinator

ATTACHMENTS:

Date: June 26, 2018

To: David Lippman

From: Doug Anders

Subject: Flow Augmentation to Malibu Creek – July 2018 Update

The following is an update of the report provided to the JPA Board in 2013 and 2015.

The NPDES permit for the Tapia Water Reclamation Facility restricts the discharge of recycled water to Malibu Creek from April 15th to November 15 except for three exceptions: (1) treatment plant upset or operational emergencies, (2) qualifying storm events as determined by the Executive Officer, and (3) "the existence of minimal streamflow conditions that require flow augmentation in Malibu Creek to sustain endangered species as determined by the Executive Office."

The third condition is defined in Section V.C. of the 2017 NPDES permit: *"The Discharger shall augment flow in the Malibu Creek, such that 2.5 cfs of maximum total flow is measured at the Los Angeles County gauging station F-130-R to sustain the steelhead trout habitat. Discharge to augment flow shall not be dependent on whether receiving water station RSW-MC004D (formerly known as station R-4) is dry or wet. The discharge shall not cause a breach of Malibu Lagoon. During the prohibition period, the Discharger must obtain permission from the Executive Officer to discharge into Malibu Creek for the purpose of this provision."* This provision has been in Tapia's permit since 2005.

Table 1 shows flow augmentation to Malibu Creek by calendar year, in both million gallon (MG) and acre feet (AF) discharge volumes, since 2005.

Table 1 - Fish Flow Augmentation (CY)

	Vol (MG)	Vol (AF)
2006	-	-
2007	0.55	1.7
2008	0.58	1.8
2009	9.17	28.2
2010	-	-
2011	-	-
2012	-	-
2013	84.47	259.2
2014	81.34	249.6
2015	76.36	234.3
2016	80.27	246.3
2017	160.02	491.1
2018*	0	0

*April 15 through May 31, 2018 – zero augmentation.

The cost of the flow augmentation includes the cost of the water plus the cost of water quality monitoring. The water cost is the difference between MWD Tier I or Tier II purchased water and the JPA wholesale price of water. In other words, the net expense is the cost of the Tier II water less the revenue from the wholesale sale of recycled water. Table 2 shows the costs for flow augmentation calendar year 2013 through 2018.

Table 2 - Fish Flow Augmentation Costs

Calendar Year	Volume (AF)	MWD Tier I or II $/AF**	JPA Wholesale Avg. $/AF***	Net Cost $/AF	Subtotal Water Cost	Monitoring Cost	Water and Monitoring Cost
2013	259.23	$997	$411.92	$585.08	$151,670	$65,000	$216,670
2014	249.62	$1,032	$377.25	$654.75	$163,440	$56,772	$220,212
2015	234.34	$923	$434.29	$488.71	$114,524	$54,000	$168,524
2016	246.34	$942	$423.41	$518.59	$127,749	$27,000	$154,749
2017	491.08	$979	$423.13	$555.89	$272,979	$54,000	$317,979
2018*	0	$1,015	n/a	n/a	n/a	n/a	$0

* April 15 through May 31, 2018.

** MWD Tier I limit / Tier II Purchases in acre feet by calendar year: 2013 (20,699 / 2,927); 2014 (20,699 / 3,289); 2015 (19,966 / 0); 2016 (24,359 / 0); 2017 (24,359 / 0)

*** Weighted average of JPA wholesale rate. Published rates: FY13: $454.78; FY14: $407.27; FY15: $373.72; FY16: $436.96; FY17: $423.41; FY18: $423.13

As shown in Table 3, between April 15 and May 31, 2017, an estimated 1,049 acre-feet (AF) of potable supplement was used in the recycled water system. The potable supplement would have been reduced by 491.08 AF, if the flow augmentation had not been required, with a corresponding savings of $317,979.

Table 3 – Potable & Well Water Supplement to the Recycled Water System - 2017[1]

	Morrison (AF)	Res 2 (AF)	Cord. Tank (AF)	Total (AF)	Total (MG)	Well Water (AF)
April	.1	0.0	0.0	.1	0.03	7.2
May	1.8	0.0	0.0	1.8	0.60	47.2
June	25.1	72.4	0.0	97.5	31.80	73.1
July	49.6	201.0	23.5	274.1	89.3	63.9
August	51.3	256.0	2.9	310.2	101.1	63.7
September	22.7	177.0	0.0	199.7	65.1	63.0
October	5.8	159.8	0.0	165.6	54.0	59.3
November	0.0	0.0	0.0	0.0	0.0	0.0
Total	156.4	866.2	26.4	1049.0	341.8	377.8

[1] JPA Recycled Water sales during this period totaled 5,414 acre-feet of water (including potable water supplement and well water). Potable supplement as a percentage of recycled water sold equals approximately 19% for this time period.

Table 4 – Potable & Well Water Supplement to the Recycled Water System - 2016[2]

	Morrison (AF)	Res 2 (AF)	Cord. Tank (AF)	Total (AF)	Total (MG)	Well Water (AF)
April	0.2	0.0	0.0	0.2	0.1	9.4
May	0.0	0.8	0.0	0.8	0.3	30.8
June	24.7	85.4	2.1	112.2	36.6	76.8
July	55.4	198.6	12.6	266.6	86.9	65.0
August	51.1	204.5	22.8	278.4	90.7	64.9
September	39.4	154.7	9.4	203.5	66.3	63.9
October	41.4	107.6	1.6	150.6	49.1	48.7
November	8.6	17.2	1.3	27.1	8.8	30.1
Total	220.8	768.8	49.8	1039.4	338.7	389.6

Table 5 – Potable & Well Water Supplement to the Recycled Water System - 2015[3]

	PW-Morrison (AF)	PW-Res 2 (AF)	PW-Cord. Tank (AF)	PW Total (AF)	Total (MG)	Well Water (AF)
April	0.0	0.0	0.0	0.0	0.0	11.4
May	36.2	62.3	0.0	98.5	32.1	12.0
June	73.2	101.5	0.2	174.9	57.0	30.8
July	86.0	167.5	1.8	255.3	83.2	46.0
August	65.4	160.8	2.9	229.1	74.7	70.8
September	78.5	117.8	0.1	196.4	64.0	54.5
October	13.8	52.5	0.0	66.3	21.6	54.6
November	0.3	3.3	0.0	3.6	1.2	19.0
Total	353.4	665.7	5.0	1024.1	337.7	298.9

The total economic impact of the flow augmentation (for calendar year 2017) should also include the loss of $207,792 (491.08 acre-feet at $423.13 per acre-foot) in wholesale revenue. Therefore, the total economic impact of the flow augmentation for 2017 is $525,817. Table 6 provides a summary of fish flow augmentation costs for 2013 through 2017.

Charts 1 & 2 provide actual levels of creek flow augmentation for calendar year 2013 through 2017. Estimates for the total JPA cost for fish flow augmentation are provided in Table 6.

[2] JPA Recycled Water sales during this period in 2016 totaled 5,231 acre-feet of water (including potable water supplement and well water). Potable supplement as a percentage of recycled water sold equals approximately 20% for this time period.

[3] JPA Recycled Water sales during the prohibition period in 2015 totaled 5,245 acre-feet of water (including potable water supplement and well water). Potable supplement as a percentage of recycled water sold equals approximately 20% for this time period.

Chart 1 - Monthly Creek Flow Augmentation

(Million Gallons per Month)

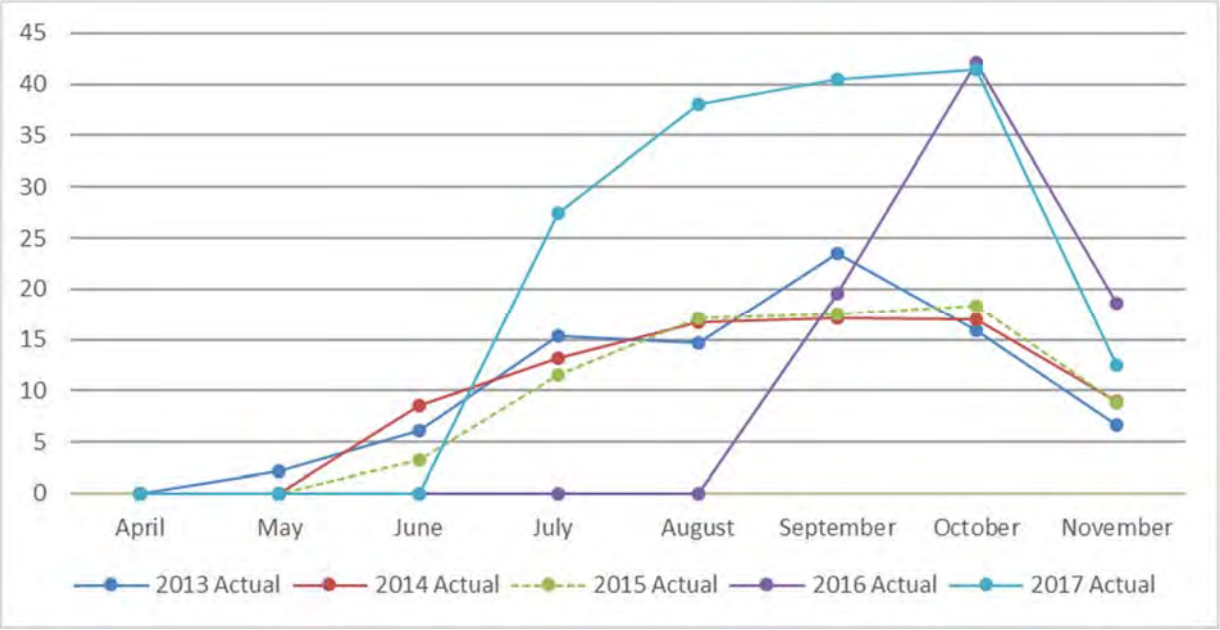

Chart 2 - Cumulative Creek Flow Augmentation by Calendar Year

(Millions of Gallons)

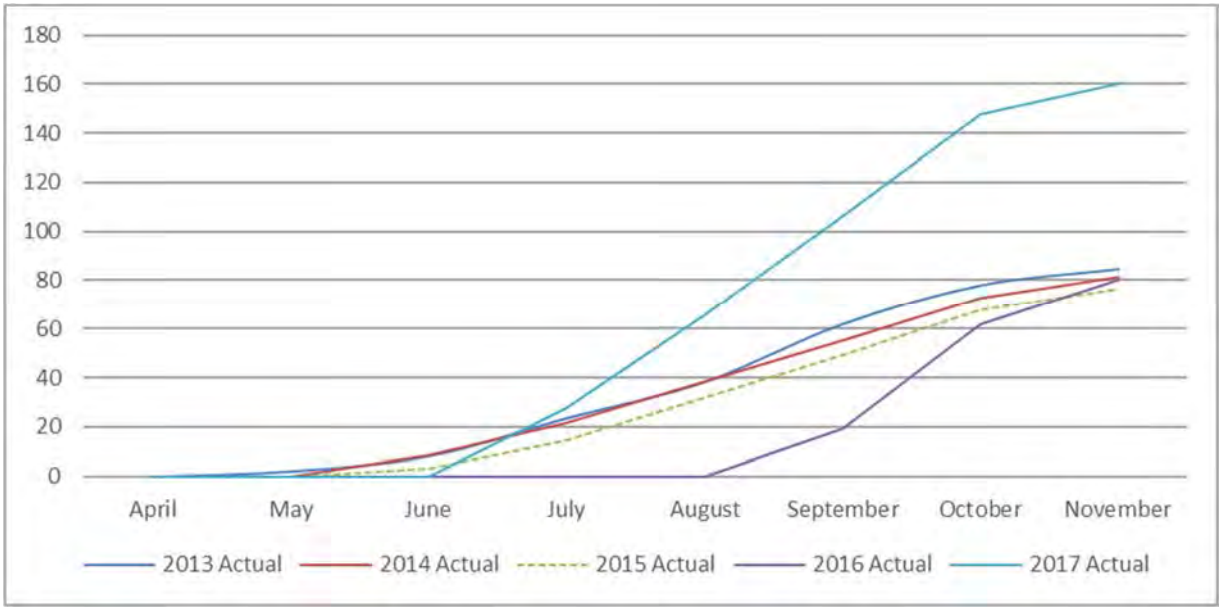

Table 6 – Fish Flow Augmentation Cost Summary

Calendar Year	Volume (MG)	Volume (AF)	Subtotal Water Cost	Monitoring Cost	Wholesale Revenue Loss	Total Cost	Total Cost ($/AF)
2013	84.47	259.2	$151,670	$65,000	$106,755	$323,408	$1,248
2014	81.34	249.6	$163,440	$56,772	$94,172	$314,383	$1,259
2015	76.36	234.3	$114,524	$54,000	$101,772	$270,295	$1,153
2016	80.27	246.3	$127,749	$27,000	$104,303	$259,052	$1,052
2017	160.02	491.1	$272,979	$45,000	$207,792	$525,771	$1,071

ITEM 10C

INFORMATION ONLY

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Pure Water Demonstration Project: Equipment Procurement

---

On June 26, 2018, the Board of the Las Virgenes Municipal Water District Board, acting as the Administering Agent of the Joint Powers Authority, waived the formal bidding requirement and authorized an informal, competitive process for the procurement of treatment equipment for the Pure Water Demonstration Project.

SUMMARY:

Staff proposes to pre-select and procure the treatment equipment for the Pure Water Demonstration Project to allow for final design of the project to be based on the selected equipment configuration and to reduce costs by eliminating the contractor markup for equipment. The treatment equipment consists of modules for ultrafiltration/nanofiltration (UF/NF), reserves osmosis (RO) and ultraviolet light/advanced oxidation (UV/AOP), at an estimated cost of $560,000.

The Las Virgenes Municipal Water District Code requires that goods included in the current budget and costing over $35,000 be purchased using a formal bidding process. Formal bidding requires the development of specifications that are advertised and open to bid by any firm that believes it can meet the requirements of the specifications. Informal bidding also involves the development of specifications, but only select vendors are invited to submit bids. Both bidding processes are competitive in nature.

The treatment equipment for the demonstration project will be unique in a variety of ways that make the use of an informal bidding process most appropriate. The equipment will be unique in size and flowrates, must be flexible to allow for testing, have a proven record of performance and available on a short schedule for project completion. Based on Carollo Engineers' experience, there are a limited number of firms that can provide the equipment for use in the proposed demonstration project.

As a result, staff recommends that formal bidding be waived and informal bidding be used for procurement of the treatment equipment for the project.

FISCAL IMPACT:

No

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

There is no financial impact associated with waiving the formal bidding requirement. A sufficient number of firms will be invited to submit bids on the equipment such that the District obtains competitive pricing.

DISCUSSION:

The treatment equipment for the Pure Water Demonstration Project is estimated to cost $560,000. The Las Virgenes Municipal Water District Code requires that goods included in the current budget and costing over $35,000 be purchased using a formal bidding process. Formal bidding requires the development of specifications that are advertised over a two-week period and open to any firm that believes it can meet the requirements of the specifications. Informal bidding also involves the development of specifications but only select vendors are invited to submit bids. There is often a fair amount of clarification of the specifications during informal bidding, allowing for flexibility in defining the goods.

The UF/NF, RO and UV/AOP equipment for the demonstration project will be unique in the following ways:

- Size: The equipment will need to be sized to fit in Building No. 1, while still providing enough flow for testing and training.
- Flexibility: The equipment, in particular the UF/NF process, will need to be flexible so different equipment, manufacturers and operating modes can be tested.
- Proven Performance:The equipment will need to have a proven record of quality performance, so the testing is valid and rigorous to comply with the requirements of the U.S. Bureau of Reclamation (BOR) grant.
- Current Technology:The equipment will need to use current technology, so operator training is based on current technology, in particular instrumentation and controls.
- Schedule:The completion date for the demonstration project is December 2019 in the BOR grant and mid-May 2019 in the TMDL Implementation Plan, so a shortened procurement time is necessary.

Based on unique aspects of the equipment and the short schedule, staff recommends that formal bidding be waived and informal bidding be used for procurement of the treatment equipment for the demonstration project. Any purchase agreement for equipment will be submitted for approval by the Board. This action is solely for the purchase of equipment, not installation or other construction services. These services will be procured as required by the Las Virgenes Municipal Water District Code and applicable laws.

Carollo Engineers, the firm hired to design the demonstration project, recommends that treatment equipment bids be solicited from the following firms:

1. Ultrafiltration/Nanofiltration
    a. Biwater

    b. H2O Innovations
    c. WesTech Engineering, Inc.
2. Reverse Osmosis
    a. Biwater
    b. Harn
    c. H2O Innovations
3. Ultraviolet/Advanced Oxidation Process
    a. Trojan UV
    b. Wedeco/Xylem, Inc.
    c. Calgon Carbon Corporation

Prepared by: David R. Lippman, P.E., Director of Facilities and Operations

ITEM 10D

INFORMATION ONLY

July 11, 2018 JPA Board Meeting

TO: JPA Board of Directors

FROM: Facilities & Operations

Subject : Tapia SCADA System Upgrade: Request for Proposals

On June 26, 2018, the Board of the Las Virgenes Municipal Water District, acting as the Administering Agent of the Joint Powers Authority, authorized the issuance of a Request for Proposals to develop plans and specifications for the Tapia SCADA system upgrade using either Rockwell Automation PLCs with the Schneider Wonderware HMI or Schneider Modicon PLCs with the Schneider Wonderware HMI.

SUMMARY:

The District uses a Supervisory Control and Data Acquisition (SCADA) system for its wastewater treatment, potable water and recycled water enterprises. The SCADA system provides automation of processes, alarm protocol, data collection for analysis and reporting, and remote control and monitoring of processes and equipment. The SCADA network includes field instruments, programmable logic controllers (PLC), a communication network, and a human machine interface (HMI).

Most of the PLCs installed at the Tapia Water Reclamation Facility and for the water systems are obsolete and no longer available or supported by the manufacturer. The District's current HMI is also obsolete and cumbersome due to its age and modifications that have been made over time. An Ovation Distributed Control System (DCS) was installed at the Rancho Las Virgenes Composting Facility, and the system currently remains fully functional with sufficient available parts and support.

Due to obsolescence of the existing PLCs and HMI for Tapia and the water systems, staff has been planning an upgrade of the SCADA system through a phased approach that would begin with Tapia. Standardization of the PLCs and HMI across the enterprises would provide consistency in equipment and programming and allow staff to focus on specific training and skill sets. To select a standard platform, four PLC/HMI platforms were evaluated taking into consideration the following factors: reliability, life-cycle cost, ease of use, ease of integration and availability of long-term support. Three systems were very close in rating and life-cycle cost. The fourth system had the lowest rating because it has yet to be deployed and had the highest life-cycle cost.

In the mid 1990s, the District had trouble with proprietary software and hardware used to control its SCADA systems. As a result, the District implemented the Wonderware InTouch SCADA software as its HMI and Historian to communicate with all of the different PLCs

installed throughout the system, eventually standardizing on the use of Modicon PLCs.

With the exception of the Emerson Ovation system, all of the platforms were very close in ratings and life-cycle cost; however, the two platforms using the Wonderware HMI would provide a distinct advantage to the District by leveraging the investment already made in the earlier version of the Wonderware software.

Staff recommends issuing a request for proposals to develop plans and specifications for the Tapia SCADA system upgrade allowing the use of either Rockwell Automation PLCs with the Schneider Wonderware HMI or Schneider Modicon PLCs with the Schneider Wonderware HMI.

FISCAL IMPACT:

No

ITEM BUDGETED:

Yes

FINANCIAL IMPACT:

There is no financial impact associated with issuing a request for proposals. The SCADA upgrades are proposed to be phased with Tapia planned for Fiscal Years 2018-20, the water and recycled water systems in Fiscal Years 2020-22, followed by the Westlake Filtration Plant in Fiscal Year 2022-23. Upgrading the SCADA system for the water system will also require an upgrade of the radio-based communication system. Sufficient funds are provided in the adopted Fiscal Years 2018-20 Two-Year Budget Plan for the SCADA system upgrade at Tapia.

DISCUSSION:

The District uses a SCADA system for all three of its enterprises: wastewater treatment, potable water and recycled water. The SCADA system provides automation of processes, alarm protocol, data collection for analysis and reporting, and remote control and monitoring of processes and equipment. Remote control and monitoring is particularly useful in the potable water system with its scattered sites and for stand-by staff who can remotely monitor the system and respond to alarms. Employees organized into four different stand-by shifts (Tapia, Rancho, the water system, and Westlake Filter Plant, when it is in operation) use laptop computers for remote monitoring and control of the systems. The stand-by shifts coupled with use of the SCADA system provide significant cost-savings to the District by avoiding the need for a second shift to provide 24-hour coverage.

The SCADA network includes field instruments, programmable logic controllers (PLC), a communication network, and a human machine interface (HMI). Tapia, Westlake, and the water systems share a common SCADA platform using Modicon PLCs and the Wonderware InTouch HMI. At Rancho, an Ovation Distributed Control System (DCS) was installed when the plant was constructed. The system has been upgraded several times and remains fully functional.

Most of the PLCs installed at Tapia and for the water systems are obsolete and no longer available or supported by the manufacturer. The current HMI is also obsolete and cumbersome due to its age and modifications that have been made over time. The Ovation DCS at Rancho still has sufficient parts availability and support.

Due to obsolescence of the existing PLCs and HMI for Tapia and the water systems, staff has been planning an upgrade of the SCADA system through a phased approach that would begin with Tapia. Standardization of the PLCs and HMI across the enterprises would provide for consistency in equipment and programming and allow staff to focus on specific training and skill sets. Cannon Consultants assisted staff to perform an evaluation of the following four PLC/HMI platforms:

- Rockwell Automation PLCs/Rockwell Automation HMI
- Rockwell Automation PLCs/Schneider Wonderware HMI
- Schneider Modicon PLCs/Schneider Wonderware HMI
- Emerson Ovation OC100

The evaluation considered the following four criteria: operational function and reliability, life-cycle cost, ease of use and integration and availability of long-term support. Importance factors of five, four and three, respectively, were assigned to each criteria, which were then rated on a scale of 1 to 10 with 10 being the highest or best rating. The importance factor and rating were multiplied for a point total with a maximum of 150 points possible. The results were as follows:

Platform	Total Points
Rockwell Automation PLC/Rockwell Automation HMI	118.75
Rockwell Automation PLC/Schneider Wonderware HMI	115.50
Schneider Modicon PLC/Schneider Wonderware HMI	114.43
Emerson Ovation OC100	89.75

As shown in the table above, the Rockwell Automation PLCs/Rockwell Automation HMI has the highest total points, closely followed by the Rockwell Automation PLCs/Schneider Wonderware HMI and Schneider Modicon PLCs/Schneider Wonderware HMI. The Emerson Ovation OC100 system had not yet been deployed, and only Emerson could provide programming and support services, resulting in the lowest total points. The Ovation platform had the highest life cycle cost, while the other three platforms had similar life cycle costs, as shown below.

Platform	Life Cycle Cost
Emerson Ovation OC100	$1,922,333
Rockwell Automation PLC/Rockwell Automation HMI	$1,668,610

Rockwell Automation PLC/Schneider Wonderware HMI	$1,658,410
Schneider Modicon PLC/Schneider Wonderware HMI	$1,556,925

The Rockwell Automation PLCs/Rockwell Automation HMI platform had the highest point total and second highest life cycle cost. This platform is a fully integrated system that has proven to be highly reliable, and Rockwell Automation provides excellent long-term support. However, if this platform was implemented at Tapia and the conversion of the water systems did not proceed, the District would be left with three different SCADA platforms to manage and maintain. As a result, this platform is not recommended.

In the mid 1990s, the District had trouble with the proprietary software and hardware used to control its SCADA systems. As a result, the District adopted the Wonderware InTouch SCADA software as its HMI and Historian to communicate with all of the different PLCs installed throughout the system, eventually standardizing on Modicon PLCs.

The Rockwell Automation PLCs/Schneider Wonderware HMI platform would leverage the reliability and support of Rockwell Automation, while continuing the use of Wonderware for the HMI. The Schneider Modicon PLCs/Schneider Wonderware HMI platform would also continue the use of Wonderware for the HMI with Modicon PLCs, which are very similar to the Rockwell PLCs based on the evaluation.

All the platforms, with the exception of the Emerson Ovation platform, were very close in ratings and life-cycle cost; however, the two platforms using the Wonderware HMI would leverage the investment the District has already made in the software. The Wonderware Intouch System is a tag-based system, and Wonderware's latest system, called System Platform, is an object-oriented system. As a part of the upgrade, the HMI would be upgraded to the object-oriented system.

Staff recommends issuing a request for proposals to develop plans and specifications for the Tapia SCADA system upgrade using either Rockwell Automation PLCs with the Schneider Wonderware HMI or Schneider Modicon PLCs with the Schneider Wonderware HMI.

Attached for reference is a copy of the SCADA Evaluation Technical Report.

Prepared by: David R. Lippman, P.E., Director of Facilities and Operations

ATTACHMENTS:

SCADA Evaluation Technical Report

May 25, 2018

Mr. Eric Schlageter
Senior Engineer
Las Virgenes Municipal Water District
4232 Las Virgenes Road
Calabasas, CA 91302

PROJECT: LAS VIRGENES MUNICIPAL WATER DISTRICT - SCADA EVALUATION

Dear Mr. Schlageter:

Las Virgenes Municipal Water District (LVMWD or District) selected Cannon to conduct a SCADA evaluation of the hardware and software implemented at the LVMWD water and wastewater systems. Currently, the District's water and wastewater systems have a variety of manufacturers and ages of equipment. The outcome of this evaluation will give the District an objective report for selecting the future PLC and HMI platforms. This report is a result of investigation, collaboration with the District, collaboration with vendors, and Cannon's experience with industry best practices and municipal water/wastewater SCADA systems.

The goal of this report is to provide an objective conclusion for standardization and modernization of the District's SCADA systems to provide high reliability, best life-cycle cost, and ease of support for long-term maintenance and expansion.

This report focuses on our findings and the technical data collected during site investigations. The embedded documentation details our evaluation of the different vendors' options for the District's SCADA system. We used a decision matrix to appropriately weight and objectively compare the four major criteria identified by the District in the kickoff meeting and evaluation workshop.

Within the attached document our project understanding and approach explains how we reached the conclusion to our evaluation. I will follow up with you soon about this evaluation. Please feel free to contact me if you would like to further discuss our findings, or if you have any questions about the content of this report.

Sincerely,

David Dutcher, PE
Sr. Principal Controls Engineer
Automation & Electrical Division

Table of Contents

Common Acronyms and Abbreviations

CIP	Common Internet Protocol
DCS	Distributed Control System
DHS	Department of Homeland Security
HMI	Human Machine Interface
IC	Interconnect
ICS-CERT	Industrial Control Systems - Cyber Emergency Response Team (part of DHS)
IDE	Integrated Development Environment
I/O	Input/output
IP	Internet Protocol
LS	Lift Station
MCC	Motor Control Center
MTBF	Mean Time Between Failures
OIT	Operator Interface Terminal
OFS	OPC Factory Suite
OLE	Object Linking and Embedding
OPC	OLE for Process Control
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
SOE	Sequence Of Events
SQL	Structured Query Language
SSRS	SQL Server Reporting Services
TCP	Transmission Control Protocol
UPS	Uninterruptible Power Supply
VM	Virtual Machine
VPN	Virtual Private Network

1. Project Understanding & Approach

LVMWD has a variety of automation infrastructure (i.e. Supervisory Control and Data Acquisition, SCADA) deployed at numerous water, wastewater, and composting facilities. Many of the programmable logic controllers (PLCs) embedded within these facilities are obsolete with no reasonable way to support the infrastructure for the future. To achieve a modern technology and standardized solution, your team requested an evaluation of the current PLC and HMI infrastructure and recommendations for the best available options for upgrading the system. This report provides an analysis and evaluation along with recommendations that will help your team make an informed decision about your future automation infrastructure.

The Tapia wastewater plant has the most pressing needs for SCADA system upgrades, as this site has the highest number of obsolete PLC hardware. The Water Ops facilities also have aging PLC and HMI hardware, but have different technical requirements based on the number of remote sites and the limited functions at each site. This report focused on finding not just gaps at the Tapia facility but gaps across the different facilities, as the final decision must be a common platform for all of the different operations.

Based on our discussions with your team, one of the most significant decisions involves the selection of a reliable and cost-effective PLC platform. Your facilities currently have an installed-base of Modicon PLCs and Ovation DCS (at the Rancho composting facility). The SCADA evaluation is not limited to PLC infrastructure, as the HMI functionality has significant impact to how the Operations team interacts with the control system and field devices. Your facilities currently have an installed-base of Wonderware InTouch HMI and Ovation DCS (only at the Rancho composting facility) for its HMI components.

Based on input from your team, the major SCADA and PLC vendors that were considered as part of this SCADA evaluation were:

- Schneider Modicon PLC / Schneider Wonderware HMI
- Rockwell Automation PLC / Schneider Wonderware HMI
- Rockwell Automation PLC / Rockwell Automation HMI
- Emerson Ovation

We included a hybrid solution in the evaluation after feedback from your team and comparison with industry experience. The installation base of SCADA systems with a combination of Rockwell Automation and Wonderware is well represented in California across water and wastewater systems.

The purpose of this report is to help LVMWD objectively select a SCADA platform from the vendors identified above. Although this evaluation will factor in the existing SCADA infrastructure, the primary decision points will focus on the following:

1. Reliability
    a. Low maintenance and high availability
    b. Reliability of hardware and software
    c. Standardized functionality
2. Life-cycle costs
    a. Initial replacement and installation costs
    b. On-going operational, maintenance and support costs
3. Ease of use and integration
    a. Ease of hardware implementation
    b. Ease of software programs, tools, and implementation
4. Long-term support
    a. Consideration for obsolescence and migration across products/platforms
    b. Vendor reliability and depth of technical support

As part of our analysis and evaluation, we worked with your team to conduct a field investigation of many of the representative sites for the water, wastewater and composting facilities. We leveraged both our investigation findings and the hardware/software inventory created by your staff to serve as the basis for the evaluation and recommendations.

We also investigated current challenges and limitations with the existing system. We identified both the most important functionality to retain and the functionality requested for any future platform. We conducted one workshop with your team during which we honed in on key criteria to evaluate the SCADA system vendor solutions against the District priorities.

We worked with each of the three identified vendors to establish a common SCADA architecture and basis for product offerings. This SCADA architecture will meet the needs and criteria identified during this workshop. We evaluated current market pricing for installation and projected 10-year operational costs.

Additionally, we included an eye toward cybersecurity in our evaluation. We did not include this as one of the decision criteria, per our workshop with your team, but we did evaluate if the vendor products provided an adequate level of security integrated with the hardware/software offerings.

Finally, we summarized the results of our field investigations, workshops and evaluation process in Sections 2 and 3, and provide conclusions and recommendations in Section 4.

As follow-on to this report, your team will need to take steps to create SCADA standards, which will leverage the functionality of the selected vendor's PLC/HMI platforms. For example, the selected vendor platform will provide capability to create global templates for PLC and HMI programs. Your team will define and own these templates for all future installations.

2. Existing Infrastructure

2.1 Tapia Wastewater Plant (WWTP)

Our investigation determined that a majority of the PLCs at the Tapia wastewater facility were Modicon 984 series controllers, which have been obsolete for many years. Additionally, we noted that many of the processors were co-located in a close proximity to each other. In several cases, the PLCs are in adjacent control panels within the same MCC or electrical room.

The existing plant fiber optic infrastructure is for the Modbus Plus network. The fiber optic network extends to every PLC node within the plant and all the SCADA client workstations. This fiber optic network distribution will be helpful for future upgrades. As your team upgrades the PLC hardware to use Ethernet IP communications, the plant can re-purpose the fiber optic network for Ethernet communications between the PLCs and SCADA servers.

The existing SCADA software is a managed Wonderware InTouch application with one main Data Acquisition Server (DAS) located in the Tapia main administration building. There are three Dell servers of varying ages (likely 2-4 years old) located in a server rack adjacent to the control room. In addition to the DAS server, a Historian server and Terminal Server are located in this same server rack. Your team uses Terminal Services for all the SCADA workstations, including Lift Station #1 and #2, which are remote sites. This approach is strategic and allows for standard workstations to run SCADA applications without installing Wonderware software on every workstation. Additionally, this approach leverages the fiber optic network backbone within the plant and extends out to the Lift Stations.

Tables 2.1, 2.2, and 2.3 identify the number and location of the site PLCs and the requirements for replacement.

Table 2.1 – Tapia WWTP PLCs for Replacement

PLC Number	Location on Site	PLC Processor	Requires Replacement?
95	Centrate	984-E275	Y
96	Centrate	Quantum	Y
97	Centrate	Momentum	Y *
97	Centrate	AB	N
5	Chemical	984-E275	Y
25	Chemical	984-E285	Y
37	Chemical	Momentum	Y *
38	Chemical	Momentum	Y *
39	Chemical	Momentum	Y *
6	Control	984-E275	Y
2	CP100	984-E285	Y
33	CP100	984-E285	Y
34	CP100	Quantum	Y
35	CP100	984-E285	Y
1	CP1000	984-E275	Y
7	CP1000	984-E275	Y
9	CP1000	984-E275	Y

29	**CP1000**	**984-E285**	**Y**
36	**CP1000**	**Momentum**	**Y ***
3	Effluent	984-E275	Y
41	Effluent PS	Momentum	Y *
4	Filters	984-E275	Y
10	Filters	984-E275	Y
11	Filters	984-E275	Y
12	Filters	984-E275	Y
13	Filters	984-E275	Y
14	Filters	984-E275	Y
15	Filters	984-E275	Y
16	Filters	984-E275	Y
17	Filters	984-E275	Y
18	Filters	984-E275	Y
19	Filters	984-E275	Y
20	Filters	984-E275	Y
21	Filters	984-E275	Y
22	Filters	984-E275	Y
8	Force Main 2	984-E285	Y
26	Headworks	984-E275	Y
27	Headworks	984-E265	Y
28	Headworks	984-E265	Y
23	Lift Station 1	984-E285	Y
41	Lift Station 1	Momentum	Y *
24	Lift Station 2	984-E285	Y
42	Lift Station 2	Momentum	Y *

* Schneider Modicon vendor has recommended that Momentum processors do not require complete replacement, but a simple replacement of the “top hat” module, which will upgrade the PLC to use the Unity Pro software application while utilizing the existing I/O terminal base.

2.2 Water Operations Sites (Ops)

We conducted site investigations at representative sites to better understand the infrastructure at typical water operations sites, the type of functions represented, and the method of communication to a central location. We opted to not investigate all of the sites, since your staff indicated that there is a high degree of similarity across most of the sites.

The water operations sites communicated data primarily to the main SCADA server at the Operations Building at the LVMWD main facility. There is a secondary connection to the Westlake Filter Plant facility. The water operations SCADA system includes both Potable and Reclaim water facilities.

The existing communication infrastructure consists of a combination of fiber optic networks to the main “hubs” within the water system and serial radio telemetry from these hubs to the remote sites.

The existing SCADA software is a managed Wonderware InTouch application with one main Data Acquisition Server (DAS) located in the District main administration building. There are three Dell servers of varying ages (likely 3-5 years old) located in a server rack adjacent to the control room. In addition to the DAS server, a Historian server and Terminal Server are located in this same server rack. Your team uses Terminal Services for all several key water hubs where the fiber optic network backbone is extended. The selected hubs smartly correlate to the water system hydraulics, such that sites which are most critical to system hydraulics are on the fiber optic network.

Table 2.2 – Water Operations PLCs for Replacement

PLC Number	Location on Site	System	PLC Processor	Requires Replacement?
205	3 Springs PS	Potable	984-E275	Y
205	3 Springs PS	Potable	Momentum	Y *
203	Agoura PS	Potable	984-E275	Y
203	Agoura PS	Potable	Momentum	Y *
204	Argos Valve	Potable	Momentum	Y *
176	Calabasas Tank	Potable	Momentum	Y *
114	Cold Canyon PS	Potable	984-E275	Y
114	Cold Canyon PS	Potable	Momentum	Y *
154	Conduit PS	Potable	984-E275	Y
154	Conduit PS	Potable	Momentum	Y *
202	Cornell PS	Potable	984-E275	Y
175	Dardenne PS	Potable	984-E275	Y
228	Equestrian Tank	Potable	Momentum	Y *
224	JBR PS	Potable	984-E275	Y
224	JBR PS	Potable	Momentum	Y *
107	Jed Smith PS	Potable	984-E275	Y
107	Jed Smith PS	Potable	Momentum	Y *
106	Jed Smith Tank	Potable	Momentum	Y *
223	Kimberly PS	Potable	984-E275	Y
223	Kimberly PS	Potable	Momentum	Y *
222	Kimberly Tank	Potable	Momentum	Y *
92	Latigo Tank	Potable	Momentum	Y *
134	Lower Oaks PS	Potable	984-E275	Y
135	Lower Oaks Tank	Potable	Momentum	Y *
163	LV1 Flowmeter	Potable	Momentum	Y *
15	LV2 PS	Potable	984-E275	Y
108	McCoy PS	Potable	984-E275	Y
110	McCoy Tank	Potable	Momentum	Y *
226	Morrison Tank	Potable	Momentum	Y *
105	Morrison PS	Potable	984-E275	Y
179	Mulwood PRV	Potable	Momentum	Y *
174	Mulwood PS	Potable	984-E275	Y

173	Mulwood Tank	Potable	Momentum	Y *
178	Oakridge PS	Potable	984-E275	Y
209	Ramera Ridge Valve	Potable	Momentum	Y *
136	Ranchview PS	Potable	984-E275	Y
113	Saddlepeak Tank	Potable	Momentum	Y *
229	Saddletree PS	Potable	984-E275	Y
229	Saddletree PS	Potable	Momentum	Y *
227	Saddletree Tank	Potable	Momentum	Y *
208	Seminole PS	Potable	984-E275	Y
208	Seminole PS	Potable	Momentum	Y *
207	Seminole Tank	Potable	Momentum	Y *
112	Stunt Road PS	Potable	984-E275	Y
162	Twin Lakes PS	Potable	984-E275	Y
164	Twin Lakes Tank	Potable	Momentum	Y *
133	Upper Oaks PS	Potable	984-E275	Y
209	Upper Oaks Tank	Potable	Momentum	Y *
156	Upper Twin Lakes PS	Potable	984-E275	Y
153	Warner PS	Potable	984-E275	Y
153	Warner PS	Potable	Momentum	Y *
172	Warner Tank	Potable	Momentum	Y *
206	Westlake PRV	Potable	Momentum	Y *
155	Woolsey Tank	Potable	Momentum	Y *
177	005 Flowmeter	Reclaim	Momentum	Y *
2	Cordillera Reservoir	Reclaim	984-145	Y
231	County Line Flow	Reclaim	Momentum	Y *
103	Indian Hills Tank	Reclaim	Momentum	Y *
232	Morrison PS	Reclaim	984-E275	Y
225	Oakpark PS	Reclaim	984-E275	Y
136	Parkway PS	Reclaim	984-E275	Y
104	Reservoir 3	Reclaim	Momentum	Y *
1	RWPS	Reclaim	984-E275	Y
230	Westlake Wells	Reclaim	984-E275	Y
230	Westlake Wells	Reclaim	Momentum	Y *

* Schneider Modicon vendor has recommended that Momentum processors do not require complete replacement, but a simple replacement of the “top hat” module, which will upgrade the PLC to use the Unity Pro software application while utilizing the existing I/O terminal base.

2.3 Westlake Filter Plant

Our investigation determined that a majority of the PLCs at the Westlake Filter Plant were Modicon 984 model controllers, which have been obsolete for some time. This plant does have a few newer Modicon M340 PLCs using Unity Pro application in the Filter Room.

The existing plant infrastructure allows for both Ethernet and Modbus Plus networking. The physical size of the plant is limited; therefore, the PLC panels are all in close physical proximity. As your team upgrades the PLC hardware to use Ethernet IP communications, the plant can re-purpose the fiber optic network for Ethernet communications between the PLCs and SCADA servers.

The existing SCADA software is a managed Wonderware InTouch application with one main Data Acquisition Server (DAS) located in the Westlake Filter Plant main administration building. There are two Dell servers of varying ages (likely 2-4 years old) located in a server rack adjacent to the control room. In addition to the DAS server, a Historian server and Terminal Server are located in this same server rack. Your team uses Terminal Services for all the site workstations, including several of the "hub" locations within the water system.

Table 2.3 – Water Operations PLCs for Replacement

PLC Number	Location on Site	PLC Processor	Requires Replacement?
23	Plant	E984-285	Y
11	Filter 1	E984-275	Y
12	Filter 2	E984-275	Y
13	Filter 3	E984-275	Y
14	Filter 4	E984-275	Y
15	Filter 5	E984-275	Y
16	Filter 6	E984-275	Y
17	Filter 7	E984-275	Y
18	Filter 8	E984-275	Y
19	Filter 9	E984-275	Y
20	Filter 10	E984-275	Y
21	Filter 11	M340	N
22	Filter 12	M340	N
25	LCP 25 - Chemical	E294-285	Y
26	LCP 26 -	E294-285	Y
27	LCP 27 - Torchwood Tank	Momentum	Y *
14A	RTU - 14A - Pump Station	M340	N

* Schneider Modicon vendor has recommended that Momentum processors do not require complete replacement, but a simple replacement of the "top hat" module, which will upgrade the PLC to use the Unity Pro software application while utilizing the existing I/O terminal base.

2.4 Rancho Composting Facility

Your management team specifically noted that the Rancho Composting Facility would not be subject to upgrade based on the recommendation of this evaluation. However, Emerson Ovation is one of the considered SCADA platforms for this evaluation, so we conducted site investigations to understand the Ovation infrastructure and how the District implemented the DCS at this facility.

The Ovation system uses five main controller cabinets distributed in each building within the facility. These controllers are all the OCR-400 series controllers. Each controller has a redundant pair and redundant network components for communication to the control room.

Your staff noted that recent requests for support for this facility were met with extremely costly estimates. In the kickoff meeting and workshop, we noted District concerns about the long-term costs with the Ovation DCS system.

The existing plant communication infrastructure uses fiber optic network which uses a proprietary bus communication between the main DCS servers and the controller cabinets.

2.5 Existing Hardware/Software Reliability

2.5.1 Redundancy & Failure Points

Your team's approach to the various systems is simple regarding hardware redundancy. The main approach for redundancy is to have a shelf-spare for the critical nodes within the system. This is problematic for the sites that have obsolete controllers and creates risk for the District, as they have a very limited number of replacement components.

Your staff has done a good job in tracking PLC applications for each site. Each site has a thumb drive in a sealed envelope with a tracking sheet for District staff or contractors to note changes. This approach allows for immediate access to the latest software application in the event of a hardware failure and replacement.

Figure 2-1 – Example Modbus Plus gateway module

The SCADA system relies upon three separate physical servers, so the functionality of the SCADA system is distributed across those servers.

For data to communicate between the existing Modicon PLCs and the SCADA system, the District uses specialized gateway modules, which convert from Modbus Plus to Modbus TCP. The District has found good success with these units and fortunately has had few issues limiting data monitoring and control, as this is a single-point of failure for the data communication to the PLCs.

2.5.2 Power & Backup Power

Most of the sites within the water system have generator backup options for power to the site and the PLC control panel. The District has standardized a simple and effective means for battery

backup using standard “off the shelf” car batteries, power chargers, and voltage. This approach has allowed your staff to maintain health in batteries and reduce costs.

Figure 2-2 – Water Operations panel with standard battery backup

2.5.3 Alarm Notification

In each SCADA server identified above, the District has implemented three different systems at each of the facilities:

- Tapia WWTP — Hardware redundant alarm dialer at PLC-6
- Westlake Filter Plant — Win911 alarm software, modem & dialer
- Water Operations — SCADAlarm 5.0 software, modem & dialer

The alarm notification is a call-out system to pre-selected list of operators. There is limited redundancy or fail-over capability in the system, so periodic checks of the system are required to validate alarm notification is operational.

Figure 2-3 – Water Operations SCADA server rack with external modem

2.6 Existing Telemetry & Networking

The District has invested in fiber optic throughout all of their SCADA system. In the case of the three main plants, this fiber optic network is the backbone for all communications. The use of fiber optic networks will pay dividends as your team can use this infrastructure for Ethernet communication in future upgrades.

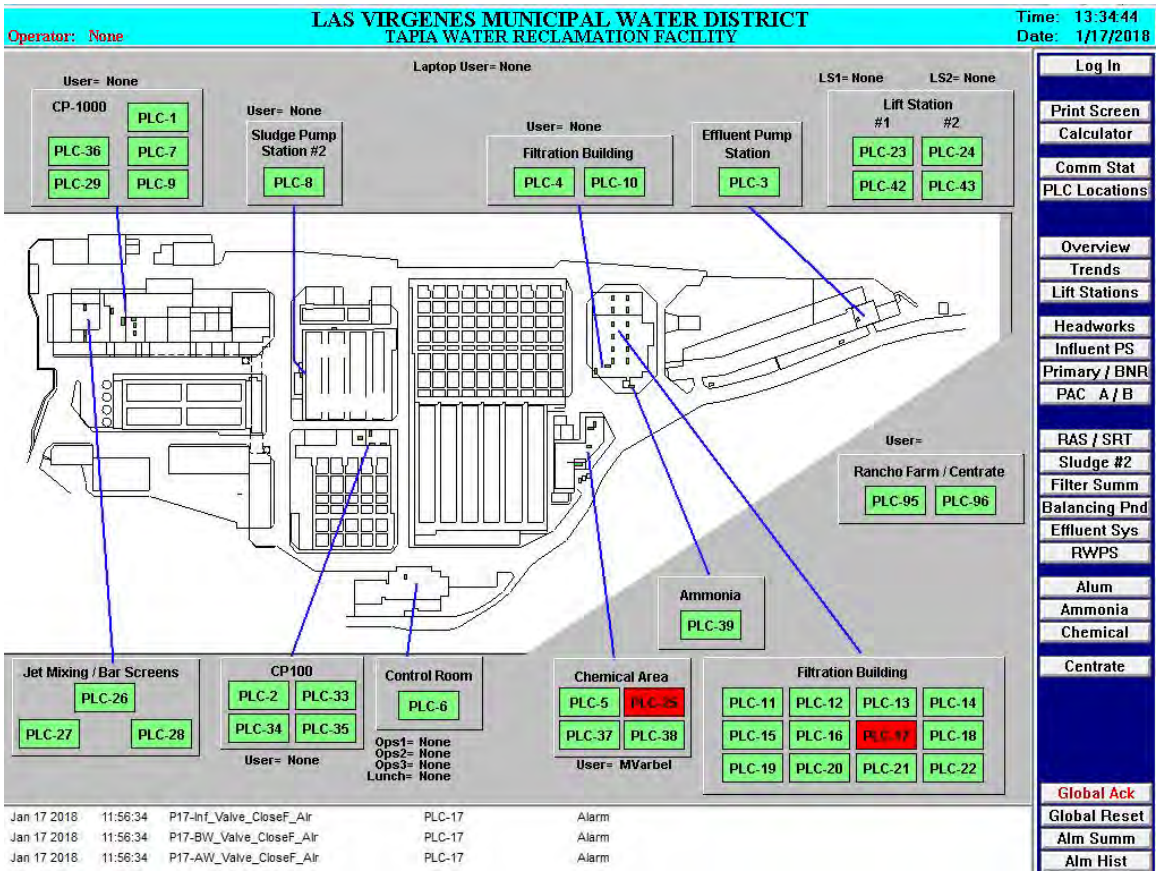

Figure 2-4 – Tapia WWTP SCADA Overview showing PLC locations

For the Water Operations sites, the combination of fiber optic infrastructure with serial radios allows for effective communication to the remote sites. The District uses GE MDS 9810 serial radios on the ISM bandwidth (902-928 MHz). The radios operate at 19,200 baud-rate, which is a low data bandwidth. These radios are obsolete, so there are limited spare parts to support radio failures. Your staff has noted that the radios have been robust and they have experienced limited failures with the telemetry/radio system. There are some limitations in the data bandwidth to the remote sites via serial radios, but your team uses smart techniques to limit the data throughput required.

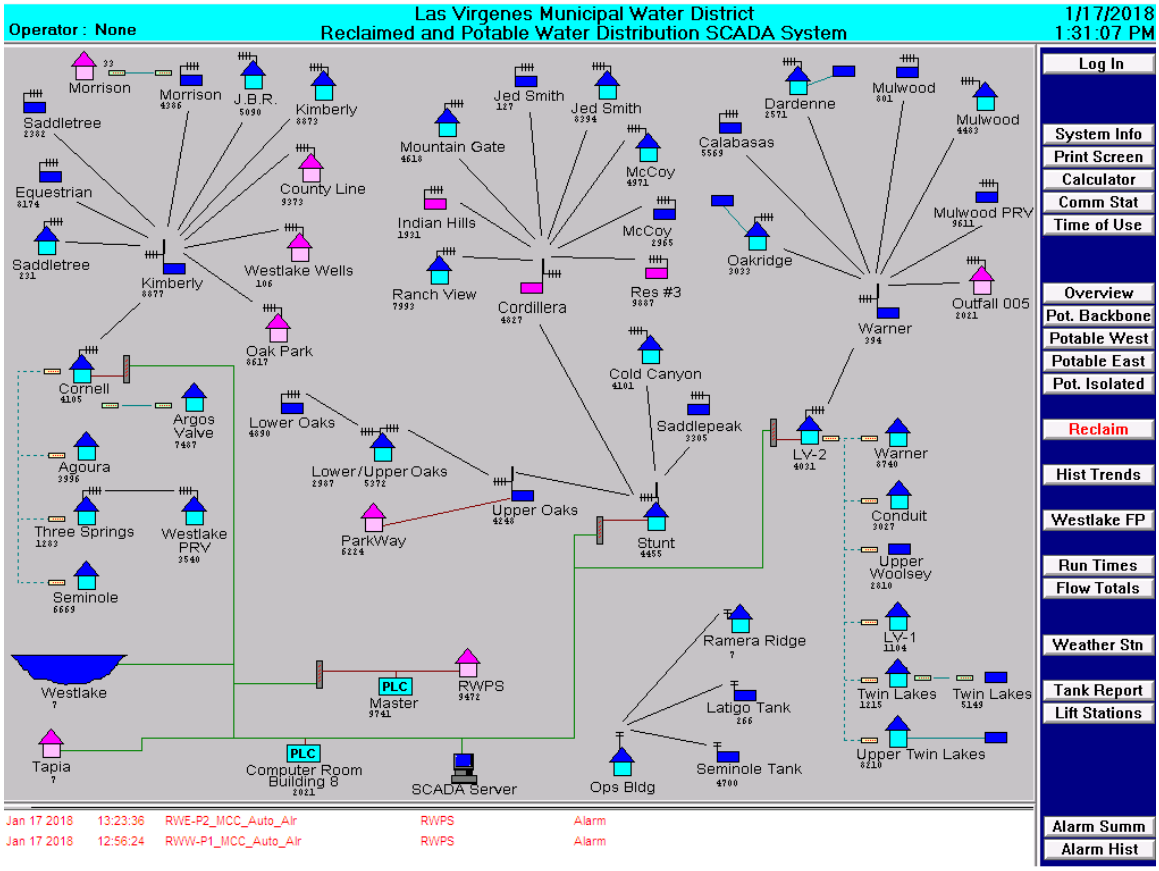

Figure 2-5 – Water Operations SCADA Overview showing telemetry

2.7 Evaluation Workshop

A significant part of the SCADA evaluation was conducting interviews of your team, ranging from operators, to maintainers, to managers. We directed a workshop to delve further into the system requirements and the attributes of the SCADA system that would be required for long-term success. Your team helped identify critical success factors for the

The following are the items that your team identified as positive functions that are working correctly in your current SCADA system. Your team identified these functions as critical to include/retain in the new SCADA system, regardless of vendor:

- HMI screen layouts are effective overviews, easy to use and allow for easy training of new operators. Overview has rough hydraulic and process layout.
- Ease of Alarm Notification or “Spotting a Problem” in the system. When an alarm is generated in the alarm banner, there is a shortcut to the exact HMI graphic in question. This helps operators “zero in” on the problem quickly.
- Common alarms exist for most items, so operators generally do not worry if they are not getting all the alarm status.
- Technicians and maintenance staff noted that spare capacity exists in the current system. Future PLC and HMI systems need to be built with spare capacity in mind.
- Connections from the SCADA system to Excel, Hach WIMS, or other user-friendly interface are very helpful for operators and managers.
- Your staff identified that trending tools are frequently used and very effective in analyzing the process and upset conditions.

From this evaluation workshop, we also identified areas for improvement to the existing SCADA system. The following are recommendations that were identified as areas for improvement for any future SCADA system, regardless of vendor:

- Recommend standardized logic and graphics, which will allow your team to better support and maintain your own processes and control system infrastructure.
    - Standardized, object-oriented blocks need to be the building blocks of the new system. This will ensure that a pump object will function and look the same across all the sites, leading to ease of troubleshooting and maintenance.
    - This will also reduce project costs when external integrators are required to support projects or upgrades.
- Recommend display of Process and System Interlocks for most processes and equipment
    - PLC programs currently have hard-coded interlocks, such that Operators cannot troubleshoot or resolve process upsets without programmer intervention, even for simple items. Interlocks need to be included on the HMI graphics.
    - Timing for PLC logic, such as start delays or alarm delays need to be included on the HMI graphics.
- Recommend the addition of better descriptors to tagging, alarms, and other displays so that “layman” or junior operator can understand the graphics.
- Recommend improved reports or dashboard functions that can be customized for managers or operators.
- Recommend standardization of PLC hardware to match across Tapia, Westlake and Water Ops facilities, at a minimum.
    - This is ensure adequate shelf spare capacity without maintaining a large inventory.
- Recommend improved redundancy to reduce single-point-of-failure, where possible. This approach will be important for both hardware and software
    - Power issues seem to be the most prevalent regarding failures. Current approach to battery backups and power uses standard off-the-shelf car batteries which
- Recommend improved documentation per site and per SCADA system.
    - The current documentation is custom per site and difficult to find.
    - Your team understands that retroactive “as-built” documentation can be costly, but future implementation needs to include detailed documentation (electronically and hardcopy).

Based on this input, it was clear that regardless of PLC and HMI vendor selected, there is a significant upgrade of the SCADA system to incorporate the standardization of hardware, logic and graphics associate with each of the facilities. As a result, we included significant engineering and programming effort estimate in the initial cost comparisons.

3. SCADA Evaluation

3.1 Reliability

From the very beginning of this evaluation, it was clear that your team wanted to make the most reliable choice for a new SCADA platform. The chosen PLC/HMI hardware and software should provide reliability for the next 10 to 15 years. One of the biggest frustrations expressed in the kickoff and workshop meetings was the age of your current PLC hardware. A majority of Tapia WWTP and the Water operations sites are operating with obsolete PLC platforms. In order to get spare parts or maintain these systems, your staff has to resort to drastic measures.

For the District to improve reliability in the chosen SCADA system, they also must be less dependent on the vendors or system integrators. Your engineers and technicians want to take more ownership in the final SCADA solution, thus increasing their ability to support the control system into the future. To do this the hardware and software tools chosen must have ease of use, good standardization and have proven support.

3.1.1 Hardware Reliability

Reliability of the selected PLC hardware is a key issue for replacing the existing PLCs. We did not evaluate hardware reliability of off-the-shelf networking or computer components (such as network switches, computer workstations, servers, etc.) As a result, we focused the hardware reliability factor on the PLC/DCS vendor specific hardware, including PLC processors, I/O modules, PLC power supplies, etc.

We evaluated hardware reliability for the selected vendors based upon several factors:

- Installation base of selected replacement PLC hardware in the region
- Point in the lifecycle of the selected replacement PLC hardware
- Mean Time Between Failure (MTBF) for the selected PLC hardware
- Frequency of returns for the selected PLC hardware

We solicited input from each of the vendors regarding this data. Based on the responses from the vendors, we have a variety of models presented. Table 2.1 identifies the selected hardware platform from each vendor. To maintain the maximum standardization across all the sites, the platforms can be restricted even further than the selected alternatives. This may increase costs, but reduce the on-the-shelf inventory.

Table 3.1 – Selected PLC/DCS Hardware for evaluation

	Rockwell Automation	**Schneider Modicon**	**Emerson Ovation**
PLC/DCS Controllers Selected	**Model**	**Model**	**Model**
Medium PLC/DCS hardware	CompactLogix L33	M580	OCC100
Compact PLC/DCS hardware	CompactLogix L24	M340, Momentum	OCC100
Remote I/O	Flex I/O	M580, Momentum	N/A

We found that the Rockwell Automation CompactLogix platform is a very robust solution, which is easily expandable and easily accommodates Remote I/O via Ethernet. The CompactLogix has been on the market for over a decade with a very strong market base in California. It is still early in the product lifecycle and Rockwell Automation has asserted this platform will be supported well beyond 15-20 years, based on previous lifecycles with PLC-5, SLC-5 products. There are two versions of the CompactLogix platform we selected for the control system architecture. The CompactLogix L24 is a good choice for remote sites with consolidated power, networking, limited I/O and simple functionality. The CompactLogix L33 is a good choice for Tapia WWTP, Westlake Filter Plant or any location where the Flex I/O will extend the I/O monitored and controlled. There are memory limitations with the CompactLogix L33 processor, but after two rounds of review,

Rockwell Automation validated that the I/O requirements at Tapia WWTP will work with the PlantPAx architecture.

The substantial install-based of processors and the reliability of the supporting software tools to support the hardware (Logix base software) have a wide acceptance in the market. The return rate and failure rate was very low on the CompactLogix and Flex I/O platforms

Figure 3-1 – Rockwell Automation CompactLogix L24 & L33 controllers

For the Schneider Modicon PLC controllers selected, we determined there is a good market base in the Momentum and M340 platforms. The Modicon Momentum platform has been on the market for over two decades. Modicon has smartly modernized this platform without abandoning the form-factor. Momentum Unity Pro base PLCs are reliable and have a good track-record in the market. As a result, the Modicon vendor has recommended that Momentum installations do not require complete replacement, but a simple replacement of the “top hat” module. This will change to Ethernet-based, Unity Pro compatible processor. This will upgrade the PLC to use the Unity Pro software application while using the existing I/O terminal base. The Modicon M340 is a newer product in the lifecycle, but was launched in 2007. This rack-based solution brings good memory, power and modularity, but has some limitations in Remote I/O supported via Ethernet and ease of significant in-panel expansion (typical with most rack-based PLC platforms). The M340 does have limitations in remote I/O capability, as any additional M340 I/O bases have to be connected via Modbus Plus data bus not Ethernet, which has distance limitations.

Figure 3-2 – Schneider Modicon Momentum & M340 controllers

For the Emerson Ovation PLC controller selected, the Emerson vendor determined that the compact OCC100 platform would be ideal for the I/O quantities identified at Tapia WWTP, Westlake Filter Plant, and Water Operations sites. The OCC100 is approximately 60% less cost than the OCC400 controller (the controller used at Rancho Composting Facility) with many of the strengths and features of the standard Ovation system.

The OCC100 is just now in production and is in the infancy of the product lifecycle. Based on information from Emerson, they anticipate the first installations of this product to occur by April 2018. Some intangible costs may be associated with the OCC100, as the form factor of the product may require more significant modifications to the existing control panels at the remote sites.

Figure 3-3 – Emerson Ovation Compact Controller (OCC100) shown without I/O modules

Comparison of the MTBF and reliability data provided from the vendors indicates that all the vendors have robust hardware that will generally last 40-50 years, which outlasts the 10-15 year target range identified in this evaluation. It was difficult to get solid data on MTBF, as the vendors calculated the information differently. However, Rockwell Automation reliability numbers were the highest reliability, exceeding 50+ years for processor and remote I/O solutions. Reliability of hardware can be difficult to compare, based on the fiscal realities of maintenance. For example, if failed items (such as a power supply) were cheaper to replace than to return/repair, end users generally opted to not return or repair the hardware. This leads to reliability numbers which may be skewed for common hardware items, such as power supplies.

As a result, one of the best strategies for mitigating hardware failures is to standardize the hardware as much as possible and maintain limited shelf spares for processors, power supplies and I/O modules.

3.1.2 Software & Communication Reliability

Your team noted concerns with comparison between Modbus TCP and Rockwell Automation CIP protocol. Based on initial investigation, we determined that Modbus TCP does have a slightly more compact structure, but the CIP will not provide a prohibitive bandwidth. In particular, this seemed to be a factor for radio communication to remote sites. However, when using the 902-928 MHz bandwidth for radio telemetry, the bandwidth limitations are minimal.

This software reliability topic also focuses on the reliability of communication and tolerance for interrupts to the communication system. Based on initial research we determined that the communication differences we looked at are minimal and will not create any substantial impact to the performance of the SCADA system. In the case of Emerson Ovation system, the proprietary bus communication uses Ethernet IP for communication between the control room and the controller nodes. The bandwidth requirements were not fully vetted or identified, but Emerson validated that communication via Ethernet radio was viable.

As part of the communication reliability between the centralized SCADA system and the remote sites, especially in the Water Ops system, the telemetry system will require upgrades. The current

radio and PLC hardware will not support Ethernet communication. As a result, when the PLC hardware is upgraded the telemetry system must be replaced at the same time. The overall architecture for the Water Ops system may remain similar, but all serial radios will need upgrade to Ethernet radios. The antenna cable and antenna infrastructure may remain the same, as we recommend maintaining the existing radio frequency of 902-928 MHz.

3.1.3 Standardized Logic

We noted a chief concern in the workshop meeting regarded standardization of the PLC and HMI functionality so that the District will gain more autonomy and ability to support the PLC logic and HMI applications. Specifically, the District wants the ability to solicit support from a variety of system integrators and yet get the same quality of PLC logic. Your team is looking for standardized solutions supported by the vendor, not just applications that are the product of an arbitrary or specific system integrator's template. For this evaluation, the more standardization supported by the vendor resulted in higher scores in the decision matrix.

The Rockwell Automation solution evaluated is widely advertised as their PlantPAx solution. This approach is dependent on running Rockwell Automation PLC and HMI applications. When using PlantPAx, your team and your chosen system integrator(s) can implement vendor-supported templates which are validated to perform in the specific application. Additionally, by using the vendor-supported templates, the Rockwell Automation tech support staff will be able to provide easy support troubleshooting or resolution for any PLC logic or HMI function. Even if the PlantPAx solution is not implemented, the Rockwell Automation PLCs have advanced Add-On Instructions (AOIs) which support object-oriented programming, including nesting of multiple levels of objects.

The current Schneider Modicon and Wonderware solution relies on tag-based mapping to translate the data from Modicon Unity Pro application to Wonderware InTouch application. However, the new Wonderware System Platform solution allows for object-oriented connection direct to the Unity Pro application and the controller. The Unity Pro software uses DDTs (Derived Data Types) and DFBs (Derived Function Blocks) and has good function block utilities, which allows the user to create standardized tag and logic templates. Wonderware System Platform uses object templates that can parallel the Unity Pro DDTs. The new Wonderware System Platform objects can be display side-by-side with the older Wonderware InTouch application. As a result, this allows your team to implements the new SCADA graphics without having to abandon the old SCADA application in an "all or nothing" approach. This approach can be tedious and add more development/programming time to SCADA application.

The Emerson Ovation solution has standardized logic that is maintained by the vendor, as they self-perform implementation of their DCS system. As a result, there is standardization at the vendor level. They have maintained multiple iterations of Ovation DCS and develop updates to the system on a yearly basis. From information provided by the vendor, it seems that periodic updates are required to implement major updates.

3.1.4 Alarm Management

Alarm management strategies have had significant improvements in the last five years, especially with the advent of the ISA 18.2 Alarm Management standard. Improved alarm management can reduce the workload and improve situational awareness for the operator. SCADA software platforms have integrated functionality to aggregate alarms, shelve alarms, and better identify alarms as part of their standard offering. Alarm management should help operators identify the root cause behind the alarm notification. Additionally, the alarm management should give operators a flexible approach to properly deal with non-critical alarms

Based on initial investigation, we determined that Rockwell Automation and Emerson have the most sophisticated alarm management, where the SCADA software application does incorporate

the recent ISA standard. Furthermore, Rockwell Automation has developed PLC-level objects and functionality for alarm management. This increases the reliability of the alarm management approach, since the PLC platform has a statistically higher MTBF than alarm management software running on a standard computer workstation or server.

Wonderware System Platform does have the ability to provide alarm severity and management, but the features associated with this functionality require more customization and scripting than that required of the other vendors. However, System Platform structure does allow for easy filtering based on “Area”, which is pre-built into the structure of the application.

Alarm notification (via phone, text or e-mail) is a critical part of alarm management, especially when your operators are typically not occupying the control room on a regular basis. Based on interviews with your team, it was clear that your operators are frequently in the field and not in front of the SCADA application. As a result, the alarm notification system holds a priority in any future upgrade.

For Emerson Ovation, the alarm notification is integral to their system. For Rockwell Automation and Wonderware, there are third party solutions recommended for alarm notification. As noted in the investigation above, the styles of alarm notification vary at each facility. We recommend that improvements in the alarm notification system to allow for more redundancy. This will provide more confidence in the alarm system.

3.1.5 Data Storage & Retrieval

Based on feedback received from your team, we included an evaluation of the Historian software included as part of any SCADA software package. The Historian software is critical for long-term storage of key process data, parameters, events and alarms. Effective trending is dependent on efficient storage and retrieval from the Historian server. We evaluated the reliability, ease of configuration and effectiveness of data retrieval of the Historian products.

Wonderware Historian is a robust platform, using SQL database “under the hood”. Wonderware System Platform integrates extremely well with Historian, such that very little configuration is required to add tags into the Historian from the System Platform IDE. The Wonderware Historian Client tool is very user-friendly and provides intuitive interface for users. Previous versions of Wonderware Historian have had challenges with the speed of data retrieval for trends and queries using the Historian client or embedded InTouch trends. Wonderware System Platform 2017 release has resolved many of the speed issues. Wonderware also offers Excel plug-in tools that allow managers and technicians to combine SCADA data with other lab, maintenance, or operational data in a simple spreadsheet retrieval. Wonderware reporting can be very simple using SQL Server Reporting Services (SSRS) or Dream Reports, offered by Wonderware.

Rockwell Automation FactoryTalk Historian also uses SQL database for data storage and retrieval. This solution was formerly OSI Pi and integrated into the Rockwell Automation product suite over 10 years ago. The FTHistorian solution is a well-integrated solution, as PlantPAx integrated architecture allows the Historian to see down to the PLC objects/tags with ease. Rockwell Automation offers several Historian client options: Processbook, VantagePoint dash-board display, and Excel plug-in tools are very helpful features for managers and technicians.

Emerson Ovation Process Historian also uses SQL database. Sequence Of Events (SOE) history review tool supports the retrieval of this data into a chronologically ordered list in response to queries. The operator can access alarms, events, and other process data to analyze upset conditions or alarm events. The scalability of the Ovation controller is good, as it can handle up to 200,000 tags, though the pricing received from vendor did not indicate this tag count. Ovation supports reporting via SAP Crystal Reports, which is a powerful but expensive reporting platform.

3.2 Total Life Cycle Costs

Your team has emphasized that total life cycle costs is not the most important metrics, but a very key metric that will support their decision for SCADA upgrades in the future. In our evaluation, we determined total lifecycle costs to be comprised of the following:

- Initial Installation Costs
- Operations & Maintenance Support Costs
- Training Costs

3.2.1 Initial PLC Hardware Costs

Using the PLC inventory developed by the District and our field investigations, we made design decisions to provide the most reliable and standardized PLC infrastructure with the lowest possible cost. We developed a preliminary PLC architecture for each of the water systems using these criteria. Based on our industry experience and these criteria, we selected the best offerings from the hardware vendors.

Several of the assumptions and decisions we made provided the most consistency in the comparison of the PLC hardware vendors. Here are the decisions that led to our PLC hardware selection and basis for hardware comparison:

- Tapia WWTP:
    - We targeted reduction of the PLCs, using Remote I/O racks where possible to consolidate PLCs. We generally focused around each of the major plant processes.
    - Where the existing PLCs had a significant number of I/O, we opted to use the Medium PLC (CompactLogix L33 and M580). We validated that expansion and memory capacity of these controllers for the functions identified. For Rockwell Automation PLCs, we revisited the memory requirements with the vendor. They validated that the CompactLogix L33 could serve a PlantPAx approach in the Tapia WWTP application.
    - For the replacement of the Filter PLCs and other PLCs with limited I/O, we opted to use the Compact PLCs (CompactLogix L24 and M340). We chose to use Individual Filter PLCs to provide the maximum process redundancy for the plant.
- Water Ops:
    - We targeted use of Compact PLCs throughout.the system, as there are limited I/O and functions per site.
    - For existing Momentum PLCs, we opted to retain the existing installation and simply replace the Momentum PLC “top hat”. We chose to use an Ethernet-based Unity Pro version of the Momentum PLC. This helped reduce the Schneider Modicon PLC costs for these sites.
- Westlake Filter Plant
    - We did not consolidate the existing PLCs at this facility, as there is already a limited number of PLCs. We chose to use Individual Filter PLCs to provide the maximum process redundancy for the plant.
    - We opted to use a blend of the Compact and Medium PLCs, based on the I/O and memory requirements. At this facility, all the Modicon PLCs were selected to be M340s. Due to memory limitations of the CompactLogix L24, we opted to use CompactLogix L33 for PLCs with more I/O and memory requirements (such as the main Plant PLC,
    - For the replacement of the Filter PLCs and other PLCs with limited I/O, we opted to use the Compact PLCs (CompactLogix L24 and M340).

After we developed the proposed PLC architecture, we tasked vendors to provide cost estimates for the PLC hardware replacement. **We ensured that vendors based quotes upon standard system integrator pricing and not project-specific pricing**.

We focused our cost comparisons on PLC hardware replacement. We did NOT include all project costs associated with replacement of these PLCs. We considered the costs associated with standard control panel hardware (power supplies, terminal blocks, relays, etc.), telemetry and other hardware appurtenances equal across the proposed vendor options. These are not included here.

To provide equitable comparison of the PLC hardware and reduce the number of PLCs at the Tapia WWTP and Westlake Filter Plant, we provided vendors with the anticipated PLC architecture and locations where Remote I/O would be feasible.

- For example, at the Tapia WWTP Centrate process area, we identified PLC 96 would be the primary PLC, while functions for existing PLCs 95 and 97 would be accomplished via Remote I/O.

We received quotes from Rockwell Automation and Schneider Modicon vendors, which broke down the costs to the individual component level. We have provided a sample cost break-down for the Tapia WWTP in Appendix C. We did not receive a cost breakdown from Emerson Ovation hardware, but a lump sum quote. As a result, we evenly distributed the lump sum cost across the PLCs in question.

As shown in the tables below, the Modicon PLC hardware solutions are the most cost-effective.

Table 3.2. – PLC Hardware Install Estimate of Costs for Tapia WWTP

PLC Number	Location Site	PLC/ RIO	Rockwell Price	Modicon Price	Ovation Price
95	Centrate	RIO	$2,318	$1,846	$2,555
96	**Centrate**	**PLC**	$7,362	$8,608	$2,555
97	Centrate	RIO	$4,154	$2,493	$2,555
5	Chemical	RIO	$4,154	$2,049	$2,555
25	**Chemical**	**PLC**	$5,620	$7,899	$2,555
37	Chemical	RIO	$4,614	$2,660	$2,555
38	Chemical	RIO	$4,614	$2,333	$2,555
39	Chemical	RIO	$4,614	$2,660	$2,555
6	**Control**	**PLC**	$5,729	$3,087	$2,555
2	CP100	RIO	$7,154	$4,412	$2,555
33	**CP100**	**PLC**	$5,894	$8,005	$2,555
34	CP100	RIO	$5,194	$3,706	$2,555
35	CP100	RIO	$4,154	$3,413	$2,555
1	CP1000	RIO	$4,614	$2,876	$2,555
7	CP1000	PLC	$5,837	$7,755	$2,555
9	CP1000	RIO	$5,070	$2,919	$2,555
29	CP1000	RIO	$5,712	$2,633	$2,555
36	CP1000	RIO	$1,920	$1,399	$2,555
3	Effluent	PLC	$4,449	$2,908	$2,555
41	Effluent PS	RIO	$1,796	$2,488	$2,555
4	Filters	PLC	$4,148	$2,780	$2,555

10	Filters	PLC	$2,411	$1,900	$2,555
11	Filters	PLC	$2,411	$2,496	$2,555
12	Filters	PLC	$2,411	$2,496	$2,555
13	Filters	PLC	$2,411	$2,496	$2,555
14	Filters	PLC	$2,411	$2,496	$2,555
15	Filters	PLC	$2,411	$2,496	$2,555
16	Filters	PLC	$2,411	$2,496	$2,555
17	Filters	PLC	$2,411	$2,496	$2,555
18	Filters	PLC	$2,411	$2,496	$2,555
19	Filters	PLC	$2,411	$2,496	$2,555
20	Filters	PLC	$2,411	$2,496	$2,555
21	Filters	PLC	$2,411	$2,496	$2,555
22	Filters	PLC	$2,411	$2,496	$2,555
8	Force **Main 2**	PLC	$6,709	$3,610	$2,555
26	Headworks	PLC	$4,527	$6,912	$2,555
27	Headworks	RIO	$2,318	$1,580	$2,555
28	Headworks	RIO	$2,318	$1,580	$2,555
23	Lift **Station 1**	PLC	$7,563	$4,061	$2,555
41	Lift Station 1	RIO	N/A	N/A	$2,555
24	Lift Station 2	PLC	$7,563	$4,061	$2,555
42	Lift Station 2	RIO	N/A	N/A	$2,555
			$165,888	$132,585	$107,310

Table 3.3. – PLC Hardware Install Estimate of Costs for Water Operations

		Rockwell	Schneider	Emerson
PLC	Location	Automation	Modicon	Ovation
Number	Site	Price	Price	Price
205	3 Springs PS	$2,355	$2,859	$2,161
203	Agoura PS	$3,010	$2,889	$2,161
204	Argos Valve	$2,153	$1,050	$2,161
176	Calabasas Tank	$2,153	$1,050	$2,161
114	Cold Canyon PS	$2,153	$2,868	$2,161
154	Conduit PS	$2,355	$2,859	$2,161
202	Cornell PS	$3,347	$2,362	$2,161
175	Dardenne PS	$3,010	$2,194	$2,161
228	Equestrian Tank	$2,153	$1,050	$2,161
224	JBR PS	$2,355	$3,010	$2,161
107	Jed Smith PS	$3,009	$3,010	$2,161
106	Jed Smith Tank	$2,153	$1,050	$2,161
223	Kimberly PS	$2,355	$2,859	$2,161
222	Kimberly Tank	$2,153	$1,050	$2,161

		Rockwell	Schneider	Emerson
PLC	Location	Automation	Modicon	Ovation
Number	Site	Price	Price	Price
92	Latigo Tank	$2,153	$1,050	$2,161
134	Lower Oaks PS	$3,010	$2,194	$2,161
135	Lower Oaks Tank	$2,153	$1,050	$2,161
163	LV1 Flowmeter	$2,153	$1,050	$2,161
15	LV2 PS	$2,153	$2,521	$2,161
108	McCoy PS	$3,010	$2,194	$2,161
110	McCoy Tank	$2,153	$1,050	$2,161
226	Morrison Tank	$2,153	$1,050	$2,161
105	Morrison PS	$2,355	$2,164	$2,161
179	Mulwood PRV	$2,153	$1,050	$2,161
174	Mulwood PS	$2,355	$2,164	$2,161
173	Mulwood Tank	$2,153	$1,050	$2,161
178	Oakridge PS	$3,010	$2,194	$2,161
209	Ramera Ridge Valve	$2,153	$1,050	$2,161
136	Ranchview PS	$3,010	$2,194	$2,161
113	Saddlepeak Tank	$2,153	$1,050	$2,161
229	Saddletree PS	$2,355	$2,859	$2,161
227	Saddletree Tank	$2,153	$1,050	$2,161
208	Seminole PS	$3,228	$2,889	$2,161
207	Seminole Tank	$2,153	$1,050	$2,161
112	Stunt Road PS	$3,010	$2,194	$2,161
162	Twin Lakes PS	$3,010	$2,194	$2,161
164	Twin Lakes Tank	$2,153	$1,050	$2,161
133	Upper Oaks PS	$3,078	$2,194	$2,161
209	Upper Oaks Tank	$2,153	$1,050	$2,161
156	Upper Twin Lakes PS	$3,010	$2,194	$2,161
153	Warner PS	$3,010	$1,050	$2,161
172	Warner Tank	$2,153	$1,050	$2,161
206	Westlake PRV	$2,153	$1,050	$2,161
155	Woolsey Tank	$2,153	$1,050	$2,161
177	005 Flowmeter	$2,153	$1,050	$2,161
2	Cordillera Reservoir	$2,153	$2,070	$2,161
231	County Line Flow	$2,153	$1,050	$2,161
103	Indian Hills Tank	$2,153	$1,050	$2,161
232	Morrison PS	$3,010	$2,194	$2,161
225	Oakpark PS	$3,010	$2,444	$2,161
136	Parkway PS	$3,010	$2,194	$2,161
104	Reservoir 3	$2,153	$1,050	$2,161

		Rockwell	Schneider	Emerson
PLC	Location	Automation	Modicon	Ovation
Number	Site	Price	Price	Price
1	RWPS	$3,010	$2,194	$2,161
230	Westlake Wells	$3,010	$2,164	$2,161
230	Westlake Wells	$2,153	$1,050	$2,161
		$136,734	$96,669	$118,855

As mentioned above, the Schneider Modicon vendor has recommended that Momentum processors do not require complete replacement, but a simple replacement of the “top hat” module, which will upgrade the PLC to use the Unity Pro software application while using the existing I/O terminal base. This approach helps reduce initial hardware cost for the Schneider/Modicon solution.

Table 3.4. – PLC Hardware Install Estimate of Costs for Westlake Filter Plant

		Rockwell	Schneider	Emerson
PLC	Location	Automation	Modicon	Ovation
Number	Site	Price	Price	Price
23	Plant	$7,454	$4,257	$2,804
11	Filter 1	$2,651	$2,581	$2,804
12	Filter 2	$2,651	$2,581	$2,804
13	Filter 3	$2,651	$2,581	$2,804
14	Filter 4	$2,651	$2,581	$2,804
15	Filter 5	$2,651	$2,581	$2,804
16	Filter 6	$2,651	$2,581	$2,804
17	Filter 7	$2,651	$2,581	$2,804
18	Filter 8	$2,651	$2,581	$2,804
19	Filter 9	$2,651	$2,581	$2,804
20	Filter 10	$2,651	$2,581	$2,804
21	Filter 11	$2,651	Existing M340	$2,804
22	Filter 12	$2,651	Existing M340	$2,804
25	LCP 25 - Chemical	$4,276	$2,334	$2,804
26	LCP 26 -	$4,575	$2,689	$2,804
27	LCP 27 - Torchwood Tank	$2,817	$2,581	$2,804
14A	RTU - 14A - Pump Station	$6,854	Existing M340	$2,804
		$57,788	$37,671	$47,668

3.2.2 *Initial HMI/SCADA Software Costs*

Using the SCADA applications developed at each facility and investigation of field functionality, we tasked vendors to provide standard cost estimates for the HMI software replacement. We requested that vendors base quotes/cost estimates upon standard pricing and not project-specific pricing.

Initial cost estimates for HMI application software were focused on the following considerations for upgrade:

- Upgrade from current HMI application to a more robust and redundant architecture:
  - This was applicable for all vendors, including Wonderware. The current Wonderware InTouch application needs additional redundancy and upgrades to provide a robust SCADA application.
- Upgrade to integrate with new PLC platform selected
  - This is applicable for all vendors, including Wonderware. Each HMI application will require engineering and programming work to integrate the existing graphics and functions to the new PLC logic. By moving to standardized, object-oriented approach for PLC logic, there will be less work to integrate with the SCADA application. However, the engineering costs associated with the PLC logic and SCADA software are still significant to incorporate PLC logic and HMI functions into the upgraded system.
- Change from current HMI application to another vendor:
  - This includes Wonderware System Platform, Rockwell Automation and Emerson Ovation solutions, as these would require new software licensing, configuration and implementation to match the existing Wonderware InTouch application.
    - The transition from Wonderware InTouch to System Platform provides more flexibility for the District to maintain the existing application and do a progressive upgrade
  - This work includes the cost to build up the new HMI application to match the graphics and process functions. This also included the software licensing associated. This did not include time required for integration to the PLC, as that of PLC hardware replacement, SCADA software replacement. We considered the costs associated with standard control panel hardware (power supplies, terminal blocks, relays, etc.), telemetry and other hardware appurtenances equal across the proposed vendor options.

Table 3.5 – Initial Software Costs Comparison

	Total (Rockwell Automation)	Total (Rockwell-Wonderware)	Total (Schneider-Wonderware)	Total (Emerson Ovation)
Initial Software Costs				
Software Licensing	$ 113,200	$ 53,000	$ 50,000	$ 133,500
Estimated Engineering/Implementation	$ 900,000	$ 900,000	$ 900,000	$ 1,130,000
	$ 1,013,200	**$ 953,000**	**$ 950,000**	**$ 1,263,500**

Note that Table 3.5 is not a total cost estimate for the upgrade of the District control systems. Rather the table is focused on the costs specifically associated with the software upgrades and modifications.

3.2.3 Operations & Maintenance Support Costs

We recommend that an upgrade of SCADA server storage, memory, or software be required within a 10-15 year span. We suggest your management team budget for at least one replacement of this during the 10-year cost cycle, which is good practice and included in our estimate for O&M costs.

Additionally, the largest recurring cost is the SCADA licensing and support. The more costs are consolidated across both PLC and HMI components, the more efficient the support costs. The annual licensing and support costs of Rockwell Automation and Schneider-Wonderware differ by an estimated $10,000, as shown below in Appendix B.

Even though Wonderware and Modicon are both under the Schneider “umbrella”, there are separate support and licensing costs associated with each software. As Wonderware and Schneider have separate distributors and support for the PLC and SCADA software packages. These costs are shown in Appendix B. Conversely, there is just one support cost for PLC and HMI support for a Rockwell Automation solution. For purposes of the cost estimate, we separated the Rockwell Automation costs to roughly show the split, according to the Rockwell Automation vendor.

3.2.4 Training Costs

Initial investigation revealed that training costs were roughly similar between the various vendors. It seemed that the approximate cost per a standard programming class ranged from $1200-$1600 per day. However, on-site training is available from most of the vendors if a large enough class attends. Distributor options for training appear to have the least cost, but may have limitations in the training content.

Training offerings and availability from Rockwell Automation and Wonderware are driven by both the vendor and their distributors. Both vendor and distributor are promoting local training opportunities on a regular basis. Training availability for Emerson Ovation seems more specific to their San Diego or other offices outside of the Southern California region. Costs associated with these training will have to factor in longer time “out of pocket” and more travel time/expense.

3.3 Ease of Use & Integration

3.3.1 Hardware

Based on information from the District, there is concern about the ease of hardware installation, but more importantly, the modularity of the hardware to facilitate hardware expansion in the future. Specifically, staff is hopeful that the new PLC platform can easily accommodate expansion without abandoning the current installation.

All three vendors have modular solutions which allow for expansion. The challenge in our evaluation was to rank that hardware based on ease of expansion and ease of modularity for the District.

The Modicon M340 and M580 solutions are rack-based solutions. This creates a modular functionality but it does create limitations for expansion. The M580 allows for Remote I/O via Ethernet, while the M340 has limitations in supporting Remote I/O. Modicon recommends extending the M340 using the Modbus Plus bus connect to additional M340 racks (up to 3 total), if within a limited distance. The Momentum controllers are also modular and add new cards by extending the Modbus Plus bus to the next chassis. The physical space required for the M340 or Momentum solutions is modest and will likely fit in existing District panels.

Additionally, we noted that the M340 and M580 backplanes are also different, so if the District selects Modicon PLC, they should expect standardization around two types of backplane. If only M340 is selected, this would limit opportunities for Remote I/O in Tapia or Westlake facilities.

The Rockwell Automation CompactLogix solution is modular and expandable without modifying an existing installation. The CompactLogix platform can support Remote I/O via Ethernet, but in a different form factor. The Rockwell Automation Flex I/O base provides the Remote I/O expandability for the CompactLogix. The physical space required for the CompactLogix solution is modest and will likely fit in existing District panels.

Similar to the M340 and M580 comparison, the in a few locations where a larger PLC is required, the Rockwell Automation ControlLogix PLC is a different style backplane so will require a second style of backplane.

The Emerson Ovation solution (OCC100) is a new product, so we were unable to view installations of this product. However, based on the Emerson documentation, the main controller supports an expandable amount of I/O, but it seems that the District may be required to select the layout/configuration in advance. We estimate that the physical space required for the OCC100 and the supported I/O modules may exceed the existing control panel size.

3.3.2 Software Development

Fault tolerance for SCADA system hardware and software, in general, relates to the criticality of the water and wastewater systems, especially in upset or failure conditions. In most cases, the criticality of the function of one remote site does not dictate redundant hardware, software or telemetry. The District does not currently have SCADA server redundancy or redundant PLCs. We anticipate that this will be the most problematic for a critical failure in the SCADA software or hardware.

As a result, we suggest that any SCADA platform selected be tailored around a more fault-tolerant approach. In this case, we evaluated the ability for the SCADA software to plan for disasters and support a disaster recovery plan for the most common failures or events. This is recommended to reduce downtime, should a failure in your SCADA software or hardware occur. Industry best practices have continued to drive toward the virtualization of software operating systems to provide hardware independence/flexibility, ease of recovery, and redeployment and reduction of hardware requirements.

The following is the recommended Server configuration to add virtualization, increase redundancy and increased disaster recovery capability. We used this architecture as the basis for comparison across the three vendor solutions:

- Server/Host 1
    - VM1 – Domain Controller, Primary
    - VM2 – SCADA Application Server, Primary w/Alarm Notification
    - VM3 – Terminal Server, Primary
    - VM4 – Development Workstation
- Server/Host 2
    - VM5 – Domain Controller, Secondary
    - VM6 – SCADA Application Server, Secondary w/Alarm Notification
    - VM7 – Terminal Server, Secondary
    - VM8 – Historian Server

Table 3.7 – Selected SCADA Software for evaluation

	Rockwell Automation	Schneider Wonderware/Modicon	Emerson Ovation
PLC Software	Studio 5000	Unity Pro	Ovation OC100
HMI Software	FactoryTalk View SE	System Platform	Ovation

There were several important factors for evaluating the ease of software implementation, including the following:

- Standardized structures, objects, and logic
- Object-oriented approach to structures, logic, and graphics
- Vendor supported standardized structures and objects

The Wonderware InTouch platform, which is currently in-place at the District, is a tag-based system and does not fully support an object-oriented approach to interface with the PLC logic. As a result, our evaluation targeted the Wonderware System Platform application. This software package is the latest offering from Wonderware and the best consideration for comparison to the other software vendors. Wonderware System Platform is a very robust and object-oriented software tool. By focusing our evaluation on this software, all the SCADA options on the table will require an upgrade to implement the SCADA recommendations.

The Modicon Unity Pro software is a very robust PLC program. Unity Pro leverages industry standard programming structures and includes many pre-defined function blocks. One of the best features is the ability to create customized and modular function blocks for a given object or process. These function blocks can be modified during runtime, unlike some of the other vendors.

For communication between the Modicon PLC and Wonderware System Platform, many System Integrators have relied upon the Modbus TCP communication driver. Your current system uses Modbus TCP drivers for communication to the Wonderware InTouch application. For purposes of this evaluation, we updated to compare the Schneider IP communication driver, called OPC Factory Server (OFS). This protocol allows for communication of objects from the Modicon Unity Pro tags to the Wonderware System Platform objects without specialized tag-mapping, scripting or third party interface. The OFS tool was developed by Schneider Modicon.

The Rockwell Automation Studio 5000 and FactoryTalk View SE platform work together in a vendor strategy called PlantPAx. This approach matches the same logic structures and objects from the PLC platform to the HMI platform. As a result, there is a high degree of synchronization between the software and the communication using the Allen Bradley CIP protocol, which is widely supported by Rockwell Automation. The Studio 5000 logic, structures and objects are also supported by Rockwell Automation, not just the local system integrator. As a result, the on-going support and standardization of the application earned a high ranking in this category. This is a significant “value-add” feature for this vendor and was a slight differentiator in the Standardization ranking of the Decision Matrix.

3.3.3 Situational Awareness integrated

Situational Awareness (SA) graphics used in HMI systems have become increasingly in demand for water agencies. Many industries have used this approach for years, as operators need their attention on the most critical events in the system and not distracted by nuisance or minor events or information. The industry best practice calls for Situational Awareness graphics to achieve a highly functional HMI and reduce workload on the operator.

Both Wonderware and Rockwell Automation have made strides in recent releases of their software to stay current with industry best practices for HMI graphics. These SA toolkits provide

the SCADA software developer with more pre-built options that can be implemented into future graphics.

More information is required from Emerson Ovation about embedded situational awareness graphics. The graphics provided at the Rancho facility did not contain the level of situational awareness consistent with the current industry best practice.

3.3.4 Data storage and retrieval

Access to historical data and configuration of the Historian both factor into the ease of use. The configuration requirements include selection of process data to be stored, ease and flexibility of retrieval of historical data. Wonderware and Rockwell Automation solution both have excellent Historian interfaces and data retrieval. In both software applications, once the Historian is installed and connected to the network there is limited configuration required to identify historical data points. Both Historian client applications are very intuitive and allow for flexible modification of trends, queries, and reports. They leverage the strength of the SQL database, while running operations to keep the file size and query time limited.

Emerson Ovation solution has good event recreation and sequence of events. The historian is a well-integrated piece of the HMI application. Alarms, events, and historical tracking of these is embedded in the development and retrieval tools.

3.4 Long Term Support

3.4.1 Distributor Support

The quantity of distributors within the region did not seem an appropriate metric for this evaluation, though that was a factor in determining how robust the Distributor support was for the vendors in question. The quality and support from the vendor-recognized distributor was an important factor. From information collected and our experience, the Wonderware, Modicon and Rockwell Automation distributors in the region are robust and well connected with the vendor. It is important to note that Schneider distributors in the region are many, but we did not find that all Schneider distributors were capable of supporting Modicon PLC support needs. Additionally, the District would need to maintain two separate distributors to support Modicon and Wonderware solutions. This may be a slight drawback in comparison. However, the hybrid solution, using Rockwell and Wonderware would also require two sets of distributors as well.

The Emerson model of business does not include distributors, so the District is required to get all their support from the Emerson San Diego office. This does create a limitation in support compared to the local distributors.

3.4.2 System Integrator Support

One of the biggest concerns that your team noted during the workshop was the ability to use multiple system integrators to implement modifications or perform troubleshooting. Currently the District is limited in their choices of system integrators. Part of this is due to the scarcity of system integrators who will support older version of Modicon; another factor is the lack of standardization and unnecessary complexity.

Table 3.8 – Number of regional recognized System Integrators, per vendor

	Rockwell Automation	Schneider Wonderware/Modicon	Emerson Ovation
System Integrators	7	5	1

Wonderware, Modicon and Rockwell Automation have programs to certify and recognize system integrators who are skilled with their product and can provide excellent performance using their product. This category was comparable between the Rockwell Automation and Schneider solutions.

Emerson does not follow the model of local system integrators. As a result, there is only the Emerson San Diego office that supports Ovation clients in the region. They have a team of engineers and technicians that support all the California-based installations.

3.4.3 Availability of Training

Initial investigation revealed that centralized training availability is comparable between the various vendors. Rockwell Automation, Wonderware, and Modicon, all have specific offices or facilities in the region that conduct training on a regular basis. However, the Rockwell Automation, Wonderware and Modicon vendors provide distributor-based training on a more frequent basis and in the local area.

Based on interviews with staff and other distributors, it appears that training focused by Distributor or vendor in local settings have as much value as training conducted in the central facilities. In the case of Emerson, the training is generally conducted in Eastern U.S., but their San Diego office does support training.

In addition to the availability, we evaluated the number of trainings required, how well the distributor trainings integrated with the vendor training. In particular, we noted that the Schneider-Wonderware solution would require two completely separate training curriculums, adding some increased costs and time for your staff. For example, Unity Pro training and Wonderware System Platform training are hosted by two completely separate distributors who apparently have little interface between them.

By contrast, we noted that the Rockwell Automation offerings have more cohesiveness between the local Distributor and the vendor, where Rockwell sponsored events through the Distributor are commonplace. Additionally, we noted that Rockwell Automation training is targeted toward the PlantPAx platform in a comprehensive training, which addresses both the PLC and HMI functions. This does not necessarily reduce the training hours, as training is still required in both areas, but it does provide training efficiencies for your team.

Emerson Ovation was evaluated for the training, though not as much information was available at the time of this report. Similar to Rockwell Automation, the training is a comprehensive training of both the controller-level logic and the HMI functions for operator interface. However, based on the training course offering, these courses are broken into several pieces.

3.4.4 Vendor Lifecycle History

One of the best metrics for future performance is past performance. As a result, this category focused on previous lifecycle history for the vendors selected.

Schneider Modicon has a good track record for lifecycles in their Quantum and Momentum PLC platforms over the last 20 years. The vendor has created transitions The M340 and M580 controller platforms are newer and early in their lifecycle. The software platforms used Unity Pro and Wonderware have decent backward compatibility for older versions.

Rockwell Automation has a proven track record for their PLC-5, SLC, CompactLogix, and ControlLogix PLC platforms over the last 20+ years. They have created legacy support programs specifically to continue manufacturing and supporting the hardware, without changing form factors or requiring additional hardware. Additionally, the software platforms used to support the

PLC and SCADA software have a long track record with compatibility across the many versions (Logix series).

Emerson Ovation approach to maintaining the DCS lifecycle is continuous updates and improvements. Emerson manages multiple supported versions of the DCS system. At strategic they recommend their “Evergreen” upgrade programs to keep end-users on the most current version of hardware/software. The Evergreen program does require additional cost for each significant upgrade of the system.

3.5 Cybersecurity

Your team noted concerns with cybersecurity, though this was not identified as a decision factor in the decision matrix. Based on industrial control system security best practices, it is clear that PLC and HMI software platform security must start at the infrastructure layers above the PLC and HMI applications. To optimize the security of the control system, physical and network access to the PLC and HMI hardware/software should be tightly governed by implementing industry best practice, including:

- Proper and frequent management of access control to the control system network and applications, including formal procedures for when employees start or finish work at the agency.
- Use of employee specific access control/permissions and not common access for groups (i.e. do not use “Operator” as user access name).
- Locate control system networks and remote devices behind firewalls, and isolate them from the business network.
- Physical controls should prevent an unauthorized person from accessing the control system servers or controllers.
- All programming software should be kept in locked cabinets and should not be connected to any network other than the control system network.
- Laptops that have connected to any other network besides the control network should not be allowed to connect to the control networks without proper scanning/cleaning.
- Minimize network exposure for all control system devices and/or systems, and ensure that they are not accessible from the Internet.
- When remote access is required, use secure methods, such as Virtual Private Networks (VPNs), recognizing that VPNs may have vulnerabilities and should be updated to the most current version available. Also, recognize that any VPN is only as secure as the connected devices.

From our site visits and the gathered information, it is clear that the District does implement these security best practices. Your team has taken care to create separation between the business and control system networks, ensuring that remote connections are made thru secure VPN channels.

In evaluating the vendor hardware/software, we determined that all the vendors evaluated have experienced periodic vulnerabilities. The Department of Homeland Security (DHS) has an ICS-CERT team that evaluates the vulnerabilities of control system platforms across a wide variety of vendors. For example in early 2018, ICS-CERT issued an alert regarding “CPU hardware vulnerable side-channel attacks”, which identified Schneider, Wonderware, Rockwell Automation, and Emerson products as vulnerable to the compromise.

All the control system vendors have responded to these increasing security threats and vulnerabilities with updates to the hardware and software applications in the last 5+ years. For example, Rockwell Automation has added a FactoryTalk Security integrated tool that is used limit access to individuals with a legitimate need. Similarly, Schneider has integrated cybersecurity improvements into Unity Pro software and M580 product line releases. These factors do impact product reliability and long-term viability and should be a consideration for the final product.

3.6 Decision Matrix

To provide an objective comparison between the vendors, we used a weighted decision matrix to evaluate each of the criteria presented above. Your team provided the weighting factors and we provided the ranking. The rankings provided under four main criteria are based on multiple factors, including the following:

- Cost estimates from the vendors
- Reliability statistics from the vendors
- Lifecycle information from the vendors
- Evaluation of key hardware and software features of each platform
- Project experience with vendor platforms
- Comparison of the hardware/software with industry standard functionality

We used the following scales for the evaluation criteria and ranking:

- Criteria: Scale of 1 to 5, where 5 is the most critical and 1 is the least critical
- Ranking: Scale of 1 to 10, where 10 is the highest rank and 1 is the lowest rank

As a result, the maximum scores for each category are shown in Table 3.9 below.

Table 3.9 – Decision Matrix Criteria Maximums

Evaluation Criteria	Importance Factor	Maximum	
		Ranking	Point Value
Operational Function & Reliability	5	10	50
Life-Cycle Costs	4	10	40
Ease of Use & Integration	3	10	30
Long Term Support	3	10	30
Totals			**150**

4. Recommendations & Conclusion

The District has a unique opportunity to standardize and modernize its SCADA systems to meet current and future service needs. Your team made a prudent decision to evaluate its options prior to advancing forward with a SCADA system upgrade that needs to support them for at least the next 10-15 years. Once implemented, the new SCADA system will provide operators the capability to focus on the most important process issues, reduce the downtime associated with non-standard hardware and programs, and have more autonomy and control over modifications/expansions to the system. By performing this evaluation and making an informed decision your team will have a SCADA system that will meet your criteria.

We found that all the vendors and solutions evaluated have good solutions. The challenge is to pick the best one for the District. Our recommendations will provide you a solid footing for making the best long-term decision.

4.1 Recommendations

The following recommendations will provide improvements to your existing SCADA system, regardless of the vendors selected:

- Improve reliability of the SCADA systems by moving to more fault tolerant, redundant and quick recovery solutions.
    - Cannon recommends a virtualized solution and upgraded version of SCADA software, for better redundancy and disaster recovery.
    - Cannon concludes that a simple, effective way to implement a SCADA system and prepare for disaster is to implement a minimum of two physical servers with sufficient memory, storage, and processing speed to handle multiple virtualized operating systems. This will allow redundant SCADA server applications to run in parallel and other virtualized SCADA applications.

- Upgrade of telemetry system will be required, especially in the Water Operations system, as each of the remote sites requiring upgrades will migrate away from natively operating using serial communications. The M340 and CompactLogix controllers evaluated use TCP/IP as the native communication.
    - We recommend the District upgrade the sites to communication via a robust and secure Ethernet radio system.
    - The existing radio paths and ISM band antennas can be reused, reducing the cost of the upgrades/installations of new Ethernet radios.

- We recommend that any upgrade of the Tapia WWTP PLCs focuses on saving cost by consolidating to a fewer number of standardized processors with remote I/O to accommodate field terminations in the local (or adjacent) cabinets.

- We recommend that your team implement a common alarm notification at all your facilities. This will provide ease of use, troubleshooting, and repair for your engineer/technician. We suggest a level of redundancy in the alarm notification, so your staff will have an increase confidence that they are receiving all the necessary alarms.

4.2 Conclusion

The rankings of the Schneider Modicon/Wonderware and Rockwell Automation solutions are very close, while the Emerson Ovation solution did not rank as well with the District's criteria.

- Despite a higher life cycle cost, the Rockwell Automation solution scored higher in reliability, standardization and support. The fully integrated options associated with Rockwell Automation PlantPAx solution scored high in the evaluation. Additionally, the installation base and product lifecycle slightly differentiated Rockwell Automation from Schneider Modicon. We found that Rockwell Automation solutions provide high reliability, excellent long-term support with a high degree of vendor-supported standardization. The PlantPAx solution is a well-integrated solution for PLC and HMI functions, with all the support coming from one vendor.

- Schneider solutions provide cost-effective solutions with similar reliability. However, despite the improved cost, the District will sacrifice a level of standardization by choosing this option. There is not a vendor supported standardized platform, so the District will have a larger challenge of creating and managing the standardization during future upgrade projects. The rating for reliability, support and standardization were impacted slightly due to the fact that Modicon and Wonderware are both under the Schneider umbrella, but do not necessarily act as one entity in implementation or support. The hardware costs are less using the Modicon PLC hardware, but the SCADA software costs are comparable to the Rockwell Automation solution, as Wonderware System Platform implementation will require "ground-up" upgrade of the existing Wonderware applications.

- Additionally, we considered a Rockwell/Wonderware hybrid which leverages the reliability of the Rockwell Automation hardware and support while leveraging the existing Wonderware HMI installation. The scores show that this option ranks almost as high as the Rockwell Automation solution.

- If reliability is weighted as the highest priority, then Rockwell Automation solution is the preferred solution for the District. The District will need to decide if the added costs offset the differences identified.

- The next step for your District is to work with the selected SCADA vendor and develop standardized tags, objects, logic, and graphics. Implementing a standardized approach for all new, upgraded, or repaired sites will bring your District onto one common platform and one common approach for future projects and for ongoing maintenance of the system.

Appendix A

Decision Matrix

Evaluation Criteria	Importance Factor	Wonderware/Modicon		Wonderware/Rockwell		Rockwell Automation		Emerson Ovation	
		Ranking	Point Value	Ranking	Point Value	Ranking	Point Value	Ranking	Point Value
Operational Function & Reliability	5	7.75	38.75	7.75	38.75	8.25	41.25	6.25	31.25
Hardware Reliability	*5*	8	40	8	40	8	40	4	20
Software & Comm. Reliability	*5*	8	40	8	40	8	40	5	25
Standardized Logic	*5*	8	40	8	40	9	45	8	40
Alarm Management	*5*	7	35	7	35	8	40	8	40
Life-Cycle Costs	4	7.34	29.34	7.0	28	7.0	28	5.0	20
Initial costs	*4*	9	36	7	28	7	28	5	20
O&M support costs	*4*	7	28	7	28	7	28	5	20
Training costs	*4*	6	24	7	28	7	28	5	20
Ease of Use & Integration	3	7.67	23	8.0	24	8.0	24	6.34	19
Hardware replacement	*3*	7	21	8	24	8	24	6	18
Software development	*3*	8	24	8	24	8	24	7	21
Situational Awareness integrated	*3*	8	24	8	24	8	24	6	18
Long Term Support	3	7.75	23.25	8.25	24.75	8.5	25.5	6.5	19.5
Distributor Support	*3*	8	24	8	24	8	24	6	18
System Integrator Support	*3*	8	24	9	27	9	27	7	21
Availability of training	*3*	8	24	9	27	9	27	7	21
Vendor product life cycle	*3*	7	21	7	21	8	24	6	18
Totals			**114.34**		**115.5**		**118.75**		**89.75**

80

Appendix B

Life Cycle Comparative Cost Estimate

Life Cycle Cost Comparison		Total (Rockwell Automation)	Total (Rockwell - Wonderware)	Total (Schneider-Wonderware)	Total (Emerson Ovation)
Initial Software Costs		**$1,373,610**	**$1,313,410**	**$1,216,925**	**$1,537,333**
	PLC Hardware Estimates	$360,410	$360,410	$266,925	$273,833
	Tapia WWTP	$165,888	$165,888	$132,585	$107,310
	Water Ops	$136,734	$136,734	$96,669	$118,855
	Westlake Filter	$57,788	$57,788	$37,671	$47,668
	Software/Installation Estimates	$113,200	$53,000	$50,000	$133,500
	PLC Development Software	$7,200	$8,000	$5,000	
	SCADA Development Software	$6,000	$5,000	$5,000	
	SCADA Server/Client Software	$50,000	$25,000	$25,000	
	Alarm Notification	$10,000	$10,000	$10,000	
	Historian	$40,000	$5,000	$5,000	
	Engineering/Implementation Estimates	$900,000	$900,000	$900,000	$1,130,000
	Integration with upgraded PLCs	$750,000	$750,000	$750,000	
	Software Configuration/Duplication	$150,000	$150,000	$150,000	
O&M Software Costs		**$295,000**	**$345,000**	**$340,000**	**$385,000**
	SCADA Upgrades/Replacements (1 upgrade per 10 years)	$45,000	$45,000	$40,000	$55,000
	Common Spare PLC & I/O	$15,000	$15,000	$10,000	$10,000
	Server & workstation hardware upgrades/replacments	$10,000	$10,000	$10,000	$10,000
	Standard software upgrades	$20,000	$20,000	$20,000	$35,000
	SCADA Software Licensing/Support (10 years)	$250,000	$300,000	$300,000	$330,000
	PLC Support per year	$5,000	$5,000	$5,000	
	SCADA Support per year	$20,000	$25,000	$25,000	$33,000
	Totals	**$1,668,610**	**$1,658,410**	**$1,556,925**	**$1,922,333**

Appendix C

Sample Cost Breakdown Tapia WWTP – Rockwell Automation & Schneider Modicon

LVMWD Cost Estimate Breakdown
Tapia WWTP
Schneider Modicon PLC Hardware

		New PLC			New PLC			New Backplane		# AI		New AI		# AO		New AO		# DI		New DI		# DO		New DO			New DI			New Enet/Misc		
	QTY	Processor	Price	QTY	Power Supply	Price	QTY	Module	Price		QTY	Module	Price		QTY	Module	Price		QTY	Module	Price		QTY	Module	Price	QTY	Module	Price	QTY	Module	Price	SubTotal
95 Centrate	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	0				32	1	DDI3202K	$260	8	1	DRA0805	$160							$1,846
96 Centrate	1	P583040	$5,452	1	CPS2000	$201	1	XBP1200	$209	16	2	AMI0810	$355	16	4	AMO0410	$327	64	1	DDI6402K	$408	16	2	DRA0805	$160							$8,608
97 Centrate	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	4	1	AMI0810	$355	2	1	AMO0410	$327	4	1	DDI3202K	$260	2	3	DRA0805	$160							$2,493
5 Chemical	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	4	1	AMO0410	$327	16	1	DDI1602	$136	8	1	DRA0805	$160							$2,049
25 Chemical	1	P583040	$5,452	1	CPS2000	$201	1	XBP1200	$209	12	2	AMI0810	$355	4	1	AMO0410	$327	48	2	DDI3202K	$260	24	3	DRA0805	$160							$7,899
37 Chemical	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	8	2	AMO0410	$327	32	1	DDI3202K	$260	16	2	DRA0805	$160							$2,660
38 Chemical	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	4	1	AMO0410	$327	32	1	DDI3202K	$260	16	2	DRA0805	$160							$2,333
39 Chemical	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	8	2	AMO0410	$327	32	1	DDI3202K	$260	16	2	DRA0805	$160							$2,660
6 Control	1	P342020	$1,121	1	CPS2000	$201	1	XBP0800	$129	24	3	AMI0810	$355	2	1	AMO0210	$271	16	1	DDI1602	$136	16	1	DDO1602	$164							$3,087
2 CP100	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	20	3	AMI0810	$355	12	3	AMO0410	$327	80	1	DDI6402K	$408	40	3	DRA1605	$209	1	DDI3202K	$260				$4,412
33 CP100	1	P583040	$5,452	1	CPS2000	$201	1	XBP1200	$209	12	2	AMI0810	$355	0				160	3	DDI6402K	$408	16	1	DRA1605	$209							$8,005
34 CP100	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	16	2	AMI0810	$355	16	4	AMO0410	$327	64	1	DDI6402K	$408	16	1	DRA1605	$209							$3,706
35 CP100	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP1200	$209	20	3	AMI0810	$355	12	3	AMO0410	$327	16	1	DDI1602	$136	8	1	DRA0805	$160							$3,413
1 CP1000	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0800	$209	8	1	AMI0810	$355	10	3	AMO0410	$327	32	1	DDI3202K	$260	16	1	DRA1605	$209							$2,876
7 CP1000	1	P583040	$5,452	1	CPS2000	$201	1	XBP1200	$209	24	3	AMI0810	$355	0				96	1	DDI6402K	$408	8	1	DRA0805	$160	1	DDI3202K	$260				$7,755
9 CP1000	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0800	$129	20	3	AMI0810	$355	8	2	AMO0410	$327	0				16	1	DRA1605	$209							$2,919
29 CP1000	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0800	$129	16	2	AMI0810	$355	4	1	AMO0410	$327	48	1	DDI3202K	$260	16	1	DRA1605	$209	1	DDI1602	$136				$2,633
36 CP1000	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0800	$129	0				0				64	1	DDI6402K	$408	0										$1,399
3 Effluent	1	P342020	$1,121	1	CPS2000	$201	1	XBP0800	$129	12	2	AMI0810	$355	4	1	AMO0410	$327	32	1	DDI3202K	$260	8	1	DRA0805	$160							$2,908
41 Effluent PS	1	P342020	$1,121	1	CPS2000	$201	1	XBP0800	$129	16	2	AMI0810	$355	0	1	AMO0410	$327	0	0	DDI3202K	$260	0	0	DRA0805	$160							$2,488
4 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	24	3	AMI0810	$355	0				16	1	DDI1602	$136	8	1	DRA0805	$160							$2,780
10 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	0				0				24	2	DAI1602	$136	16	1	DRA1605	$209							$1,900
11 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
12 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
13 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
14 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
15 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
16 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
17 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
18 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
19 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
20 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
21 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
22 Filters	1	P342020	$1,121	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	2	1	AMO0210	$271	24	2	DAI1602	$136	16	1	DRA1605	$209							$2,496
8 Force Main 2	1	P342020	$1,121	1	CPS2000	$201	1	XBP1200	$209	8	1	AMI0810	$355	2	1	AMO0210	$271	64	1	DDI6402K	$408	72	5	DAO1605	$209							$3,610
26 Headworks	1	P583040	$5,452	1	CPS2000	$201	1	XBP0800	$129	12	2	AMI0810	$355	0				32	1	DDI3202K	$260	8	1	DRA0805	$160							$6,912
27 Headworks	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	0				16	1	DDI1602	$136	8	1	DRA0805	$160							$1,580
28 Headworks	1	BMXCRA31200	$661	1	CPS2000	$201	1	XBP0600	$97	4	1	AMI0410	$325	0				16	1	DDI1602	$136	8	1	DRA0805	$160							$1,580
23 Lift Station 1	1	P342020	$1,121	1	CPS2000	$201	1	XBP0800	$129	12	4	AMI0810	$355	4	1	AMO0410	$327	32	2	DAI1602	$136	8	1	DRA0805	$160				1	ART414 RTD	$431	$4,061
41 Lift Station 1		Incoporated in PLC 23								16				0				0				0										$0
24 Lift Station 2	1	P342020	$1,121	1	CPS2000	$201	1	XBP0800	$129	12	4	AMI0810	$355	4	1	AMO0410	$327	32	2	DAI1602	$136	8	1	DRA0805	$160				1	ART414 RTD	$431	$4,061
42 Lift Station 2		Incoporated in PLC 24								16				0				0				0										$0
																																$132,585

LVMWD Cost Estimate Breakdown
Tapia WWTP
Rockwell Automation PLC Hardware

		New PLC			New PLC			New Backplane		# AI		New AI		# AO		New AO		# DI		New DI		# DO		New DO			New Misc			New Enet/Misc			
		QTY	Processor	Price	QTY	Power Supply	Price	QTY	Module	Price		QTY	Module	Price		QTY	Module	Price		QTY	Module	Price		QTY	Module	Price	QTY	Module	Price	QTY	Module	Price	SubTotal
95	Centrate	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	0				32	1	1794-IB32	$417	8	1	1794-OW8	$297	3	1794-TB3	$163				$2,318
96	Centrate	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		16	2	1769-IF8	$655	16	4	1769-OF4	$634	64	2	1769-IQ32	$356	16	1	1769-OW16	$160	1	1769-ECR	$30				$7,362
97	Centrate	1	1794-AENT	$584	1	1794-PS13	$176		N/A		4	1	1794-IE8	$355	2	1	1794-OE12	$1,673	4	1	1794-IB32	$417	2	1	1794-OW8	$297	4	1794-TB3	$163				$4,154
5	Chemical	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	4	1	1794-OE12	$1,673	16	1	1794-IB32	$417	8	1	1794-OW8	$297	4	1794-TB3	$163				$4,154
25	Chemical	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		12	2	1769-IF8	$655	4	1	1769-OF4	$634	48	2	1769-IQ32	$356	24	2	1769-OW16	$160	1	1769-ECR	$30				$5,620
37	Chemical	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	8	1	1794-OE12	$1,673	32	1	1794-IB32	$417	16	2	1794-OW8	$297	5	1794-TB3	$163				$4,614
38	Chemical	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	4	1	1794-OE12	$1,673	32	1	1794-IB32	$417	16	2	1794-OW8	$297	5	1794-TB3	$163				$4,614
39	Chemical	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	8	1	1794-OE12	$1,673	32	1	1794-IB32	$417	16	2	1794-OW8	$297	5	1794-TB3	$163				$4,614
6	Control	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		24	3	1769-IF8	$655	2	1	1769-OF4	$634	16	1	1769-IQ32	$356	16	1	1769-OW16	$160							$5,729
2	CP100	1	1794-AENT	$584	1	1794-PS13	$176		N/A		20	3	1794-IE8	$355	12	1	1794-OE12	$1,673	80	3	1794-IB32	$417	40	5	1794-OW8	$297	12	1794-TB3	$163				$8,190
33	CP100	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		12	2	1769-IF8	$655	0				160	5	1769-IQ32	$356	16	1	1769-OW16	$160	1	1769-ECR	$30				$5,894
34	CP100	1	1794-AENT	$584	1	1794-PS13	$176		N/A		16	2	1794-IE8	$355	16	2	1794-OE12	$1,673	64	2	1794-IB32	$417	16	2	1794-OW8	$297	8	1794-TB3	$163				$7,548
35	CP100	1	1794-AENT	$584	1	1794-PS13	$176		N/A		20	3	1794-IE8	$355	12	1	1794-OE12	$1,673	16	1	1794-IB32	$417	8	1	1794-OW8	$297	6	1794-TB3	$163				$5,190
1	CP1000	1	1794-AENT	$584	1	1794-PS13	$176		N/A		8	1	1794-IE8	$355	10	1	1794-OE12	$1,673	32	1	1794-IB32	$417	16	2	1794-OW8	$297	5	1794-TB3	$163				$4,614
7	CP1000	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		24	3	1769-IF8	$655	0				96	3	1769-IQ32	$356	8	1	1769-OW16	$160	1	1769-ECR	$30				$5,837
9	CP1000	1	1794-AENT	$584	1	1794-PS13	$176		N/A		20	3	1794-IE8	$355	8	1	1794-OE12	$1,673	0				16	2	1794-OW8	$297	6	1794-TB3	$163				$5,070
29	CP1000	1	1794-AENT	$584	1	1794-PS13	$176		N/A		16	2	1794-IE8	$355	4	1	1794-OE12	$1,673	48	2	1794-IB32	$417	16	2	1794-OW8	$297	7	1794-TB3	$163				$5,712
36	CP1000	1	1794-AENT	$584	1	1794-PS13	$176		N/A		0				0				64	2	1794-IB32	$417	0				2	1794-TB3	$163				$1,920
3	Effluent	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		12	1	1769-IF8	$655	4	1	1769-OF4	$634	32	1	1769-IQ32	$356	8	1	1769-OW16	$160	1	1769-ECR	$30				$4,449
41	Effluent PS	1	1794-AENT	$584	1	1794-PS13	$176		N/A		16	2	1794-IE8	$355	0				0				0				2	1794-TB3	$163				$1,796
4	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		24	3	1769-IF8	$655	2		Built-in L24		16		Built-in L24		8		Built-in L24		1	1769-ECR	$30				$4,148
10	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
11	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
12	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
13	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
14	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
15	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
16	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
17	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
18	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
19	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
20	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
21	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
22	Filters	1	1769-L24ER-QBFC1B	$2,153		Built-in L24			N/A		4		Built-in L24		2		Built-in L24		24	1	1769-IB16	$258	16		Built-in L24								$2,411
8	Force Main 2	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		8	1	1769-IF8	$655	2	1	1769-OF4	$634	64	4	1769-IA16	$325	72	4	1769-OA16	$369	1	1769-ECR	$30				$6,709
26	Headworks	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		12	1	1769-IF8	$655	0				32	3	1769-IQ32	$356	8	1	1769-OW16	$160	1	1769-ECR	$30				$4,527
27	Headworks	1	1794-AENT	$584	1	1794-PS13	$176		N/A		4	1	1794-IE8	$355	0				16	1	1794-IB32	$417	8	1	1794-OW8	$297	3	1794-TB3	$163				$2,318
28	Headworks	1	1794-AENT	$584	1	1794-PS13	$176		N/A		4	1	1794-IE8	$355	0				16	1	1794-IB32	$417	8	1	1794-OW8	$297	3	1794-TB3	$163				$2,318
23	Lift Station 1	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		28	4	1769-IF8	$655	4	1	1769-OF4	$634	32	2	1769-IA16	$325	8	1	1769-OW16	$160				1	1769-IR6	$885	$7,563
41	Lift Station 1		Incorporated into PLC 23						N/A		0				0				0				0										$0
24	Lift Station 2	1	1769-L33ER	$2,384	1	1769-PA2	$230		N/A		28	4	1769-IF8	$655	4	1	1769-OF4	$634	32	2	1769-IA16	$325	8	1	1769-OW16	$160				1	1769-IR6	$885	$7,563
42	Lift Station 2		Incorporated into PLC 24						N/A		0				0				0				0										$0
																																$165,888