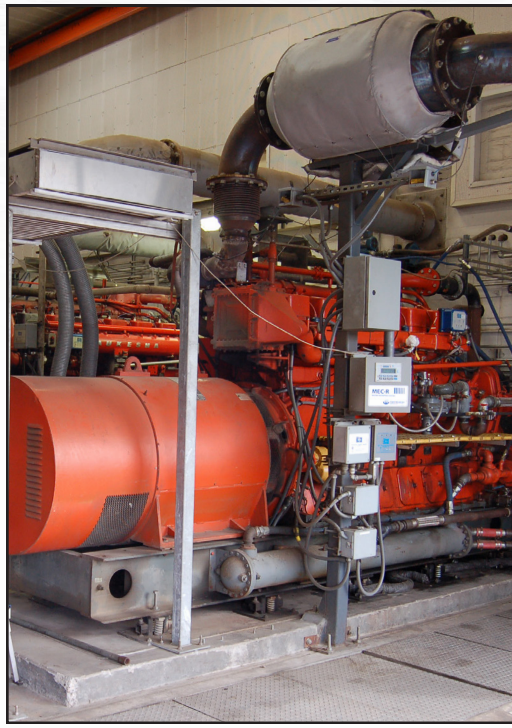


SEPTEMBER 2017
FINAL

DUBLIN SAN RAMON SERVICES DISTRICT

Wastewater Treatment and Biosolids Facilities Master Plan

Volume II Appendices

WEST YOST ASSOCIATES

in association with

HDR

Table of Contents

List of Appendices

APPENDIX A

Peak Storm Event Wet Weather Flows

- Figure A-1. Peak Wet Weather Flows and I&I, March 23–25, 2011
- Figure A-2. Peak Wet Weather Flows and I&I, January 20–21, 2012
- Figure A-3. Peak Wet Weather Flows and I&I, November 30–December 2, 2012
- Figure A-4. Peak Wet Weather Flows and I&I, December 21-24, 2012
- Figure A-5. Peak Wet Weather Flows and I&I, December 2–3, 2014
- Figure A-6. Peak Wet Weather Flows and I&I, December 11-12, 2014
- Figure A-7. Peak Wet Weather Flows and I&I, February 6–8, 2015

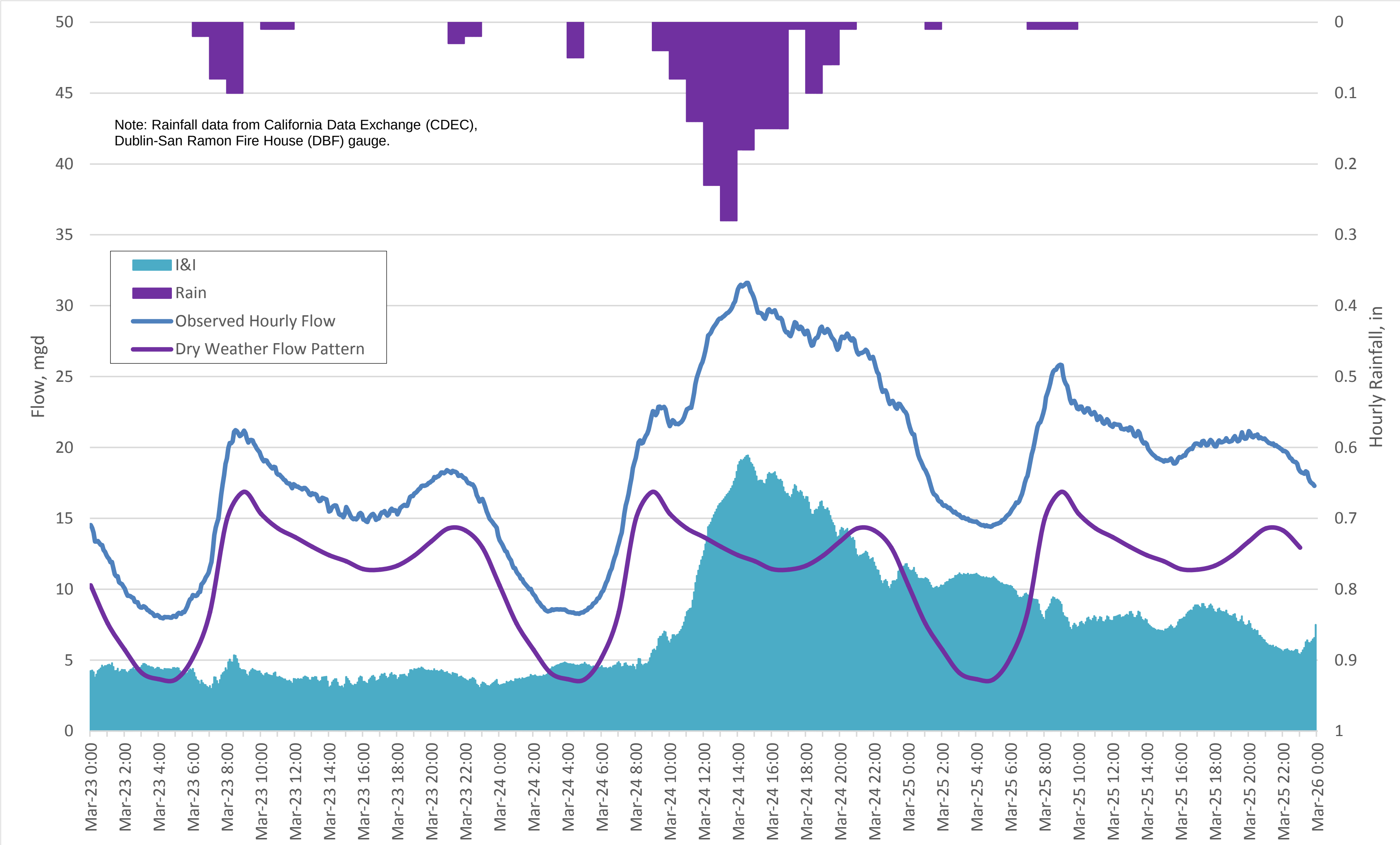


Figure A-1
Peak Wet Weather Flows and I&I, March 23–25, 2011

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

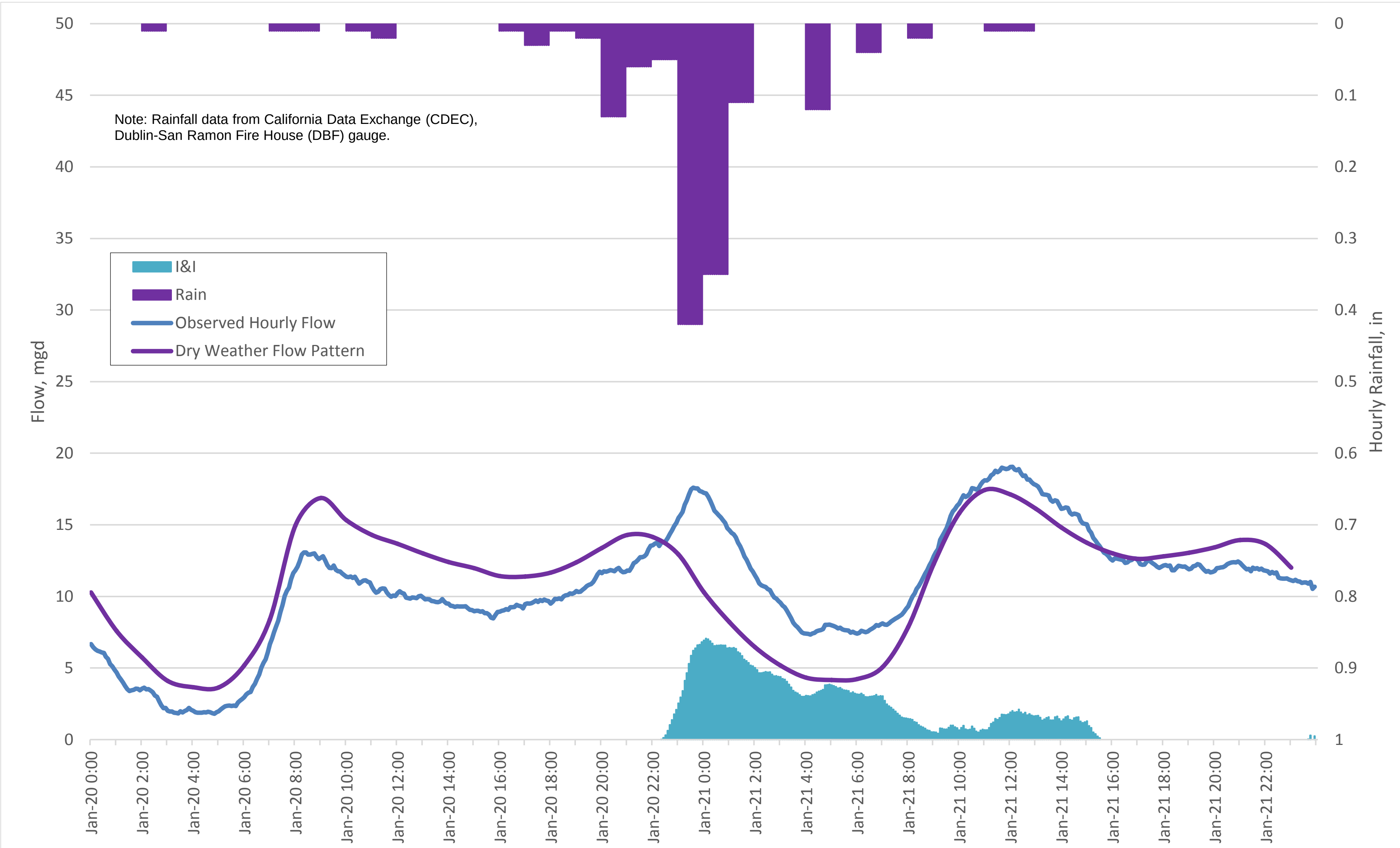


Figure A-2
Peak Wet Weather Flows and I&I,
January 20–21, 2012

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

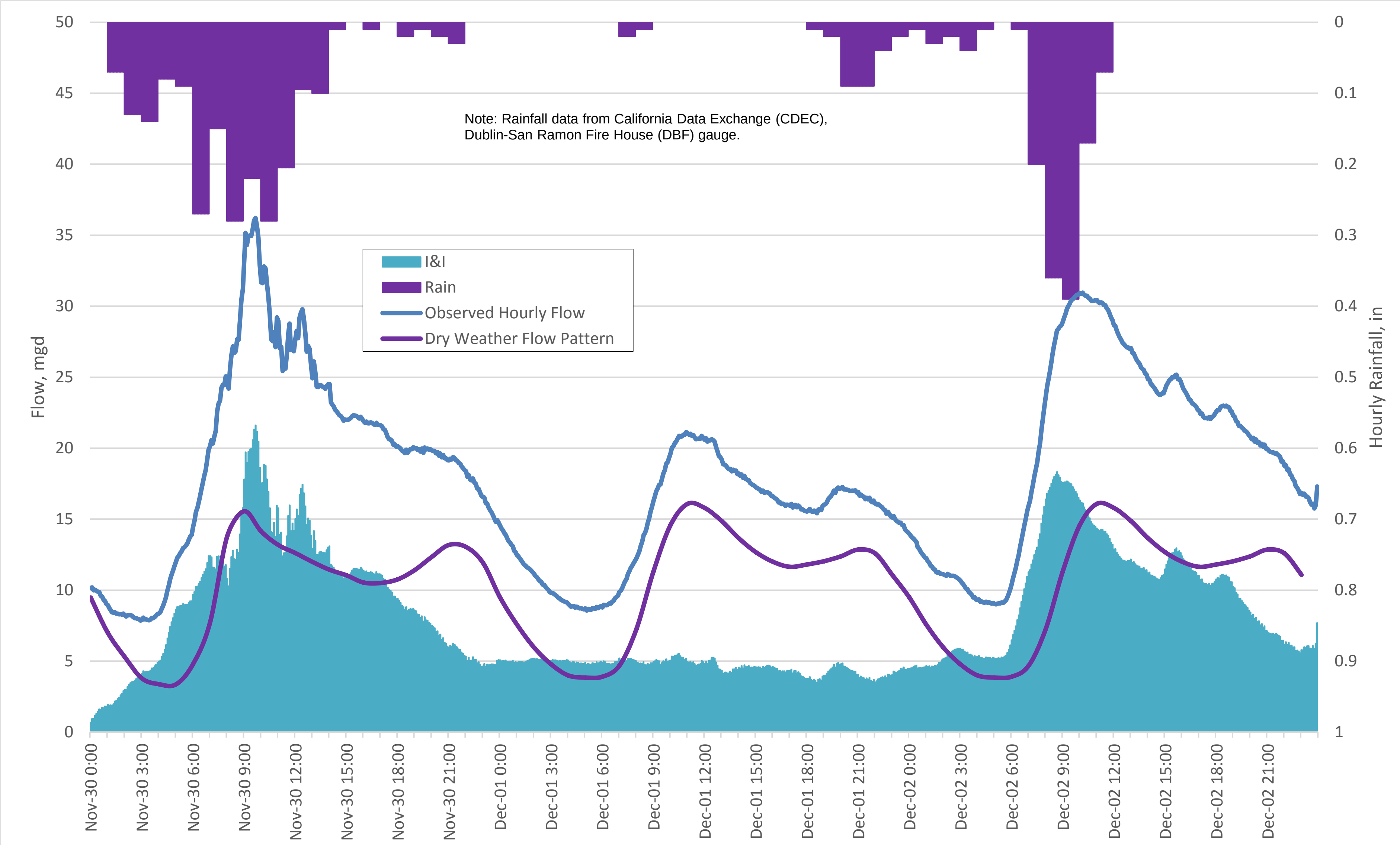


Figure A-3
Peak Wet Weather Flows and I&I,
November 30–December 2, 2012

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

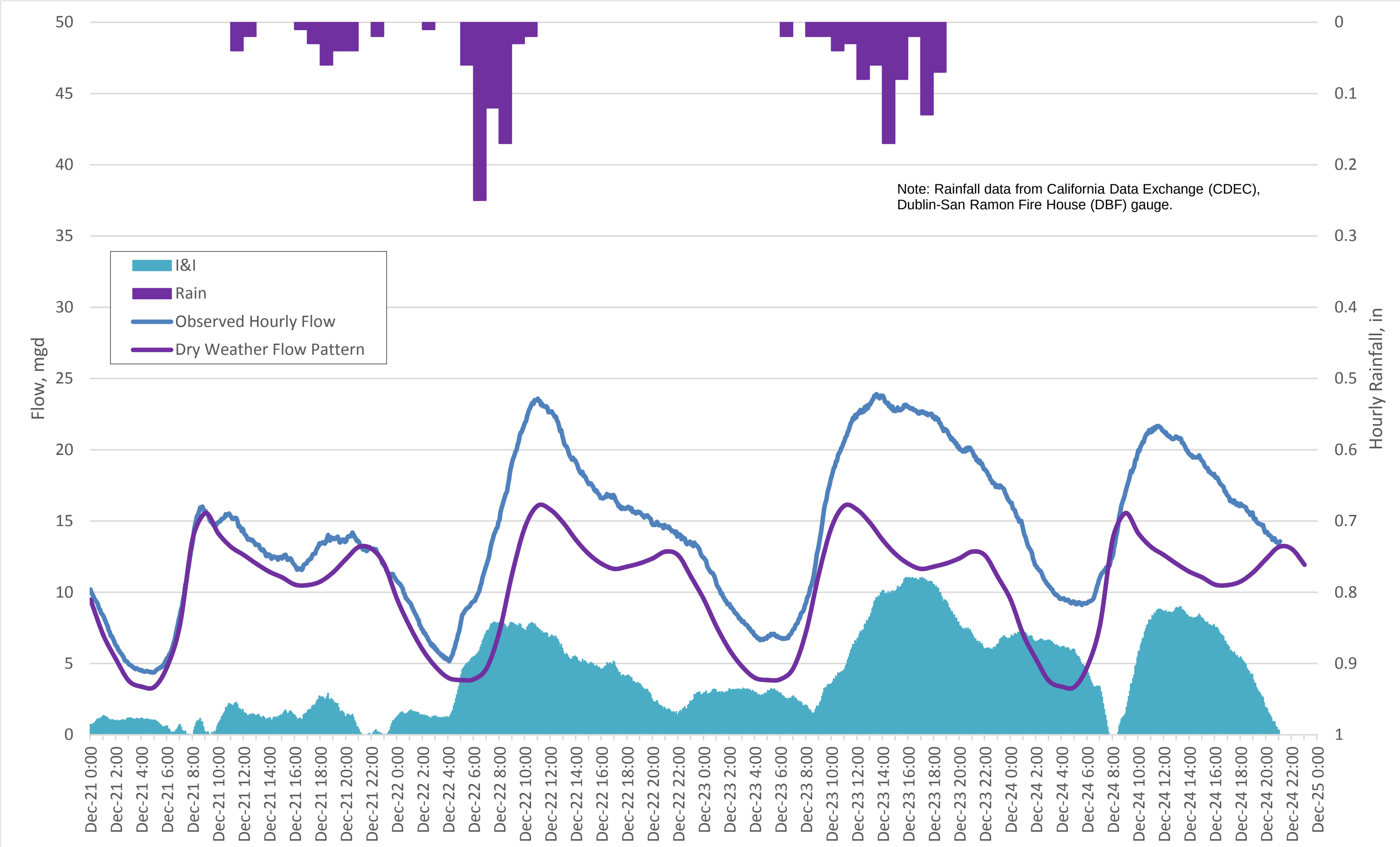


Figure A-4
Peak Wet Weather Flows and I&I,
December 21–24, 2012

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

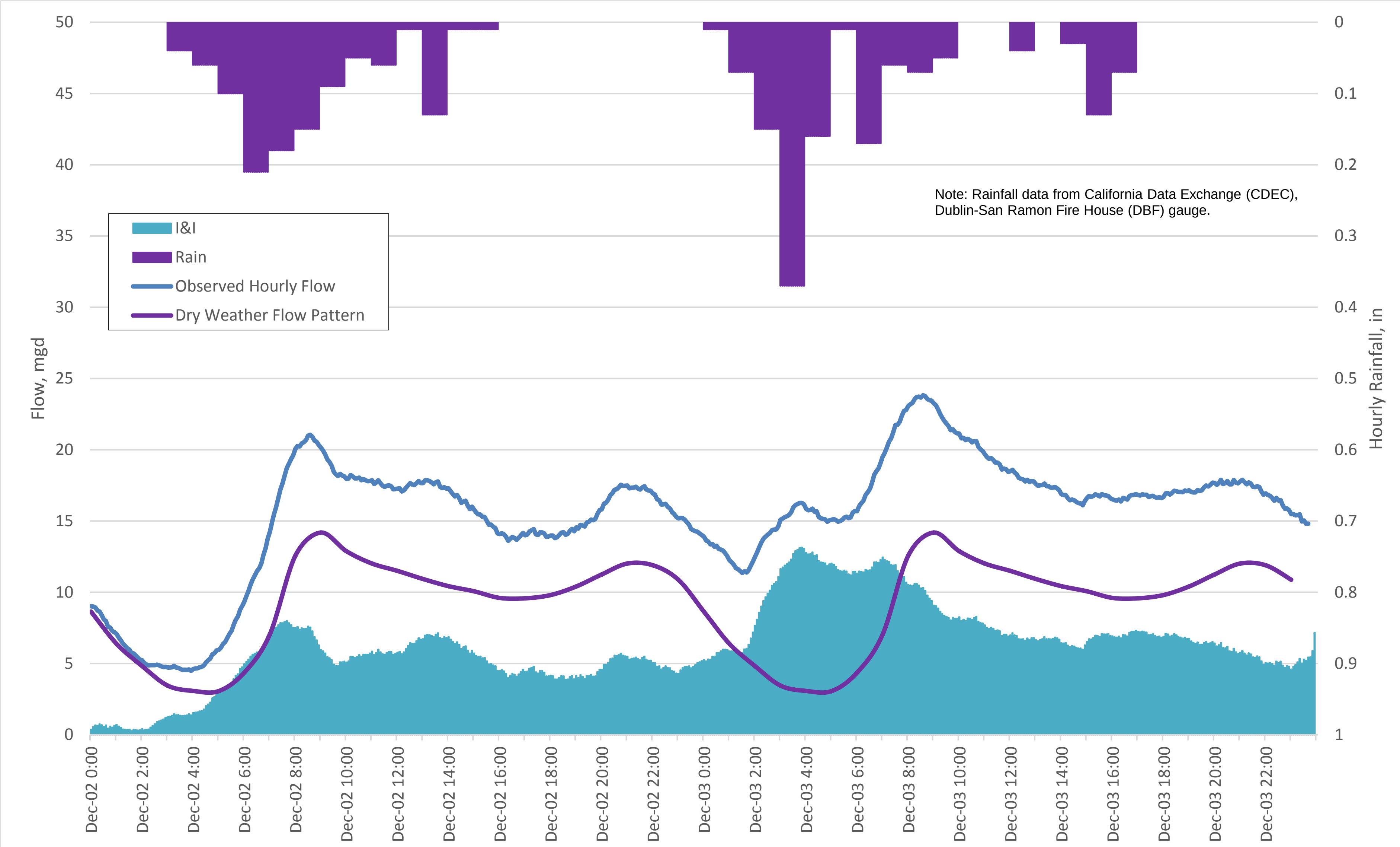


Figure A-5
Peak Wet Weather Flows and I&I,
December 2–3, 2014

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

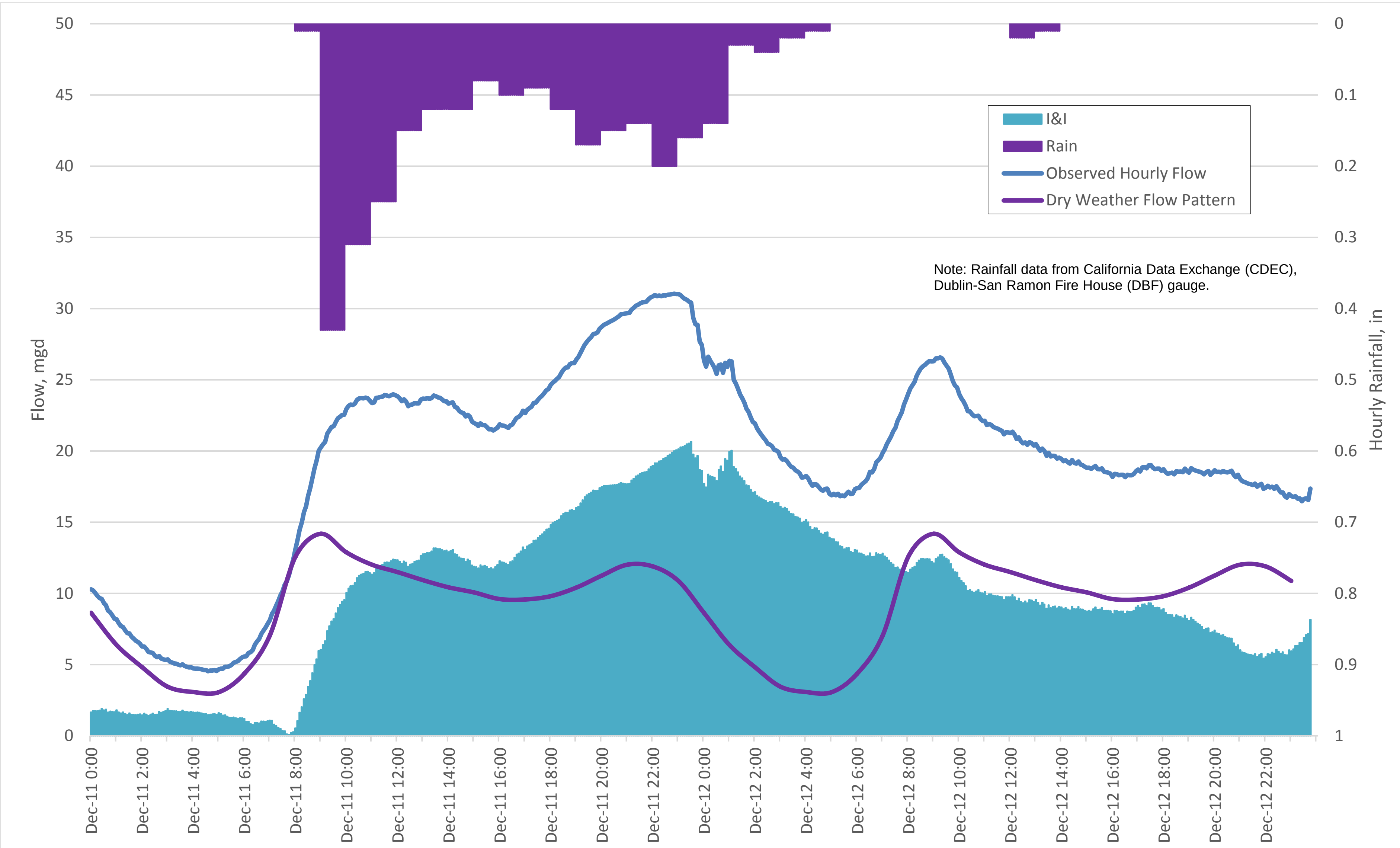
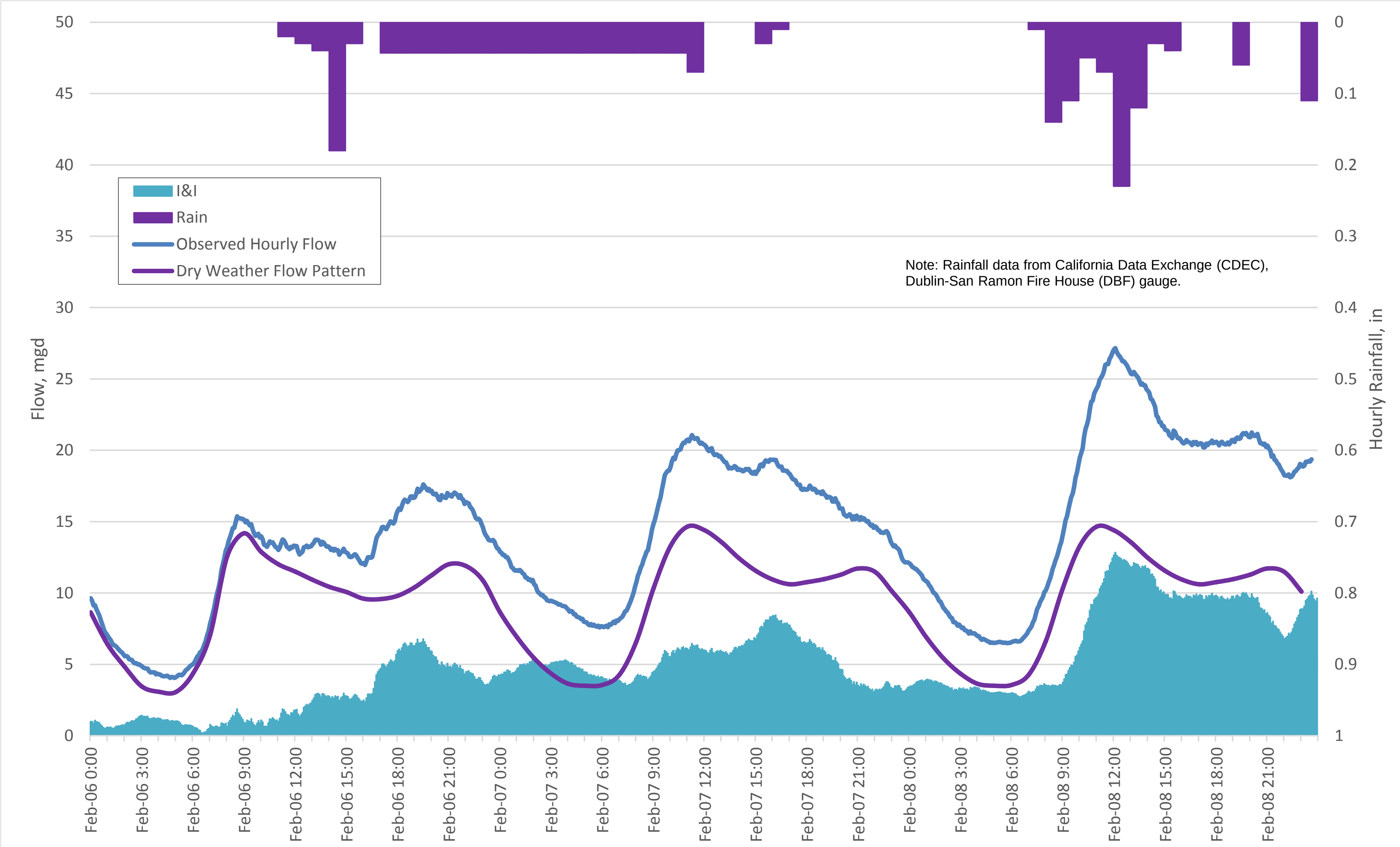


Figure A-6
Peak Wet Weather Flows and I&I, December 11–12, 2014

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan



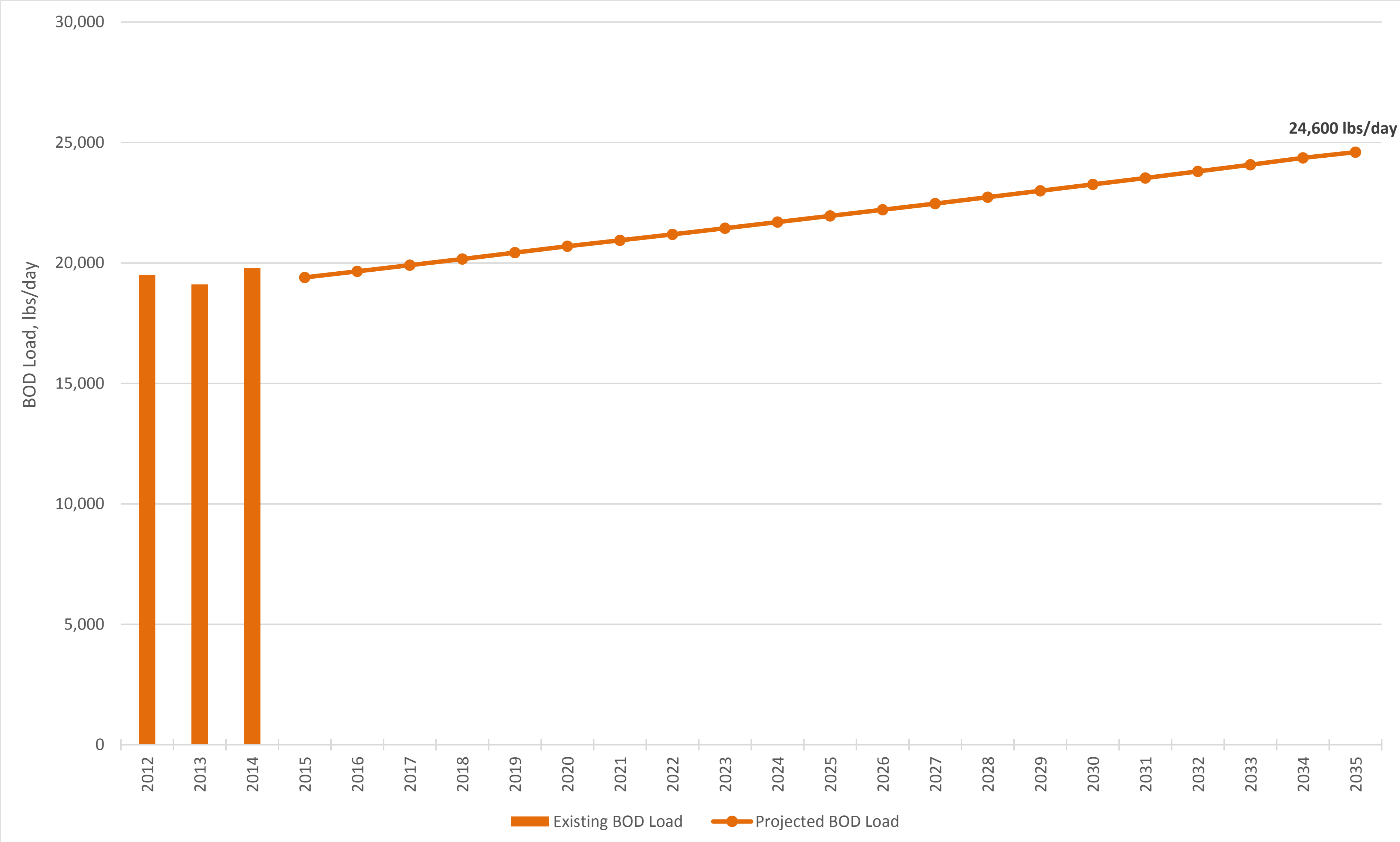
WEST YOST ASSOCIATES

Figure A-7
Peak Wet Weather Flows and I&I, February 6–8, 2015

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

APPENDIX B

2035 Load Projections



WEST YOST ASSOCIATES

Figure B-1
Existing and Projected BOD Load, 2012–2035

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

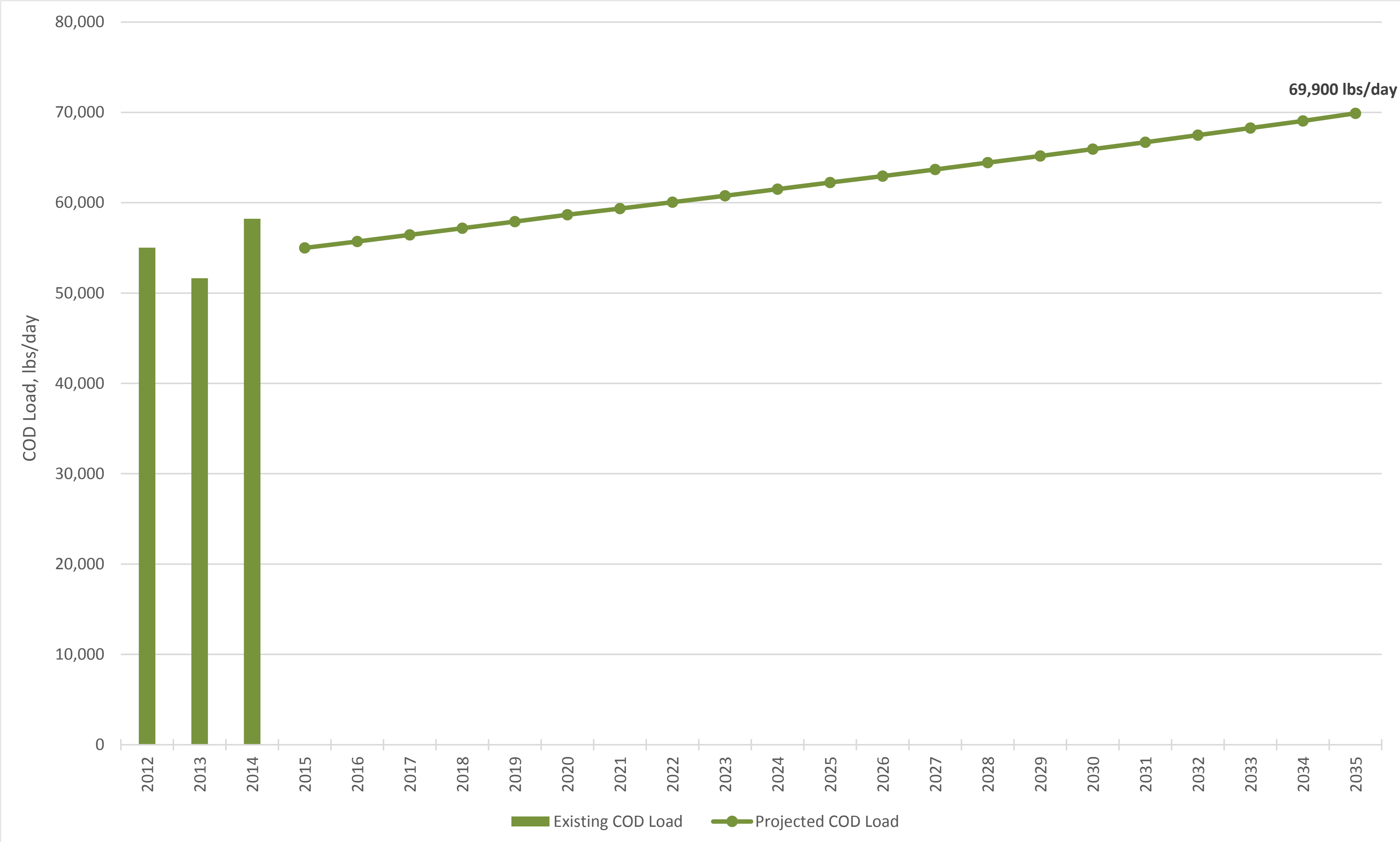


Figure B-2
Existing and Projected COD Load, 2012–2035

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

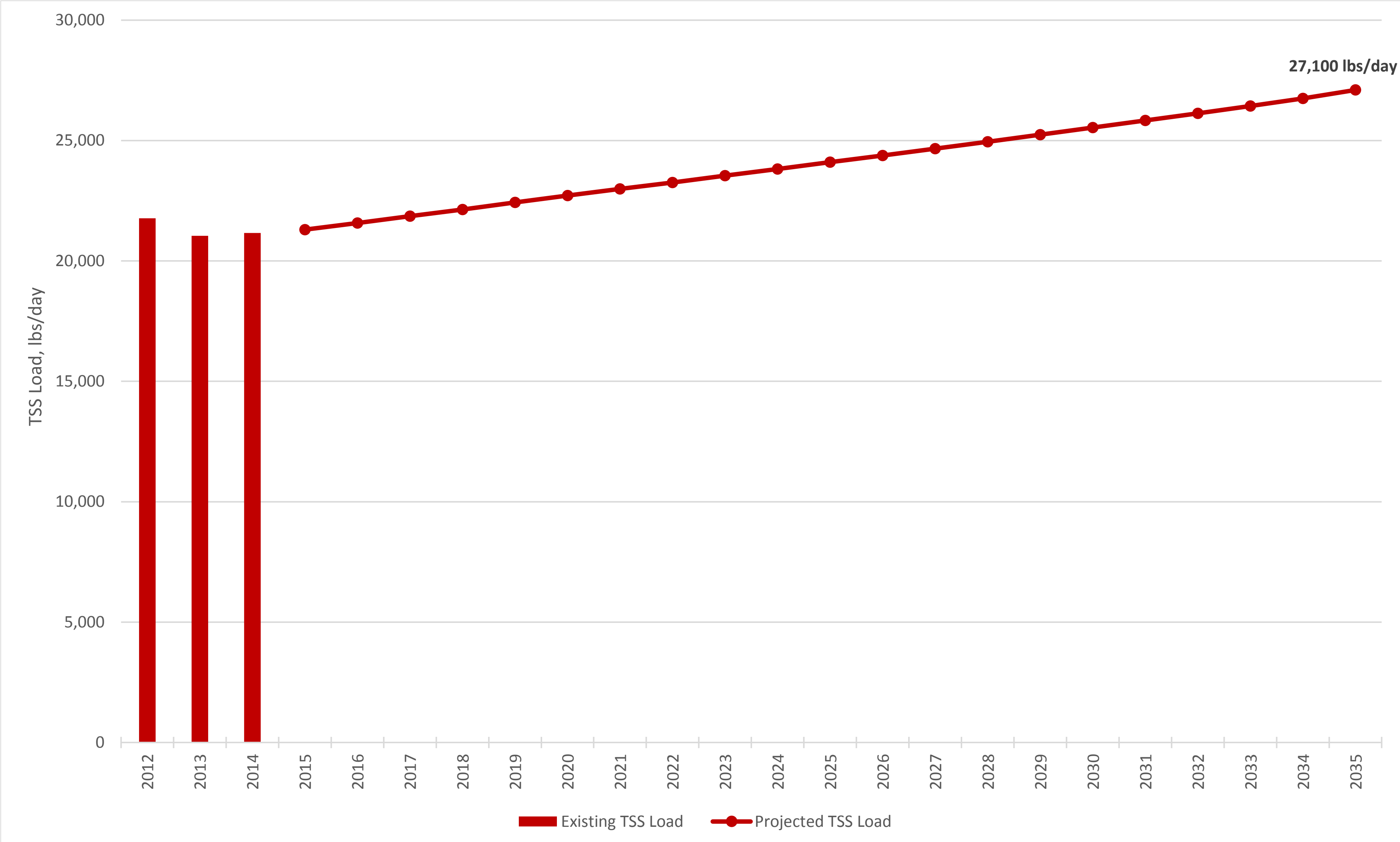


Figure B-3
Existing and Projected TSS Load, 2012–2035

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

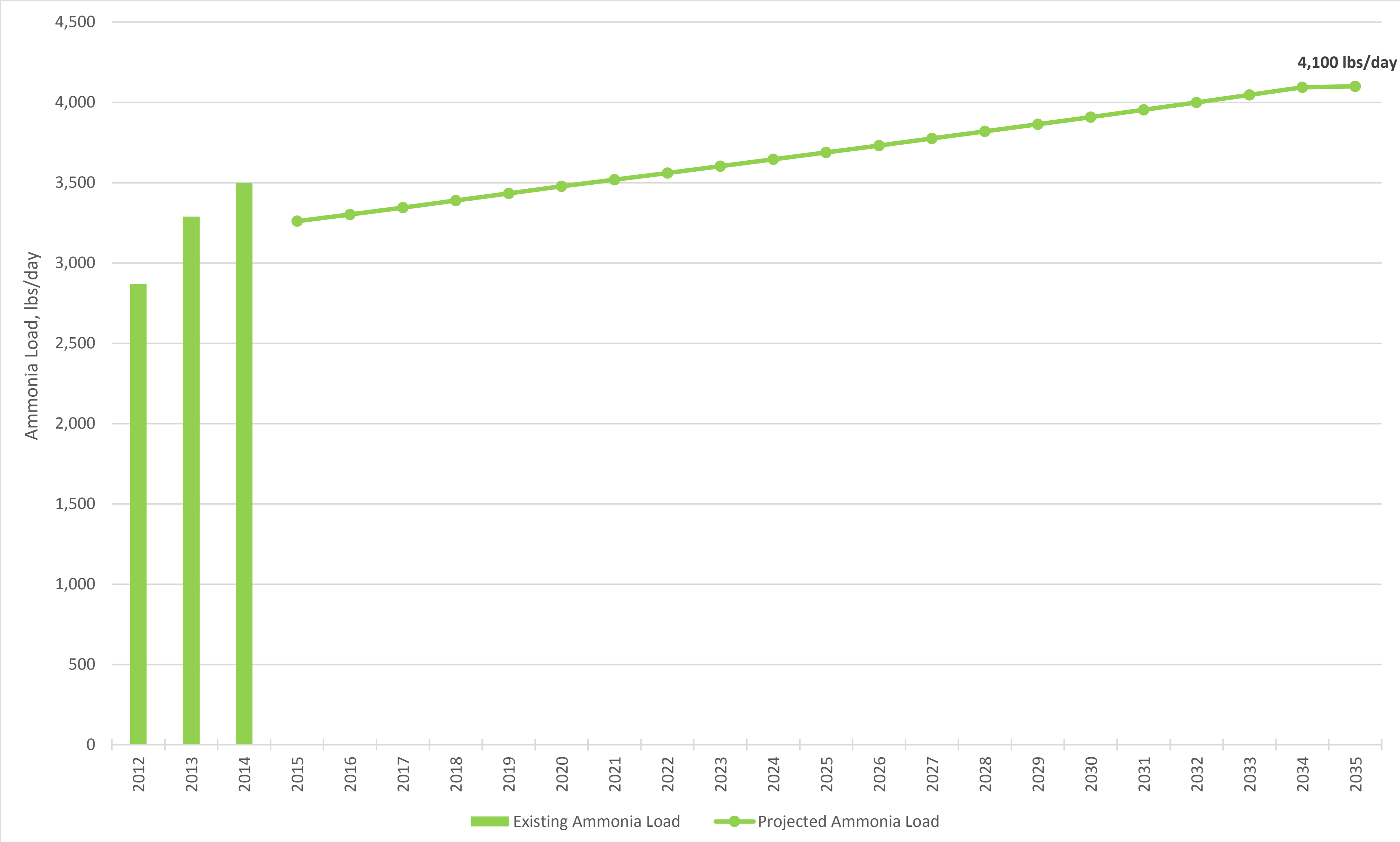
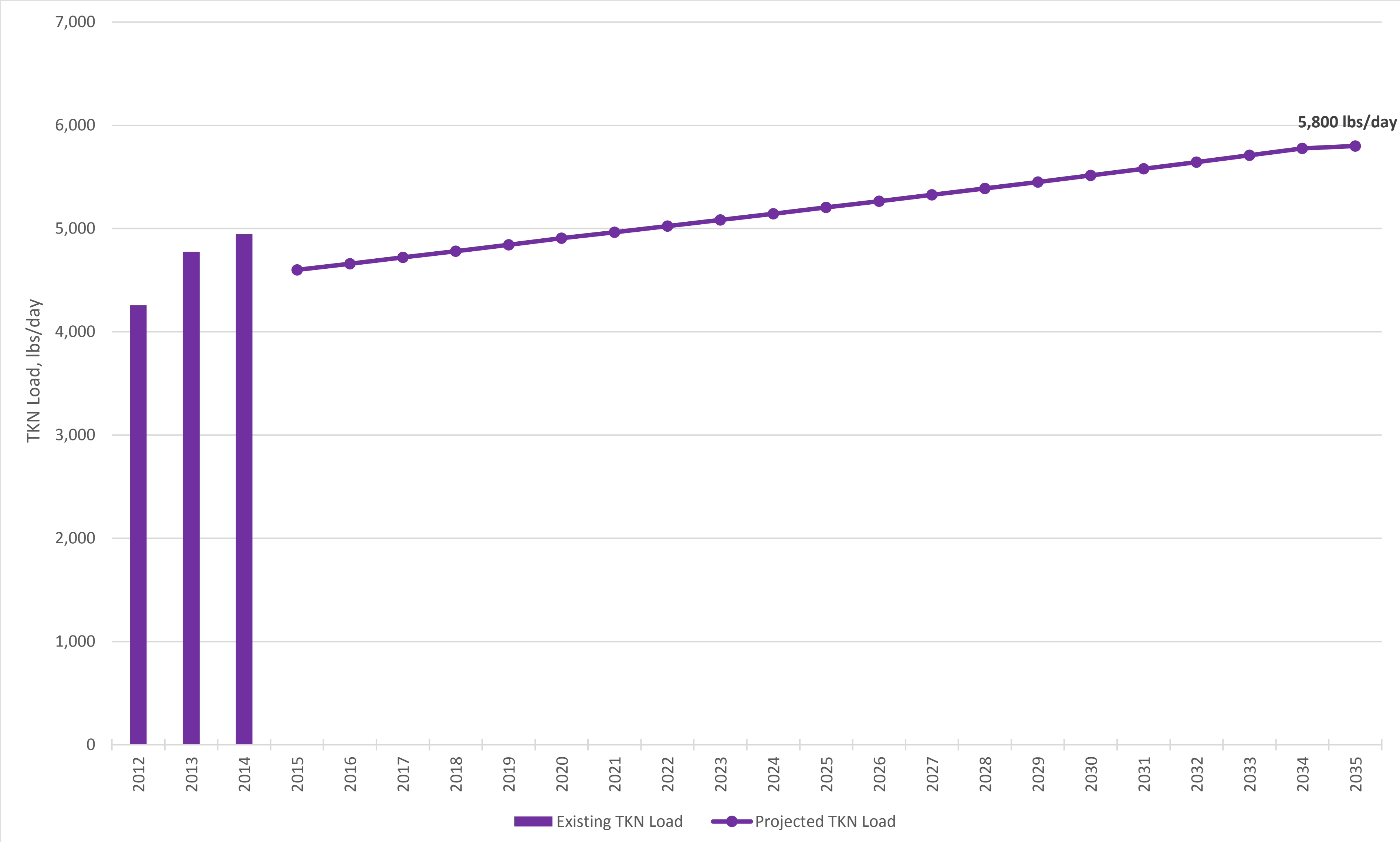


Figure B-4
Existing and Projected Ammonia Load, 2012–2035

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan



WEST YOST ASSOCIATES

Figure B-5
Existing and Projected TKN Load, 2012–2035

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

APPENDIX C

Wastewater Storage Assessment Technical Memorandum,
October 14, 2016

TECHNICAL MEMORANDUM NO. 1

DATE: October 14, 2016

Project No.: 406-19-15-39
SENT VIA: HAND DELIVERY

TO: Judy Zavadil, PE, DSRSD

FROM: Chris Malone, PE, RCE #51009

REVIEWED BY: Kathryn Gies, PE, RCE #65022

SUBJECT: Wastewater Storage Assessment

The purpose of this Technical Memorandum (TM) is to present an assessment of the current and potential future storage needs for the Dublin San Ramon Sanitation District (DSRSD or District) Wastewater Treatment and Biosolids Facility (WWT&BF). Current uses for storage include wet-weather equalization and emergency storage. This TM also considers opportunities for using to storage to maximize recycled water production and/or minimize discharges to the San Francisco Bay. This TM is intended to serve as an attachment to the DSRSD Wastewater Treatment and Biosolids Facilities Master Plan (WWT&BF Master Plan). The major topics covered in this TM include:

- Background Information
- Wet Weather Equalization
- Emergency Storage
- Flow Equalization for Meeting Recycled Water Demands
- Conclusions and Recommendations

The information presented herein is intended to provide the District with a better understanding of how storage is currently used, and how it may be used more efficiently in the future. It must be noted, however, that the results presented herein should be viewed as rough approximations of the District's ultimate storage needs for the following reasons:

- The analyses presented in this TM are highly sensitive to assumptions that have been made about the magnitude and pattern of future wastewater flows and recycled water demands. Therefore, any significant deviations from those assumptions may produce results substantially different from those presented here.
- The assumptions that have been made regarding future wastewater flows and recycled water demands are based on limited available flow data. Therefore, although a certain amount of conservatism is built into the derivation of design flow values, there is nevertheless a fair amount of uncertainty in terms of the magnitude of flows that might actually occur, and how long those flows might be sustained.

- The analyses presented herein assumes ideal conditions in terms of optimizing storage to meet limitations on available capacities for treatment and/or discharge. In many cases, these operations would need to be estimated, and any inaccuracies in the estimation process would result either in not storing enough flow or in storing more flow than necessary to meet the objectives.

For these reasons, the District should continue to evaluate both the wastewater flows and recycled water demands as additional data becomes available and revisit the conclusions presented herein, when appropriate. In addition, more evaluation of the WWT&BF storage needs and strategies for optimizing the storage operations should be made if the District decides to move forward with a project that substantially modifies the current storage arrangements.

BACKGROUND INFORMATION

This section presents relevant background information related to the capacity of the existing storage facilities, the projected wastewater flows, and the projected recycled water demands.

Existing Storage Facilities

This section presents and overview of the existing and potential storage facilities that have been considered as part of this analysis. The topics addressed include:

- DSRSD Holding Basins 1 through 4
- DSRSD Facultative Sludge Lagoons
- Livermore-Amador Valley Water Management Authority (LAVWMA) Storage Facilities

DSRSD Holding Basins 1 through 4

The DSRSD maintains four wastewater storage basins at the main WWT&BF site. Holding Basins 1, 2 and 3 can receive raw wastewater, screened wastewater, primary effluent, and secondary effluent flows. These three basins can therefore be used for influent or inter-process flow equalization during peak flow events, or can be used to store treated effluent when flows exceed LAVWMA discharge flow limits. The basins are also available for emergency storage in the event that treated effluent does not adequately meet the water quality requirements for surface water discharge.

Holding Basin 4 is hydraulically isolated from the other three basins, and is predominantly used to hold secondary treated effluent prior to tertiary treatment or discharge, but can also be used for emergency storage or if flows exceed allowable discharge capacity. In the event that flow is directed to Holding Basin 4 that does not meet water quality standards for surface water discharge or recycled water use, the water held in Basin 4 can be returned to Basin 2 via a transfer pump.

Table 1 summarizes the available storage volume provided by these ponds for various types of flow. Additional details regarding the operations of these four basins are provided in Chapter 3 of the WWT&BF Master Plan.

Table 1. DSRSD Basin Storage Capacities, Mgal

Storage Facility	Basins	Minimum of One Foot Freeboard	No Freeboard
Raw Wastewater	1, 2 & 3	11.4	12.6
Screened Wastewater	1, 2 & 3	12.6	13.9
Primary Effluent	1, 2 & 3	12.2	13.6
Secondary Effluent	1, 2, 3 & 4	18.6	20.4

DSRSD Facultative Sludge Lagoons

The DSRSD currently operates a total of six facultative sludge lagoons (FSLs), which are located across Stoneridge Dr. from the main WWT&BF site. The key dimensions of the six FSLs are summarized in Table 2. Comparing the values in Table 2 to the values provided in Table 1 demonstrates that each of the FSL basins are approximately equal in size to the storage capacity provided by Holding Basins 1, 2, and 3.

Table 2. DSRSD Basin Storage Capacities

Storage Facility	Volume, Mgal [a]	Surface area, acres [a]
Facultative Sludge Lagoon 1	13.6	3.9
Facultative Sludge Lagoon 2	11.7	3.4
Facultative Sludge Lagoon 3	15.5	4.1
Facultative Sludge Lagoon 4	13.4	3.9
Facultative Sludge Lagoon 6	10.7	3.1
Facultative Sludge Lagoon 7	16.6	5.3
Total	**81.5**	**23.7**

[a] Numbers are reflective of storage conditions at two feet of freeboard.

At this time, the FSLs are a key component of the WWT&BF solids handling process. In the future, alternative biosolids dewatering facilities may be constructed, which could make some or all of the FSLs available for other purposes, including dry or wet season storage of wastewater. Therefore, these facilities are considered herein with respect to the possible benefits they could provide if reconfigured to provide wastewater storage.

Livermore-Amador Valley Water Management Authority (LAVWMA) Storage Facilities

The LAVWMA storage facilities are located southeast of the FSLs. The LAVWMA basins were constructed to help equalize flows being pumped into the LAVWMA system, and generally must be maintained for this purposes. The total available storage in this facility is 18 Mgal. However, because this facility must equalize the combined flow from Livermore and DSRSD, it is expected that approximately 50 percent of the capacity of these basins will be available for use by DSRSD to equalize LAVWMA discharges.

Influent Wastewater Flows

The following topics are addressed with respect to the influent wastewater flows:

- Flow Projections
- Diurnal Flow Curves
- Storm Event Flow Curve
- Wet Season Daily Flow Pattern
- Potential Dry Season Flows from San Ramon
- Dry Season Daily Flow Pattern

Flow Projections

Wastewater flow projections are presented in Chapter 2 of the WWT&BF Master Plan. Table 3, below, provides a summary of the existing and projected 2035 flow parameters relevant to this analysis, which include:

- Average dry weather flow (ADWF)
- Long-term average flow (LTAF)
- Peak day dry weather flow (PDDWF)
- Maximum month flow (MMF)
- Peak day wet weather flow (PDWWF)
- Peak hour wet weather flow (PHWWF)

All values are expressed in units of million gallons per day (mgd).

Also shown in Table 3 are the flows that were presented in DSRSD's Wastewater Treatment Plant Stage 4 Improvements Contract Documents, January 2000 (Stage 4 Improvements Design). As shown, projected flows for 2035 conditions are significantly lower than projections that were presented in the Stage 4 Improvements Design. The fact that current predictions for 2035 flows are significantly lower than previously anticipated is driving the decision at this time to review previous assumptions regarding wet-weather equalization needs.

Table 3. Existing and Projected Wastewater Flows, mgd					
	WWT&BF Master Plan			Stage 4 Improvements Design	
Statistic	Existing Conditions	Projected 2035 Conditions	Peaking Factor	Projected 2020 Conditions	Peaking Factor
ADWF	9.7	12.3	-	17.0	-
LTAF	10.3	13.5	1.1	not specified	
PDDWF	12.1	15.4	1.25	not specified	
MMF	12.3	16.0	1.3	not specified	
PDWWF	20.1	25.8	2.1	not specified	
PHWWF	36.2	46.7	3.8	60.7	3.6

Diurnal Flow Curves

A typical diurnal flow curve was developed for the WWT&BF Master Plan based on flow data from September 2014 (see Figure 2-5 in the Master Plan). This typical pattern was then applied to various flow conditions to develop diurnal curves, and these curves are used to assess the number of hours that the District could discharge to emergency storage under varying flow conditions. Diurnal flow curves were specifically developed for both current and 2035 conditions for the following flow scenarios:

- ADWF
- LTAF
- PDDWF
- MMF

The flow value associated with each of the above-listed scenarios is shown in Table 3 above. For the analysis, the typical dry weather diurnal flow curve pattern is then applied to the flow value. The resultant flow curves for current conditions is shown on Figure 1 and the flow curves for 2035 conditions are shown on Figure 2.

Storm Event Flow Curve

As discussed in Chapter 2 of the WWT&BF Master Plan, three large storm events have occurred since the current flow metering system was installed. (Prior to the installation of these flows meters, the flow data being collected is not considered reliable.) Characteristics of the three storms are listed in Table 4. When evaluating wastewater flows during a given storm event, it is assumed that the peak design storm would have the same shape as one of these three largest storms. For each storm event listed in Table 4, the observed flow pattern is extrapolated upward to achieve a PHWWF value of 46.7 mgd. The resulting flow curves for all three storms are shown on Figure 3.

Table 4. Design Storm Events			
Basis	Total Event Rainfall, inches	Storm Return Period, years [(a)]	Observed PHWWF, mgd
March 24–25, 2011	1.86	1.0	31.6
November 30 –December 2, 2012	3.82	2.2	36.2
December 11–12, 2014	2.87	2.4	31.0

(a) National Oceanic and Atmospheric Administration rainfall event return periods, Dublin Blvd. Station

As shown in Table 4, the storm return period results from the National Oceanic and Atmospheric Administration (NOAA) demonstrates that the largest of the three storm events for which reliable flow data were available had a return period of about 2½ years. There is some question, therefore, as to whether significantly higher peak flows may be possible during rare extreme storm events. It is expected that within a few more years there will be data available to confirm peak flows during extreme storm events, but until that time, considerable uncertainty remains. Accordingly, DSRSD should continue to analysis peak wet weather flow conditions over the coming years. Once adequate data is available to confidently predict peak flows in a rare extreme storm event, the analysis presented herein should be revisited.

Wet Season Daily Flow Pattern

A wet season daily flow pattern was developed for purposes of this analysis. Wet season flow data were provided for four different wet seasons: 2011/2012 through 2014/2015. Daily flow factors (defined as daily flow divided by the ADWF value for the applicable year) were calculated for each day of the period of record. For any given day of the year, a “typical” flow factor was developed by averaging the flow factors together from the four different wet seasons.

None of these years was especially wet by historical standards, however. Therefore, a hybrid wet year curve was developed by combining flow factors from multiple years of data. Specifically, daily flow factors from December 2014 (which had the highest flow values for the period of record) were combined with the daily flows factors for the other wet season months from 2013/2014 (which had the highest overall peaking factor of all the years for the period of record). The resultant daily wet season flow pattern curves for average year and wet year conditions are shown on Figure 4.

Potential Dry Weather Flows from San Ramon

One option that has been identified for meeting the recycled water shortfalls, which are discussed further in later sections of this TM, would be for DSRSD to begin receiving the wastewater flow from the Dougherty Valley area of San Ramon that is currently being exported to the Central Contra Costa Sanitary District (CCCSD) via the San Ramon Pump Station. The five-year average flow recorded at the pump station for the period of 2011 through 2015 is 2.75 mgd. However, the flows have trended downward recently, with the 2015 average being 2.57 mgd. To avoid overestimating the Dougherty Valley flows, an available flow of 2.5 mgd is used, and is assumed to be delivered at a constant rate throughout the dry season.

If San Ramon flows were imported, a key issue that would need to be addressed would be the timing of the imported flows. Negotiations with CCCSD would need to be undertaken to establish the terms of any future transfer, so it is presently unclear what the volume and timing would be. Based on discussions with District staff, a likely scenario would be that the District would accepted flows at the designated amount (2.5 mgd) for a fixed period of time that would be negotiated between the parties. he analysis presented herein demonstrates that the District would only need to accept flows from San Ramon June through August to maximize the benefits with respect to meeting recycled water peak demands.

Dry Season Daily Flow Pattern

A dry season daily flow pattern was developed for recycled water production and storage assessment purposes. Dry season flow data were used from the period of January 2012 through March 2015. Specifically, daily flow factors were derived by dividing the average flow from the given calendar for the period of record, divided by the 3-year average of the ADWF values from the period of April 2012 through October 2014. The resultant daily dry season flow pattern curve is shown on Figure 5.

The flow factors on Figure 5 serve as the basis for dry weather flows for all future years. The resultant flow curve for 2035 conditions is shown on Figure 6. In addition, Figure 6 shows how the flow curve changes when 2.5 mgd of flow is added in at a continuous rate for the period of June through August.

Recycled Water Demands

The following topics are addressed with respect to recycled water demands:

- Demand Projections
- Dry Season Recycled Water Demand Curve
- Anticipated Recycled Water Demand Shortfalls
- Wet Season Recycled Water Demand Curve
- Flows Available for Potable Reuse

Demand Projections

Projected recycled water demands for the years 2015–2020 and for 2035, as provided by DSRSD staff, are shown in Table 5 in units of acre-feet per year (AFY). The expected users of the recycled water include the DSRSD/East Bay Municipal Utility District Recycled Water Authority (DERWA) and the City of Pleasanton. As shown, the estimated maximum day demands significantly exceed the anticipated 2035 ADWF (12.3 mgd).

Table 5. Projected Recycled Water Demands					
Year	Annual Recycled Water Demand, acre-feet per year				Equivalent Max Day Demand, mgd[a]
	DSRSD	EBMUD	Pleasanton	Total	
2015	2,770	1,000	50	3,830	8.5
2016	3,030	1,150	410	4,590	10.2
2017	3,310	1,420	1,230	5,960	13.3
2018	3,730	1,420	1,630	6,780	15.2
2019	3,840	1,420	1,660	6,920	15.4
2020	3,900	1,480	1,660	7,040	15.7
2035	4,200	2,580	1,660	8,430	18.8

(a) Based on an assumed max day peak factor of 2.5 relative to annual average demand.

Dry Season Recycled Water Demand Curve

Recycled water demand curves for the dry season (defined here as April through October) were generated for purposes of this analysis. The curve is expressed in terms of daily recycled water flow factors, which are defined as daily recycled water demand values divided by the annual average demand value. For this analysis, 7-day average recycled water usage data from 2012 were used. (The data were supplemented with October 2014 data because October 2012 recycled water usage data were unusually erratic). Data from 2012 were selected because there was one clear peak usage period (August 2012), and because the resultant peaking factor (2.5) is consistent with DSRSD assumptions about future recycled water demands. The resultant daily dry season recycled water demand pattern curve is shown on Figure 7.

Anticipated Recycled Water Delivery Shortfalls

Recycled water shortfalls that are expected to occur can be quantified by comparing the daily recycled water demand curve (shown on Figure 7) to the projected daily dry season flow curves, for DSRSD flows, and for DSRSD plus San Ramon flows (example for 2035 flows are shown on Figure 6). For the 2035 condition, the projected wastewater flows, the recycled water demands, and the delivery shortfalls with no assumed flow from San Ramon and no long-term storage are depicted on Figure 8. The same conditions, except with San Ramon flows added at a constant rate of 2.5 mgd are shown on Figure 9.

The recycled water delivery shortfalls by year, assuming that filtration and disinfection capacity not limiting, are indicated in Table 6 for both a zero San Ramon flow scenario and a 2.5 mgd San Ramon flow scenario. The results indicate that, without San Ramon flows, there would be significant delivery shortfalls beginning in 2017 and continuing through 2035.

Table 6. Total Recycled Water Delivery Shortfalls in the Absence of Storage			
Simulation Year	Total Projected Recycled Water Demand, Mgal	Demand Shortfall, Mgal	
		San Ramon Flow = 0 mgd	San Ramon Flow = 2.5 mgd
2016	1,425	2	0
2017	1,846	106	6
2018	2,106	237	43
2019	2,144	245	47
2020	2,182	254	53
2035	2,607	315	106

Wet Season Recycled Water Demand Curve

Historically, and for the foreseeable future, demands for recycled water from the WWT&BF continue through the wet season at much lower levels than the dry season. Recycled water demand curves for the wet season (defined here as November through March) were also generated for purposes of this analysis. The assumed wet season recycled water demand pattern is based on data from the period of November 2011 through March 2015. It is assumed that wet season recycled water demands will increase proportionally with the annual demand increased shown in Table 5, with 2015 serving as the baseline year. The resultant recycled water flow curves for 2015 and projected 2035 conditions are shown on Figure 10.

Flows Available for Potable Reuse

The District has an interest in implementing a potable reuse project that would maximize the use of available treated effluent water supplies year-round. With this concept, the potable reuse system would treat any flows not being sent to irrigation reuse customers, up to the capacity of the potable reuse treatment system. The examination of potable water reuse is limited to 2035 flow conditions, as that would likely serve as the basis for the sizing of advanced treatment facilities.

The flows available for potable reuse in 2035 were estimated by subtracting the wet season wastewater flows for an average year (based on the flow pattern is shown on Figure 4) from the wet season recycled water demands (shown on Figure 10). The resultant curve showing the flows available for potable reuse is shown on Figure 11.

WET WEATHER EQUALIZATION

This section addresses the following topics related to wet weather flow equalization at the WWT&BF.

- Discharge Constraints
- Equalization Storage Requirements for Design Flow Conditions
- Storage Available for Rare Extreme Storm Events

Discharge Constraints

The two major constraints that exist on effluent discharge from the WWT&BF include the available treatment and conveyance capacity downstream of the primary clarifiers and the LAVWMA discharge limits.

Primary Effluent Equalization

The issue of the sizing of treatment facilities downstream of the primary clarifiers is addressed in Chapter 6 of the WWT&BF Master Plan. Because the sizing of post-primary treatment facilities is itself a variable target, the objective of this analysis is to determine the optimal balance between primary effluent storage and the sizing of post-primary treatment facilities. The available wet weather holding capacity for primary effluent equalization is limited to Basins 1 through 3, which have a combined storage capacity between 12.2 and 13.6 Mgal (see Table 1 above).

LAVWMA Discharge Limits

The DSRSD discharge to the East Bay Dischargers Authority (EBDA) outfall via the LAVWMA pipeline is limited to a peak discharge rate of 41.2 mgd, of which only 28.8 mgd is allocated to DSRSD, as specified in the LAVWMA Joint Powers Agreement (discussed in Chapter 4 of the WWT&BF Master Plan).

The DSRSD/LAVWMA/EBDA discharge permit (Order No. R2-2011-0028, NPDES No. CA0038679) also allows for discharges of up to 55 mgd to Alamo Creek, which is adjacent to the LAVWMA export pump station, under certain conditions, as follows:

> *Discharge to Alamo Canal is prohibited unless, as a result of an extreme wet weather event, the maximum export pumping capacity is in use (i.e., either the full 41.2 MGD to the EBDA pipeline or 19.2 MGD to the EBDA pipeline and at most 21.5 MGD to San Lorenzo Creek), storage facilities are being utilized to optimize dilution in the receiving water, and both the Regional Water Board and Alameda County Water District have been given prior notification that a discharge to Alamo Canal is needed. The discharge to Alamo Canal shall only occur during a 10-year flow event or greater and shall not exceed 55 MGD. Discharge is prohibited during dry weather.*

For purposes of planning for and managing wet weather operations, it is very difficult to determine whether a 10-year event will occur or is occurring in real time. Typically, the return period of any given flow event can only be determined retroactively when the event has ended and there is an opportunity to analyze available data. Therefore, the ability to discharge to Alamo Creek is ignored in this analysis.

It is recommended that DSRSD and LAVWMA work with San Francisco Regional Water Quality Control Board (Regional Board) staff to better define when an Alamo Canal discharge is allowable and exactly how that determination can be made under real-time conditions. The permit does state that "*during a 10-year return frequency storm (800 MGD), and based on the maximum discharge from the outfall (55 MGD), the mixing zone would result in dilution of at least 15:1 (D=14). This is the highest dilution justified.*" Thus, the language of the permit is such that a 10-year return frequency is indicated, but it also suggests that a dilution factor of 15:1 is the target, which equates to a flow rate in Alamo Canal of 800 mgd for a discharge of 55 mgd. With the recent installation of a flow meter in Alamo Canal, data from this meter could be used to more clearly assess when discharges are allowed, and potentially allow for increased frequency of discharges. For example, a 15:1 dilution can be achieved in Alamo Canal at lower streamflow rates if the discharge flow rate is less than 55 mgd, which represents the vast majority of situations where measureable flow is occurring in Alamo Canal.

Equalization Storage Requirements for Design Flow Conditions

Consistent with the discharge constraints defined above, the 2035 design flow storage requirements have been defined for:

- Primary Effluent Equalization
- Final Effluent Equalization

In both cases, the three storm events shown on Figure 3 were used as the basis for estimating storage requirements under peak wet weather conditions. Any flows in excess of the available treatment or discharge limits are assumed to be diverted to storage and held there until after the given storm event ends. In general, the use of the March 23–25, 2011 storm pattern produces the highest primary effluent storage requirements. Recycled water demands are assumed to be inconsequential during peak wet weather events.

Primary Effluent Equalization

The relationships between post-primary treatment capacity and required primary effluent equalization storage requirements for peak wet weather conditions are indicated on Figure 12. As shown, a post-primary treatment capacity of 30 mgd equates to a storage requirement of 7.1 Mgal, which is a little more than half of the available storage capacity. A post-primary treatment capacity of 25 mgd equates to a storage requirement of 14.1 Mgal, which exceeds the combined capacity of Basins 1 through 3.

As discussed further in Chapter 6 of the WWT&BF Master Plan, it is not recommended that the District assume it is possible to rely on all of the available primary effluent storage capacity to equalize peak flows until there is enough reliable flow data available to understand what the full range of peaking factors may occur. Specifically, as discussed previously, there is a high likelihood that a storm that is larger than the currently defined design storm will occur which could generate significantly more volume than any of the three storm curves used in the analysis. Given this likelihood, a post-secondary treatment capacity of 30 mgd is considered to be a good balance between treatment and storage. Such an arrangement would use approximately half of the available storage for the design storm condition, and would leave a roughly equal amount of storage still available for rare storm condition or emergency storage needs.

It should be noted that the District does not currently have the ability to control peak flow shaving in a way that allows for flows less than a given value to be directed through the treatment facilities. Therefore, current peak shaving operations are not based on trying to achieve a certain flow through the process downstream of the primaries. Instead, flows are shaved off until the operators feel comfortable that the hydraulic or capacity constraint downstream has been mitigated. Because this strategy can result in storing a significantly larger volume than necessary, and the need to maximize storage capacity will become more critical as flows increase, it is recommended that improvements be made that allow District operations staff to reliably control primary effluent equalization based on a desired flow through the downstream processes.

Final Effluent Equalization

As noted above, Basins 1 through 4 and approximately ½ of the LAVWMA basins are assumed to be available for use for final effluent equalization. The four basins have a combined capacity between 18.6 and 20.4 Mgal, as indicated in Table 1 above, and the LAVWMA basins should provide up to 9 Mgal of capacity for DSRSD flows, for a total potential storage volume of 29.4 Mgal.

The anticipated storage volumes needed to accommodate design peak flow conditions when flow discharges are constrained to the LAVWMA discharge limit of 28.8 mgd are indicated in Table 7 for the three different storm bases used in this analysis. As indicated, it is estimated that less than half the available storage volume in Basins 1 through 4 would be needed to accommodate the design storm condition.

Table 7. Potential Storage Requirements for Projected PHWWF Flow of 46.7 mgd

Basis	Storm Return Period, years[a]	Observed PHWWF, mgd	Required Storage in 2035, Mgal
March 24–25, 2011	1.0	31.6	8.6
November 30 – December 2, 2012	2.2	36.2	4.4
December 11–12, 2014	2.4	31.0	8.2

[a] NOAA rainfall event return periods, Dublin Blvd. Station.

As discussed previously, there is some uncertainty with respect to the projected flows used as the basis of design in the WWT&BF Master Plan. Therefore, even though Table 7 shows that significantly less storage is needed than is available, it is recommended that DSRSD maintain all of the available storage capacity to the extent feasible until a better understanding of the long-term storage needs can be achieved.

For equalization of effluent flows upstream of the LAVWMA pump station, the District has the ability to hold any flows that cannot be discharged to LAVWMA in the LAVWMA storage ponds and Storage Basin 4. Moreover, if the capacity of Storage Basin 4 is exceeded, flows can be transferred to Holding Basin 2 (which can flow to Basins 1 and 3). Because discharges from the LAVWMA basins is positively controlled by the LAVWMA pumps, there is no need to install additional facilities to improve the control of secondary effluent peak shaving.

Storage Available for Rare Extreme Storm Events

One way to assess the ability of the existing system to accommodate a potential future storm event that exceeds the design storm used herein is to evaluate the magnitude of the wet weather peaking factor that might be accommodated with the storage available. As noted above, for primary effluent equalization, the volume of Basins 1 through 3 is assumed to be available (up to 12.2 Mgal if one foot of freeboard is maintained). For final effluent equalization, the volume of all four basins, plus 50 percent of the LAVWMA storage basins is assumed to be available (29.4 Mgal).

For this analysis, the flows curves for the three storms in question (shown on Figure 3) were upwardly adjusted until the calculated total diversion to storage achieved the applicable storage threshold. For the primary equalization scenarios, all flows above 30 mgd are assumed to be diverted to storage. For the final effluent equalization, all flows above the LAVWMA discharge limit of 28.8 mgd are assumed to be diverted storage.

The upwardly adjusted PHWWFs and associated peaking factors identified through this analysis are summarized in Table 8. As indicated, the available primary effluent storage (Basins 1 through 3) may be able to accommodate a 7 to 21 percent increase in the PHWWF peaking factor above the design flow condition identified in the WWT&BF Master Plan, depending on the assumed peak flow pattern curve. Similarly, the final effluent storage capacity (Basins 1 through 4) may be able to accommodate up to a 34 to 54 percent increase in the PHWWF factor.

Table 8. Potential PHWWFs Accommodated with Available Storage During Theoretical Rare Peak Wet Weather Events			
Scenario/ Storm Basis	Increase in Peak Flow Above Design Condition	Resultant PHWWF, mgd	Theoretical Peaking Factor
Primary Effluent Equalization: Flows Greater Than 30 mgd; 12.2 MGal Storage			
March 24–25, 2011	7%	50.0	4.1
November 30 – December 2, 2012	21%	56.6	4.6
December 11–12, 2014	8%	50.5	4.1
Final Effluent Equalization: Flows Greater Than 28.8 mgd; 29.4 MGal Storage			
March 24–25, 2011	34%	62.6	5.1
November 30 – December 2, 2012	54%	72.0	5.9
December 11–12, 2014	40%	65.4	5.3

EMERGENCY STORAGE

In the event of a plant upset and/or discharge limit exceedance, primary effluent flows can be diverted to Holding Basins 1 through 3 and secondary effluent can be diverted to Holding Basin 4, from where it can be pumped to Holdings Basins 1 through 3. However, during the dry season, Holding Basin 4 is used for diurnal equalization of secondary effluent to maximize recycled water projection. Accordingly, it is assumed that if a process upset were to occur in the summer months, the preferred operation would be to avoid discharging partially treated flow to Holding Basin 4, unless absolutely necessary. Therefore, separate analyses are performed for primary effluent emergency storage in the summer months and secondary effluent emergency storage in the winter months.

Primary Effluent Emergency Storage

Emergency storage of primary effluent would only likely occur in summer months when 1) a major process upset occurred that would preclude the District’s ability to produce secondary effluent quality and 2) recycled water demands are at a peak and a shutdown of Pond 4 for extended period of time is not reasonable. Therefore, for the primary effluent equalization analysis, only the dry-season conditions were considered.

For this analysis, the ADWF and PDDWF diurnal flow patterns (as shown on Figures 1 and 2) were used to predict hourly flows for both current and 2035 conditions. Under the emergency conditions described above, it is assumed that all of the primary effluent flows would be discharged to Basins 1 through 3, which would have a total storage capacity of 12.2 Mgal. The results of this analysis are indicated in Table 9. Note that a range of times is indicated because the diversion time would be dependent on the time of day at which diversions begin, unless the flow rate (in mgd) matches the available volume (in Mgal), which is essentially the case for the existing PDDWF and buildout ADWF scenarios. As shown, the plant would be expected to have less than 24 hours of emergency storage during the dry season under 2035 PDDWF conditions.

Table 9. Dry-Season Primary Effluent Emergency Diversion Capacity (Basins 1 through 3)		
Flow Condition	Daily Flow, mgd	Maximum Diversion Time, hours
Existing Conditions		
ADWF	9.7	28–33
PDDWF	12.1	24
2035 Conditions		
ADWF	12.3	23
PDDWF	15.4	15–20

Secondary Effluent Emergency Storage

For the analysis of emergency storage of secondary effluent, the worst-case conditions would occur during the winter months when flows are elevated due to inflow and infiltration. However, to avoid being overly conservative, emergency storage during a peak wet weather flow event is not considered. Instead, the LTAF and MMF diurnal patterns (shown on Figures 1 and 2) were used to predict hourly flows for both current and 2035 conditions during a typical wet season day (but during non-rainfall conditions). The results of the wet season analysis, assuming the 18.6 Mgal of emergency storage is available, are provided in Table 10. As shown, the plant would be expected to have less than 36 hours of emergency storage during the wet season under 2035 PDDWF conditions.

Table 10. Wet-Season Secondary Effluent Emergency Diversion Capacity (Basins 1 through 4)		
Flow Condition	Daily Flow, mgd	Maximum Diversion Time, hours
Existing Conditions		
Long-Term Average Flow	10.3	39–44
Maximum Month Flow	12.3	33–38
2035 Conditions		
Long-Term Average Flow	13.5	30–35
Maximum Month Flow	16.0	26–31

FLOW EQUALIZATION FOR MEETING RECYCLED WATER DEMANDS

This section addresses potential opportunities for using storage (or flow equalization) to maximize recycled water production and minimize effluent discharge volumes. Topics that are addressed include:

- Equalization to Meet Peak Dry Season Demands
- Potential Effluent Discharge Volume Reductions Associated with Irrigation Reuse
- Maximizing Winter-Month Potable Reuse Water Production

Equalization to Meet Peak Dry Season Demands

As discussed previously in this TM, the recycled water demands are expected to be significantly greater than the anticipated available effluent flows. One option for addressing this issue is to generate and store recycled water storage during the spring months (when recycled water demands are low), and release the stored flows to the irrigation system during the peak demand periods (typically June through August). Accordingly, the following topics are covered in this section:

- Seasonal Storage Requirements
- Potential Reduced Demand Scenarios

Seasonal Storage Requirements

For scenarios involving storage of flow to meet recycled water demands, it is assumed that the District would use the available recycled water treatment capacity to treat flows during the spring months and release the treated flows to irrigation customers during the peak summer months. An alternative strategy would be to store secondary effluent, and then treat the stored flows during the peak recycled water demand periods. However, this later strategy would require tertiary treatment capacity this is equal to the peak day recycled water demand. Thus, the benefits of storage with respect to offsetting treatment capacity would not be realized.

The amount of storage needed to accommodate the recycled water shortfalls with and without San Ramon flows (as shown in Table 6) are presented in Table 11. As shown, the storage required slightly exceeds the shortfall amount, and this difference is due to anticipated losses to evaporation. However, such losses may be mitigated if the storage is covered.

Table 11. Recycled Water Storage Requirements for Meeting Shortfalls			
Simulation Year	Peak Day Demand, mgd	Storage Required, MGal	
		San Ramon Flow = 0 mgd	San Ramon Flow = 2.5 mgd
2016	10.4	0	0
2017	13.4	109	0
2018	15.3	241	37
2019	15.6	246	38
2020	15.9	251	41
2035	19.0	359	127

The anticipated storage volumes, wastewater flows, recycled water demands, and peak flows treated through tertiary filtration with no San Ramon flows are indicated on a month-by-month basis on Figure 13 for the period of 2016 through 2020, and on Figure 14 for 2035 conditions. As indicated in the figures, the maximum throughput tertiary treatment capacity that would be needed to meet the 2035 peak day irrigation demand is approximately 14.2 mgd if flows were treated during the shoulder months. This is significantly lower than the projected maximum day recycled water demand of 18.8 mgd.

The anticipated storage volumes, wastewater flows, recycled water demands, and flows through tertiary filtration with 2.5 mgd of San Ramon flows included are indicated on a month-by-month basis on Figure 15 for the period of 2016 through 2020, and on Figure 16 for 2035 conditions. As indicated in these figures, a maximum throughput treatment capacity would increase to 16.2 mgd to take advantage of San Ramon flows. This increase in throughput capacity is offset by the reduced amount of storage required.

Potential Reduced Demand Scenarios

There is a high probability that the timing and/or magnitude of the future recycled water demands will be different from what is presented in this TM. Therefore, a second evaluation was conducted to assess the magnitude of recycled water demands that could be accommodated with varying levels of storage. The storage volumes under consideration include 0, 20, 40, 60 and 80 Mgal, because these numbers roughly reflect the storage volume increments that would be available if the existing FSLs were converted to recycled water storage.

For this analysis, the recycled water demand curve was uniformly reduced throughout the season by a given percentage, while the wastewater generation curve remains unadjusted. For all years, it was assumed that the storage basins would be available to start filling on April 1.

Table 12 summarizes the demands that could be accommodated for each of these storage scenarios. As shown, the addition of San Ramon flows allows all near-term recycled water demands to be met with 40 Mgal of storage, with only slight demand reductions needed in 2035 to avoid shortfalls. In the absence of San Ramon flows, however, significant demand reductions would be required to ensure no demand shortfalls.

Table 12. Reductions in Projected Demands That Can Be Accommodated with Different Storage Scenarios											
Required Demand Reductions, San Ramon Flow = 0 mgd											
Year	Max Day Demand (no reduction), mgd	Scenario 1: 0 Mgal		Scenario 2: 20 Mgal		Scenario 3: 40 Mgal		Scenario 4: 60 Mgal		Scenario 5: 80 Mgal	
		Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd
2016	10.4	**5%**	**9.8**	0%	10.4	0%	10.4	0%	10.4	0%	10.4
2017	13.4	**26%**	**9.9**	**12%**	**11.8**	**8%**	**12.4**	**6%**	**12.6**	**4%**	**12.9**
2018	15.3	**34%**	**10.1**	**22%**	**12.0**	**18%**	**12.6**	**16%**	**12.9**	**14%**	**13.2**
2019	15.6	**34%**	**10.3**	**22%**	**12.2**	**18%**	**12.8**	**16%**	**13.1**	**14%**	**13.4**
2020	15.9	**34%**	**10.5**	**22%**	**12.4**	**18%**	**13.0**	**16%**	**13.3**	**14%**	**13.6**
2035	19.0	**36%**	**12.2**	**26%**	**14.1**	**22%**	**14.8**	**20%**	**15.2**	**19%**	**15.4**
Required Demand Reductions, San Ramon Flow = 2.5 mgd											
Year	Max Day Demand (no reduction), mgd	Scenario 1: 0 Mgal		Scenario 2: 20 Mgal		Scenario 3: 40 Mgal		Scenario 4: 60 Mgal		Scenario 5: 80 Mgal	
		Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd	Demand Reduction	Max Day Demand, mgd
2016	10.4	0%	10.4	0%	10.4	0%	10.4	0%	10.4	0%	10.4
2017	13.4	**7%**	**12.5**	0%	13.4	0%	13.4	0%	13.4	0%	13.4
2018	15.3	**18%**	**12.6**	**4%**	**14.7**	0%	15.3	0%	15.3	0%	15.3
2019	15.6	**18%**	**12.8**	**5%**	**14.8**	0%	15.6	0%	15.6	0%	15.6
2020	15.9	**18%**	**13.0**	**5%**	**15.1**	0%	15.9	0%	15.9	0%	15.9
2035	19.0	**23%**	**14.7**	**12%**	**16.7**	**7%**	**17.7**	**5%**	**18.1**	**3%**	**18.5**

Potential Effluent Discharge Volume Reductions Associated with Irrigation Reuse[1]

One of the District's goals with respect to resource utilization is to maximize recycled water production and minimize discharges to San Francisco Bay. Discharge volumes are also a potential concern because the Regional Board is proposing to establish nutrient load caps for existing discharges through the Nutrient Watershed Permit, and the District's strategy for meeting these loading caps is to increase recycled water production (in lieu of proving nutrient removal through treatment means). The purpose of this analysis presented in this section is to 1) quantify the anticipated reductions in discharge volumes associated with planned irrigation reuse, 2) identify how the importation of flows from San Ramon will impact discharge volumes, and 3) determine how the use of storage to meet recycled water demands could impact discharge volumes. This analysis is discussed below under the following headings:

- Anticipated Dry Season Discharge Volumes
- Potential Impacts of San Ramon Flows and Recycled Water Storage on Dry-Season Discharge Volumes
- Seasonal Discharge Volumes

Anticipated Dry Season Discharge Volumes

Table 13 provides a comparison of the current discharge volumes, by month, to the discharge volumes anticipated in 2020 and 2035 given current influent flow and recycled water demand projections. In this table, "current" discharge volumes reflecting the period of April 2014 through March 2015, which reflect the conditions that were occurring around the time the Nutrient Watershed Permit was adopted. For the 2020 and 2035 conditions, the discharge is defined as the total effluent flow less the amount used for season recycled water demands.

As shown in Table 13, discharge volumes are expected to be almost half of current volumes by 2020, and approximately 40 percent lower in 2035 than current flows. It should also be noted that the information shown in Table 13 is for average year conditions. During a wet year, discharge volumes would actually be somewhat higher than those shown because influent flows would be higher and recycled water demands would tend to be reduced in a high-rainfall, high-flow year.

[1] Note that a potable reuse project would have an even more dramatic impact on nutrient discharge loads because the nutrients would need to be removed in the secondary process under this scenario. Chapter 6 of the WWT&BF Master Plan provides additional details regarding the treatment requirements for potable reuse and its relationship to meeting nutrient limits for Bay discharge.

Table 13. Wet Season Discharge Volumes for Average Rainfall Year Conditions

	Discharge Volume, Mgal		
	Current Conditions [(a)]	2020 Conditions	2035 Conditions
January	301	279	331
February	296	261	310
March	315	216	256
April	312	252	296
May	305	47	51
June	290	0	0
July	290	0	0
August	288	0	0
September	281	12	11
October	282	109	124
November	270	255	303
December	372	321	381
Total	**3,602**	**1,752**	**2,063**

(a) Based on wastewater and recycled water data from November 2014 through March 2015.

Potential Impacts of San Ramon Flows and Recycled Water Storage on Dry-Season Discharge Volumes

As discussed previously, the District is considering importing approximately 2.5 mgd of wastewater from San Ramon during the summer months as a means of meet peak recycled water demands. In addition, this TM presents a scenario where seasonal storage is used to maximize production volumes. Tables 14 and 15 show potential discharge volumes with and without San Ramon flows and with and without recycled water storage.

As shown in Tables 14 and 15, the lowest discharge volumes occur with no San Ramon flows and the use of unlimited storage to meet peak recycled water demands. However, this condition also assumes a significant amount of storage is available (see Table 11). The highest discharge volumes occur with San Ramon flows and not storage. This is partially attributable to the assumption that San Ramon flows are accepted daily between June and August. However, during the early part of the San Ramon flow period, flows in excess of recycled demand requirements would need to be discharged by the District. The ideal situation for the District would be to only accept flows when they are needed and in the exact amounts necessary to meet recycled water demands. However, this scenario is not likely to be realistic.

Table 14. Potential Dry Season Discharge Volumes at 2020 Conditions				
	Discharge Volumes, Mgal			
	San Ramon Flow = 0 mgd		San Ramon Flow = 2.5 mgd	
Month	Zero Storage	Unlimited Storage	Zero Storage	Unlimited Storage
April	252	57	252	252
May	47	0	47	35
June	0	0	16	0
July	0	0	1	1
August	0	0	12	12
September	12	12	12	12
October	109	109	109	109
Total	**421**	**178**	**450**	**422**

Table 15. Potential Dry Season Discharge Volumes at 2035 Conditions				
	Discharge Volumes, Mgal			
	San Ramon Flow = 0 mgd		San Ramon Flow = 2.5 mgd	
Month	Zero Storage	Unlimited Storage	Zero Storage	Unlimited Storage
April	296	0	296	227
May	51	0	51	0
June	0	0	11	0
July	0	0	0	0
August	0	0	8	8
September	11	11	11	11
October	124	124	124	124
Total	**481**	**135**	**500**	**370**

Tables 14 and 15 also show that, for the zero storage scenarios, the importation of San Ramon flow only has a small effect on discharge volumes because almost all of the imported flows would be used to produce recycled water during the high-demand months of June through August. For the scenarios where storage is not limiting, the importation of San Ramon flows reduces the total storage required (as discussed previously in this TM), but this reduced storage has the effect of significantly increasing discharge volumes during the months of April and May. In other words, in the absence of San Ramon flow importation, the wastewater generated during April and May would need to be stored to meet summer demands, whereas with the San Ramon flow importation, those same flows would be discharged.

Seasonal Discharge Volumes

As noted previously, the Regional Board is proposing that nutrient loading caps be placed on existing dischargers to the San Francisco Bay through the Nutrients Watershed Permit process. The District is planning to meet the loading cap requirements by reducing the flow being discharged to the San Francisco Bay and increasing the amount of effluent that is used for irrigation. At this time, however, it is not clear whether the nutrient loading caps will be based on annual loads, or seasonal loads, where the seasonal loading periods are defined as May to September and October to April[2]. This section presents a summary of the anticipated discharge volumes for these seasonal periods.

Table 16 provides the estimated range of DSRSD discharge volumes for current, 2020, and 2035 conditions both seasonally (as defined by the Nutrient Control Study) and year-round. A shown, dry-season flows are expected to be a small fraction of current flows. Indeed, the average daily discharge flow over the 153-day period from May through September would be between 0.1 and 0.6 mgd, where the lowest values are associated with secondary effluent storage.

Table 16. Current and Projected Seasonal Discharge Volumes

Time Period	Seasonal Storage, Mgal		
	Wet Season (Oct–Apr) [a]	Dry Season (May–Sep) [a]	Year-Round
Current	2,148	1,454	3,603
2020	1,498 - 1,693	12 - 89	1,510 - 1,782
2035	1,705 - 2,001	11 - 80	1,716 - 2,081

(a) Based on the wet and dry season definitions from the BACWA Control Study.

[2] These seasonal periods are defined in the Nutrient Control Study being developed under a partnership between the Regional Board and the Bay Area Clean Water Agency (BACWA).

Maximizing Winter-Month Potable Reuse Water Production

As discussed previously, the District is interested in implementing a potable reuse project as a means of using the available treated effluent that is not being directed to irrigation customers. The purpose of this analysis it to identify strategies for optimizing the volume of water that is ultimately beneficially reused by the District via a potable reuse project. The following topics are discussed:

- Optimum Treatment System Sizing to Maximize Potable Reuse Potential
- Storage of Secondary Effluent to Further Maximize Potable Reuse Potential

Optimum Treatment System Sizing to Maximize Potable Reuse Potential

The purpose of this portion of the analysis is to identify the potable reuse treatment system capacity that would maximize the use of the available treated effluent water supply. For this analysis, effluent flows that exceed the input flow to the advanced treatment system are assumed to be discharged. In addition, the analysis is limited to the wet season period of November through March. However, additional flows would be treated during the shoulder months (primarily April, May, September, and October), and it is likely that all of the available flows could be treated in these periods. Nevertheless, because the flow that occur during the shoulder month periods would not serve as the basis for the sizing of advanced treatment facilities, they are not included in the analysis presented herein.

The total volumes of potable water generated, effluent that would be discharged, and reject stream flow are depicted on Figure 17 for an average rainfall year and on Figure 18 for an above-average rainfall year. As shown, in an above average rainfall year, discharge volumes decrease dramatically with treatment capacity, up to about the 13 or 14 mgd treatment capacity range, whereas in a wet rainfall year, discharge volumes disappear altogether around 12 mgd. However, the amount of additional volume that can be treated in an average year by increasing the capacity from 11 mgd and 12 mgd is nominal (equal to about three days of flow). Based on this information, a treatment system with an input capacity of no more than approximately 11 mgd is recommended, which would result in an approximate production rate of 9 mgd.

Figures 17 and 18 also show that, regardless of treatment facility size, an advanced treatment brine/reject stream would be generated that would require disposal. For this analysis, it is assumed that the volume of the reject stream would be 20 percent of the volume undergoing advanced treatment, as discussed in Chapter 6 of the WWT&BF Master Plan. Unless an alternative means of disposal is developed, the reject stream would need to be discharged to the San Francisco Bay. Therefore, a true zero discharge scenario is not feasible.

Finally, it should also be noted that optimizing the use of available treated effluent supplies may not result in the most economical potable reuse project. Specifically, if flows sent to the reuse system are significantly lower than the available treatment capacity most of the time, then the added cost of sizing the system larger to take advantage of a small amount of additional flow may not make sense. Nevertheless, the approach presented herein will identify the largest recommended potable reuse system sizing, and provides a reasonable “book end” for future planning.

Storage of Secondary Effluent to Further Maximize Potable Reuse Potential

The purpose of this analysis is to evaluate the benefits of storage with respect to being able to generate additional treated water for potable reuse purposes. For this scenario, it is assumed that all wet season flows in excess of the advanced treatment system capacity would be diverted to storage, and then returned to the advanced treatment facilities when flows drop back down below treatment capacity. The storage requirements for advanced treatment facilities ranging in size from 10 mgd to 20 mgd are indicated on Figure 19 for both wet year and average year conditions.

As indicated on Figure 19, for wet year conditions, storage requirements start to increase dramatically at treatment thresholds below 13 or 14 mgd. In an average year, storage requirements start to increase dramatically at treatment thresholds below 11 mgd. This analysis confirms that with a storage volume of approximately 50 million gallons, the District could recover just as much flow as a 15 mgd advanced treatment system (as shown on Figure 17), but at a much smaller cost.

It should be noted that the same storage facility that was conceptualized previously for storage of effluent in April through June to meet peak irrigation demands could be the same facility used to store peak winter-season flows that cannot be immediately processed through the advanced treatment facilities. For example, if the District were to accept 2.5 mgd of flows from San Ramon and construct a 130 Mgal storage facility (and/or re-purpose the FSLs to provide some of this storage), the District could reuse almost all of the flow generated while meeting peak irrigation reuse demands, while using only a disinfected tertiary treatment system that has a throughput capacity of 16.2 mgd (which is currently planned) and an advanced treatment system with a throughput capacity of 11 mgd.

CONCLUSIONS AND RECOMMENDATIONS

Key conclusions and recommendation regarding wastewater equalization storage, emergency storage, and storage to maximize recycled water projection are provided below.

Wastewater Equalization

1. A post-primary treatment capacity of 30 mgd equates to a primary effluent storage requirement of 7.1 Mgal, which is approximately 60 percent of the combined primary effluent storage capacity provided in Basins 1 through 3. Because of uncertainties regarding potential future peak flow conditions, a minimum post-primary treatment capacity of 30 mgd is recommended. This approach should maintain some of the available equalization storage capacity in the event that flows exceed the projected PHWWF and/or if operations staff inadvertently divert more flow to storage than necessary.
2. To maintain storage equalization flexibility in peak flow operations, it is recommended that the District install flow control facilities at the primary effluent diversion point that will allow operations staff to maintain a minimum flow of 30 mgd in during peak flow events (assuming flows into the plant exceed this value). If the minimum flow is not capped, the District runs the risk of diverting more flow to storage than necessary, and thus using up available primary effluent equalization capacity that may be needed if higher flows or several large storms were to occur over a relatively short period.

3. When considering the LAVWMA discharge limit of 28.8 mgd, it is estimated that less than half of the available storage (i.e. Holdings Basins 1 – 4 and approximately half of the LAVWMA storage capacity) is expected to be needed for storage of DSRSD flows in a peak flow event.
4. Given the storage available, the District should be able to accommodate a storm event with a peak flow that is as much as 20 to 40 percent higher than anticipated.
5. To be able to better plan for future equalization storage needs, the DSRSD should work with the Regional Board to more clearly define the terms for which effluent discharges to Alamo Canal are permissible. The language of the current permit suggests that storm return periods, Alamo Canal flows, and effluent dilution are all factors, but these various constraints may not be consistently applied in real time.

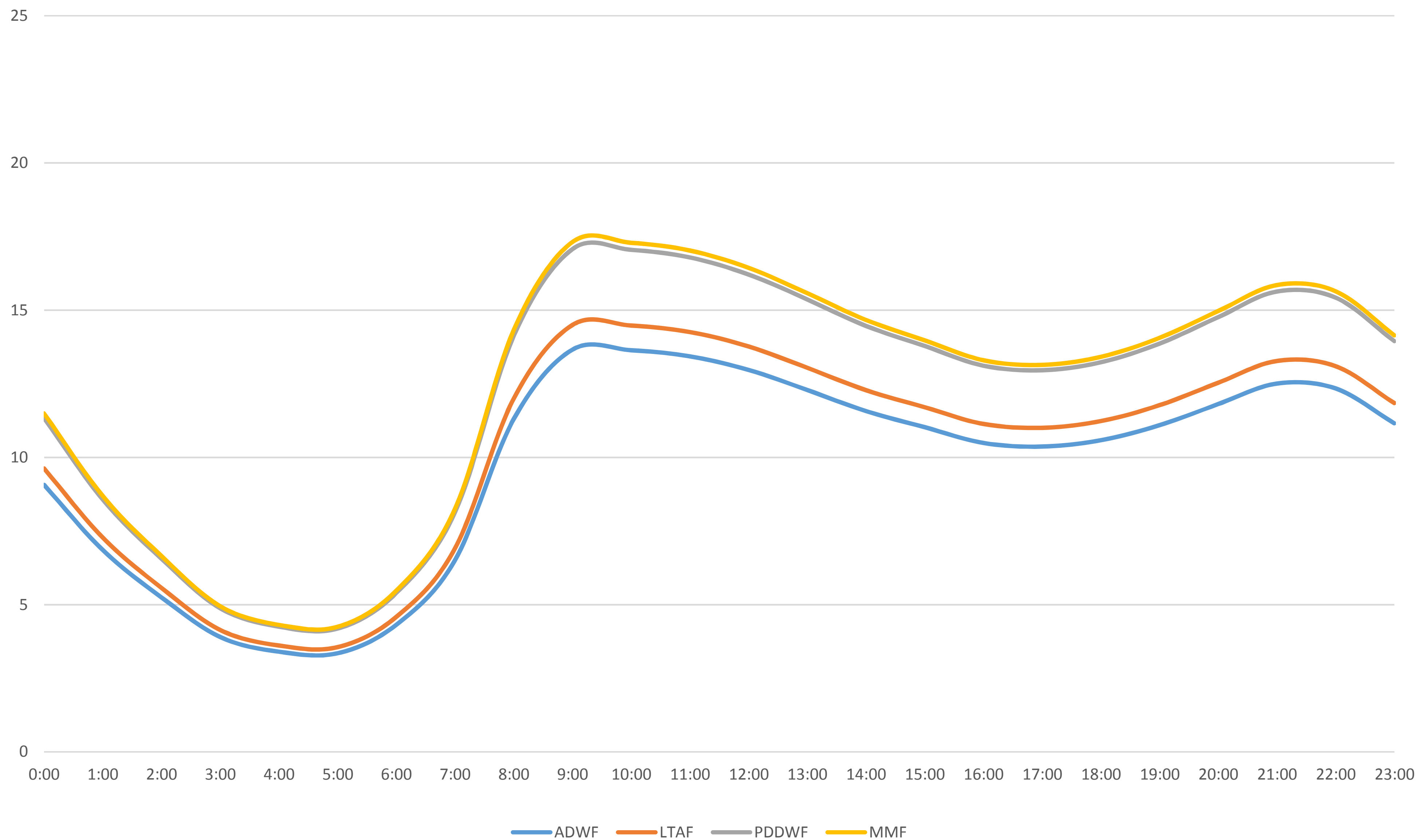
Emergency Storage

1. When used for dry season emergency storage of primary effluent, Basins 1 through 3 are expected to be able to accommodate roughly 23 hours of flow volume at ADWF conditions, and approximately 15-20 hours of flow volume at 2035 PDDWF conditions.
2. When used for wet season emergency storage of secondary effluent, Basins 1 through 4 are expected to be able to accommodate 30–35 hours of flow volume at 2035 LTAF conditions, and approximately 26 to 31 hours of flow volume at 2035 MMF conditions.

Storage to Maximize Recycled Water Production

1. Recycled water supplies are expected to fall significantly short of dry season demands. Up to 360 MGal of storage would be needed to meet this shortfall.
2. Based on flow data collected at the San Ramon Pump Station from the period of 2011 through 2015, it is estimated that 2.5 mgd of Dougherty Valley wastewater flows could reliably be available throughout the dry season. Negotiations with CCCSD would need to be undertaken to establish the terms of any future transfer.
3. If 2.5 mgd flows are accepted from San Ramon June through August, the District would only need approximately 130 Mgal of storage to offset the peak irrigation demands. With these San Ramon flows and just 80 Mgal of storage (i.e. the approximate storage provided by the FSLs), the District could meet a peak irrigation demand of 18.5 mgd, which is just 3 percent lower than the anticipated 2035 peak day demand.
4. Regardless of what strategies are employed to meet peak irrigation demands (if any), the discharge volumes in 2035 are expected to be approximately 60 percent of current volumes, or less. Moreover, the average daily discharge flows that are expected to occur during the 153-day dry period defined by BACWA (i.e. May through September) are likely to be somewhere between 0.1 and 0.6 mgd.

5. For a potable reuse scenario in which effluent flows above a given full advanced treatment system capacity would be discharged, discharge volumes would decrease dramatically with increasing treatment capacity, while reject stream volumes would increase slightly with treatment capacity. An advanced treatment capacity of 11 mgd (9 mgd throughput) would result in the ability to treat most of the available flows in an average year. Sizing a system much larger than this will only provide benefits in above average rainfall years, when the need for water is lower. Thus, the benefits of sizing the advanced treatment system much larger do not likely justify the added costs.
6. With a storage volume of approximately 50 Mgal, the District could recover as much flow as a 15 mgd advanced treatment system could recover, but with an 11 mgd system. The cost of a 50 Mgal storage basin would be significantly less than the cost of an additional 3 mgd of advanced treatment capacity.
7. The same facility conceptualized for storage of effluent in April through June to meet peak irrigation demands could be used to store peak winter-season flows that cannot be immediately processed through the advanced treatment facilities. Therefore, if the District were to accept 2.5 mgd of flows from San Ramon and construct between 80 and 130 Mgal storage facility (and/or re-purpose the FSLs to provide some of this storage), the District could reuse almost all of the flow generated while meeting peak irrigation reuse demands, while using a disinfected tertiary treatment system that has a throughput capacity of 16.2 mgd (which is currently planned) and an advanced treatment system with a throughput capacity of 11 mgd.



WEST YOST ASSOCIATES

Figure 1

Diurnal Curves,
Current Flow Conditions

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

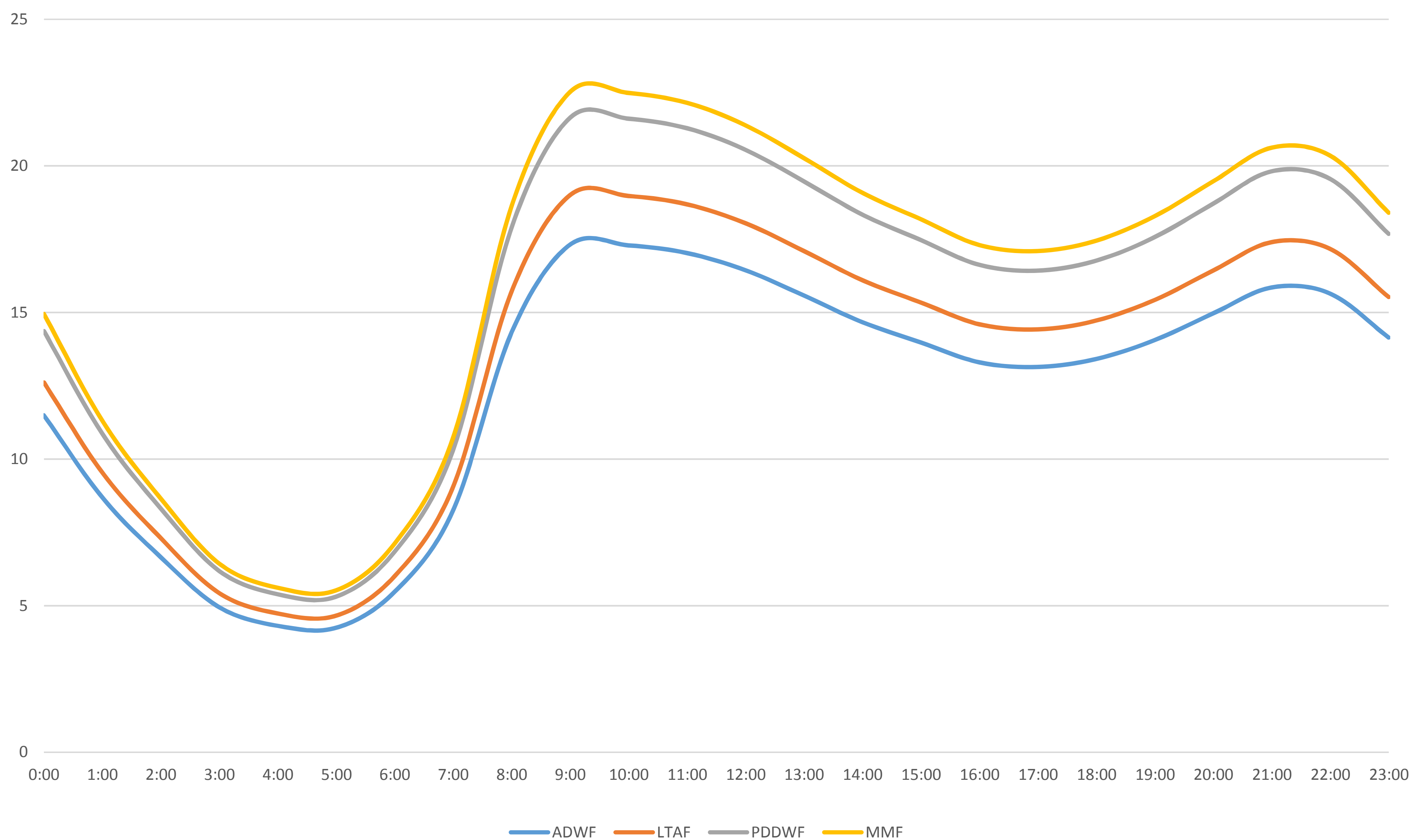


Figure 2

Projected Diurnal Curves, 2035 Flow Conditions

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

WEST YOST ASSOCIATES

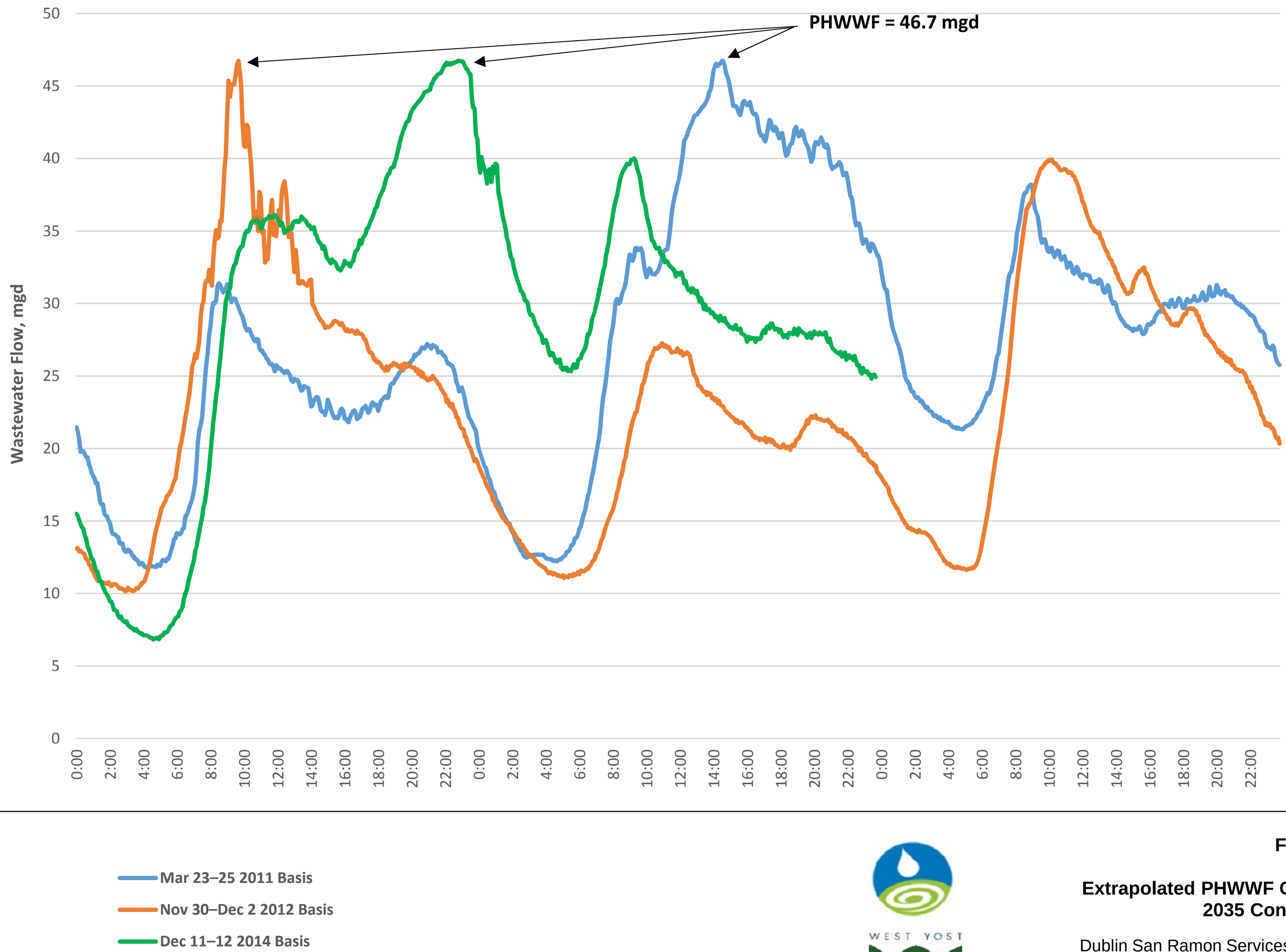


Figure 3

Extrapolated PHWWF Curves, 2035 Conditions

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017 W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\Wet Weather Storage (RE-revised).xlsx

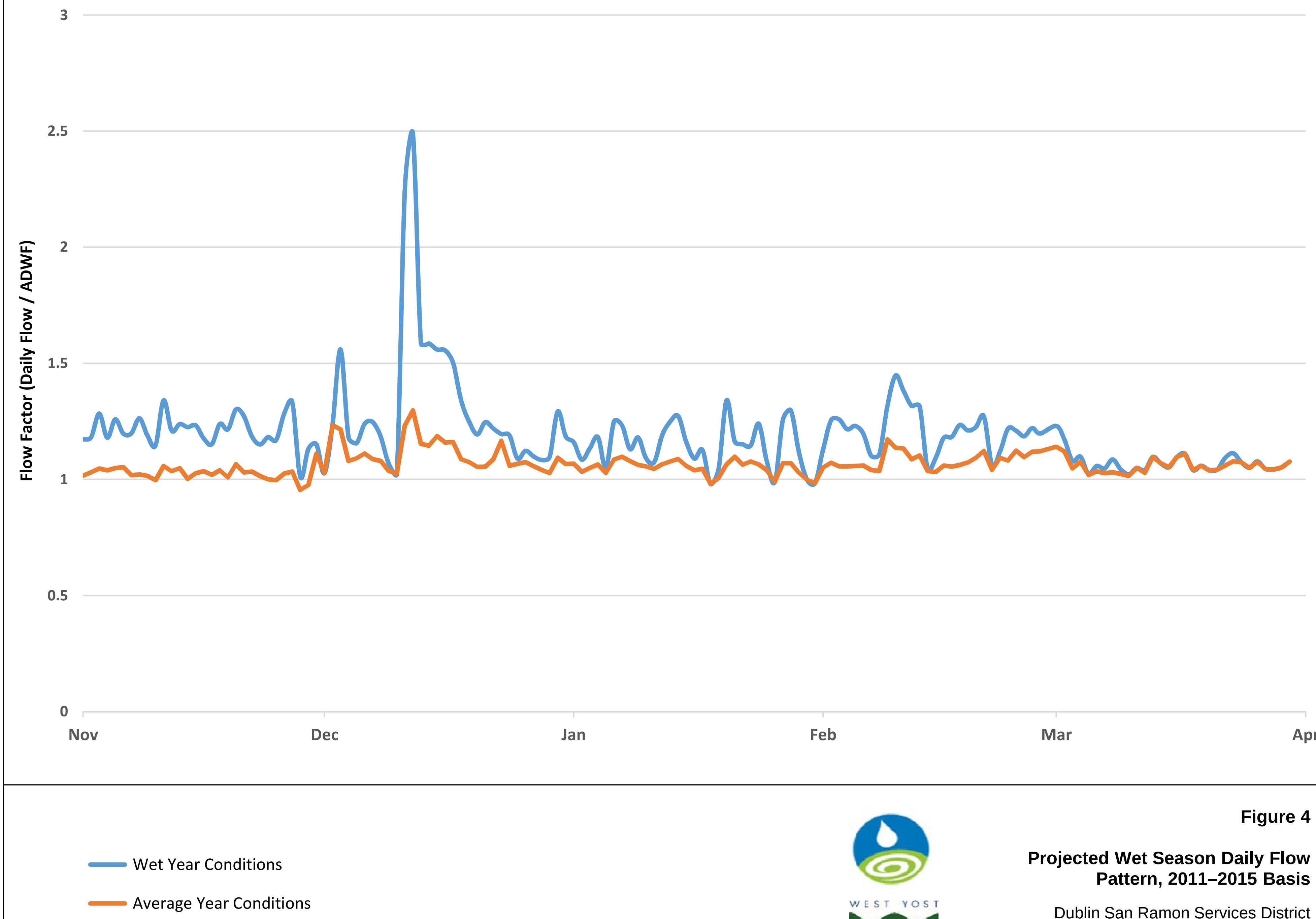


Figure 4

Projected Wet Season Daily Flow Pattern, 2011–2015 Basis

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017 W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx

Figure 5

Projected Dry Season Daily Flow Pattern, April 2012 through October 2014 Basis

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

WEST YOST ASSOCIATES

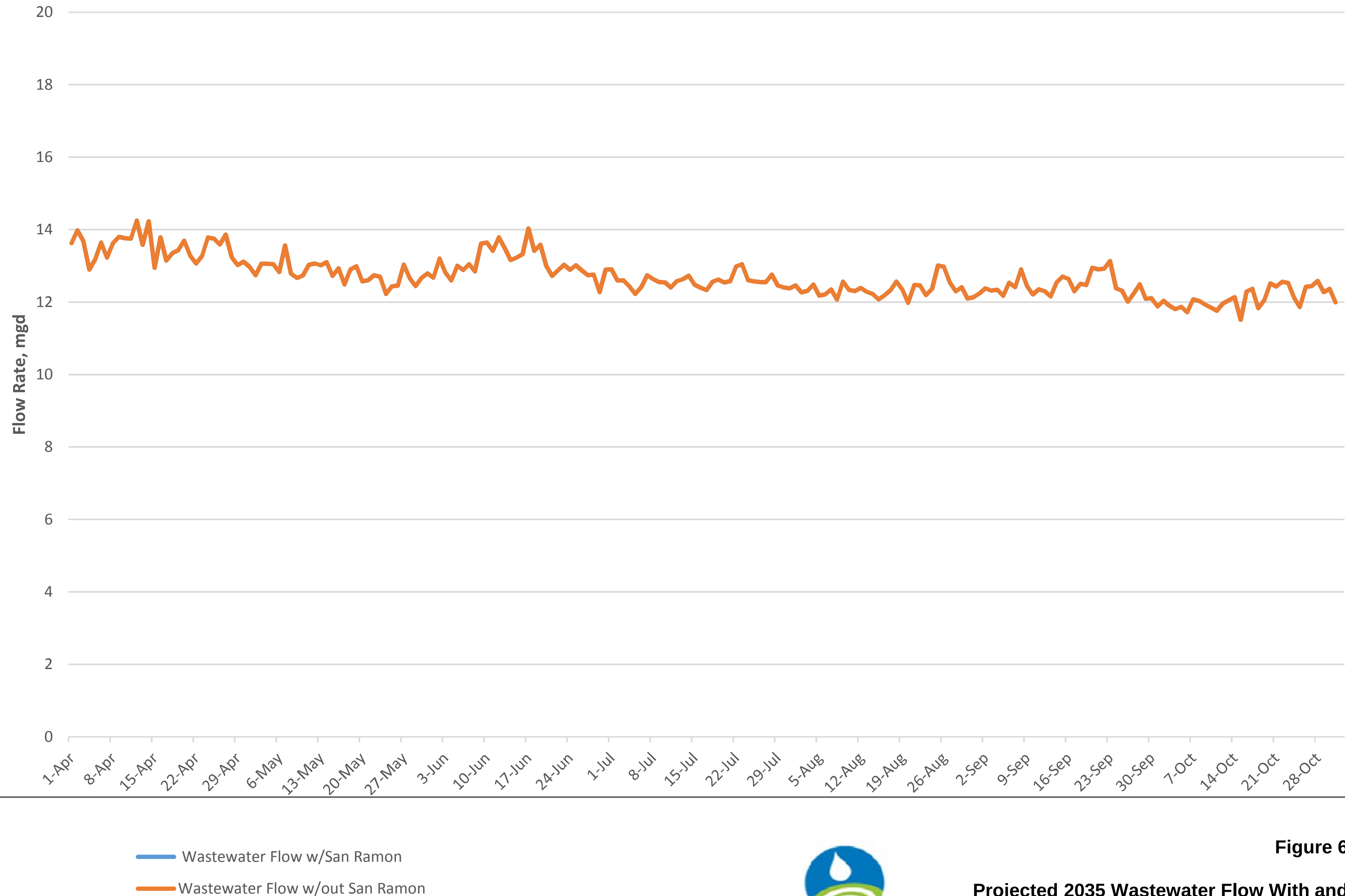


Figure 6

Projected 2035 Wastewater Flow With and Without 2.5 mgd of San Ramon Flow

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017 W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx

WEST YOST ASSOCIATES

Figure 7

Projected Dry Season Recycled Water Demand Curve (2012 Basis)

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017; W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx

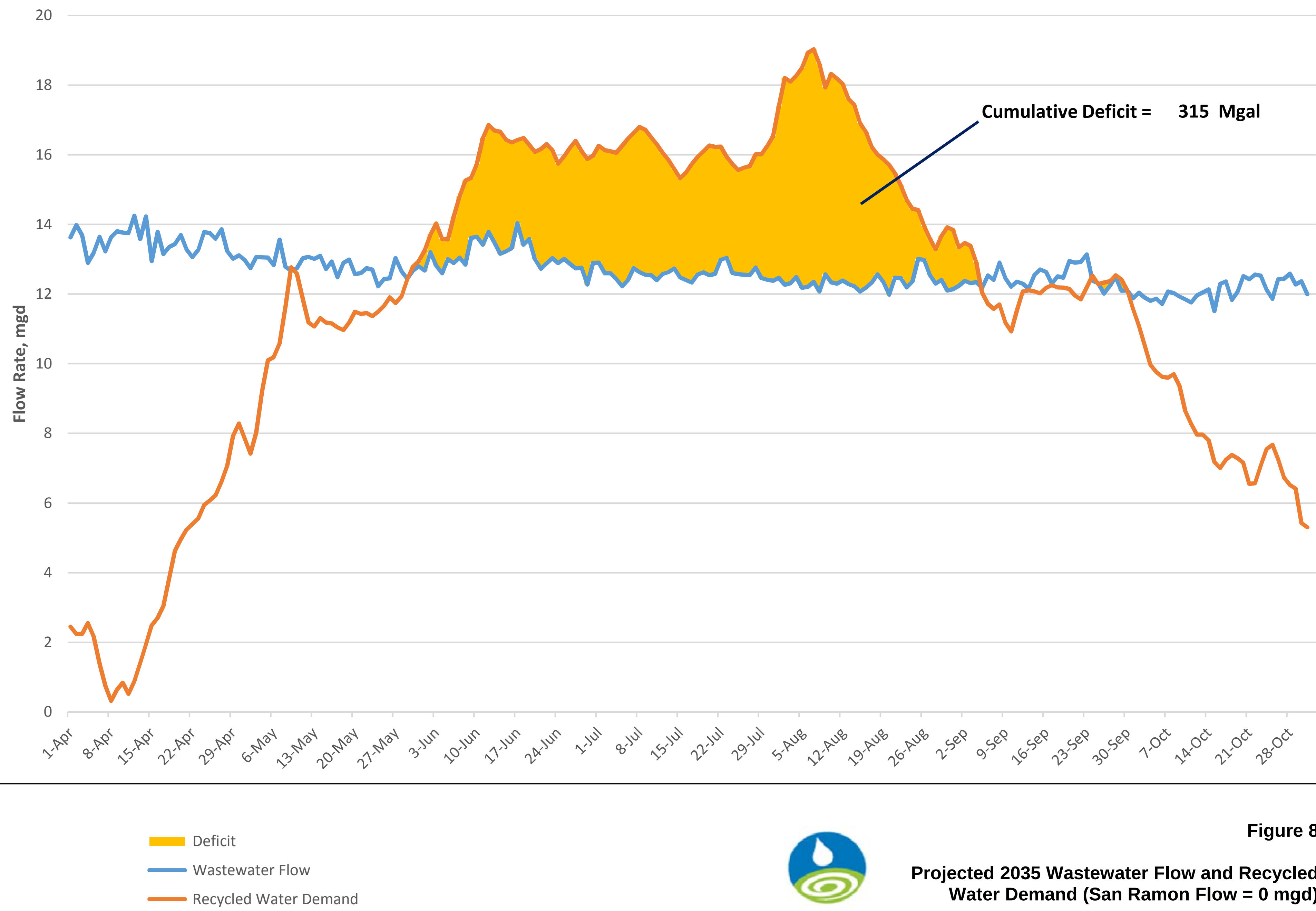


Figure 8

Projected 2035 Wastewater Flow and Recycled Water Demand (San Ramon Flow = 0 mgd)

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017; W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx

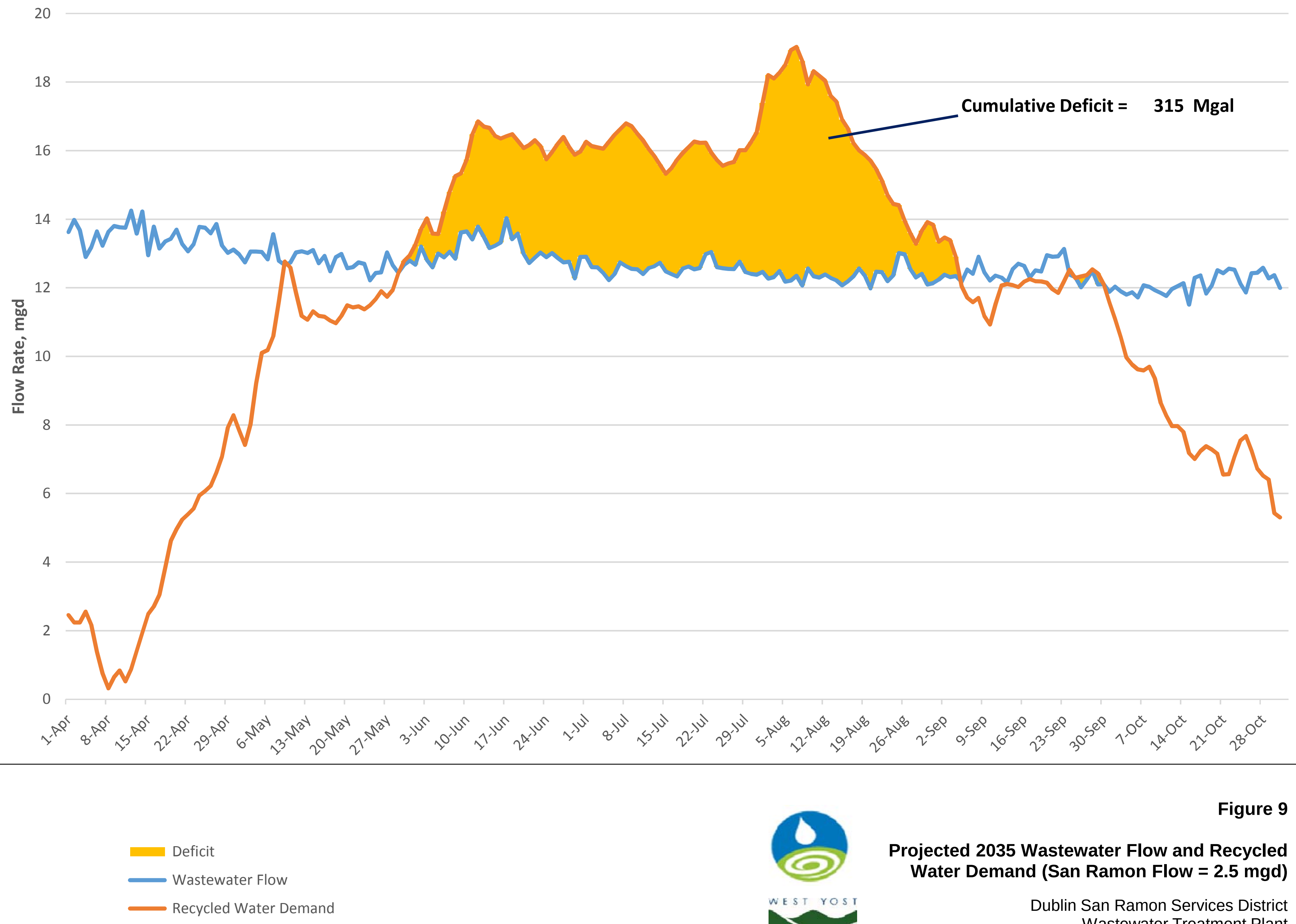
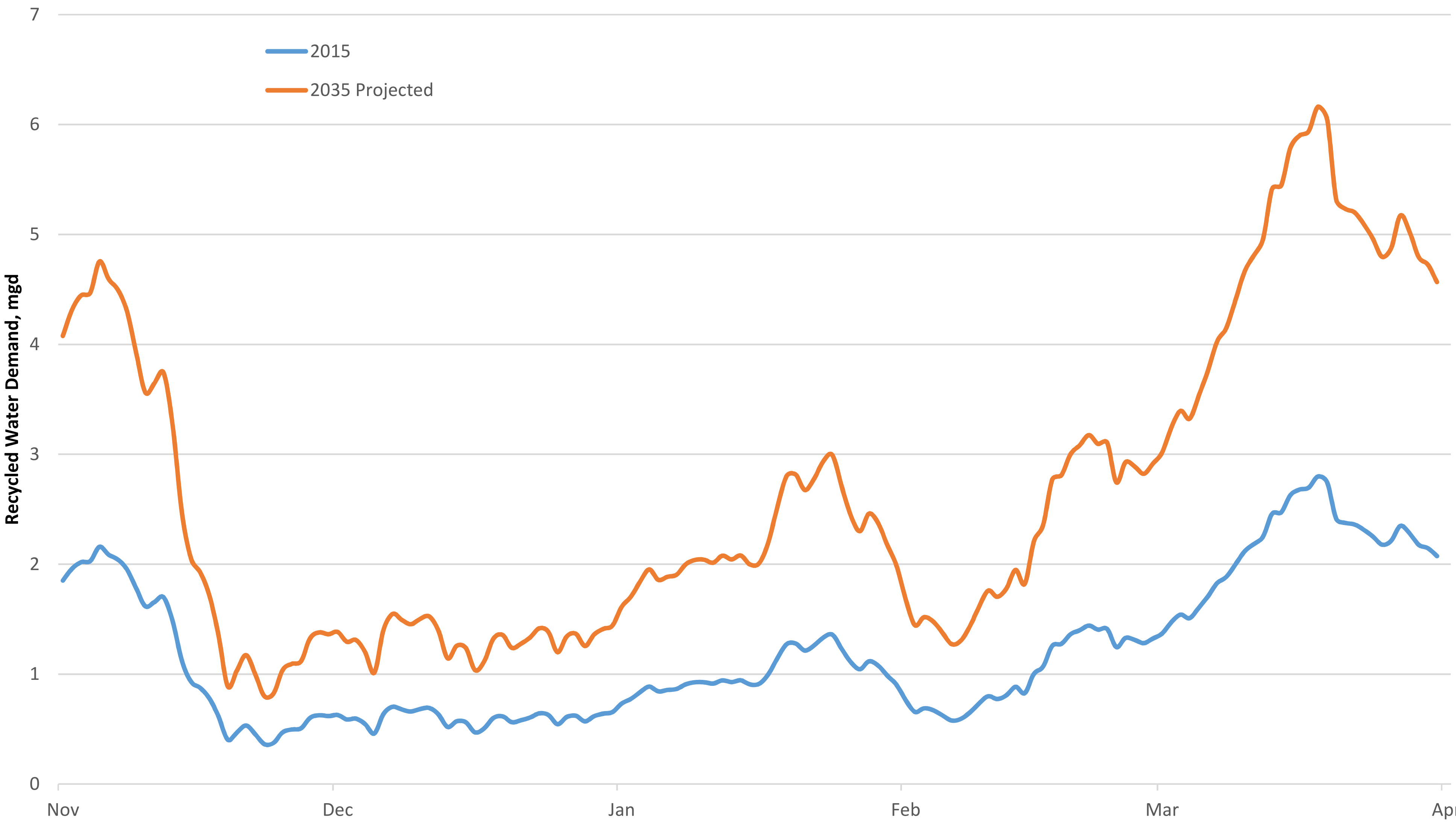


Figure 9

Projected 2035 Wastewater Flow and Recycled Water Demand (San Ramon Flow = 2.5 mgd)

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan



WEST YOST ASSOCIATES

Figure 10

Wet Season Recycled Water Demand Pattern, 2011–2015 Basis

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

Last Revised: 9/20/2017 W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\Wet Weather Storage (RE-revised).xlsx

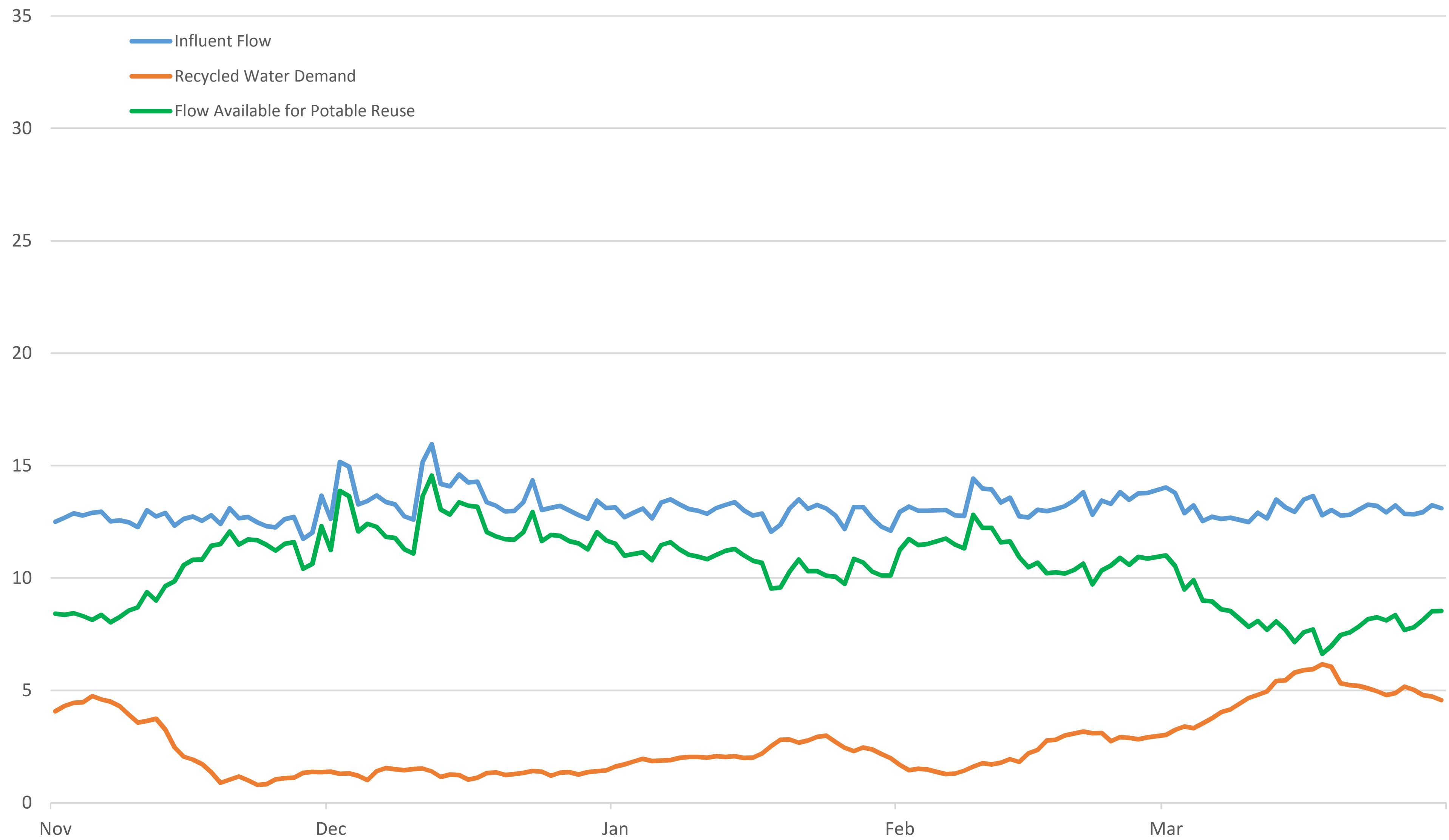
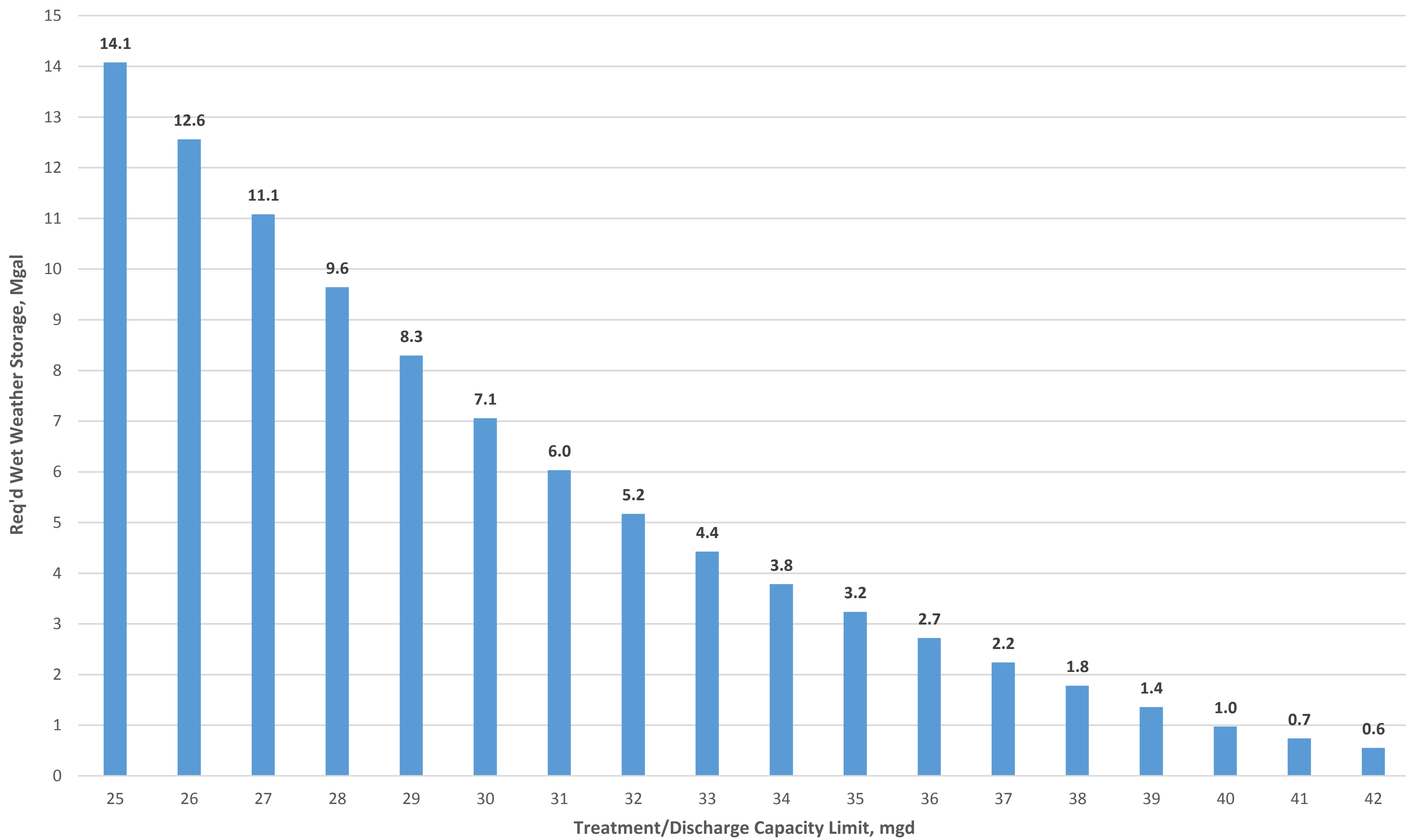


Figure 11

Flow Available for Potable Reuse, 2035 Average Year Conditions

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

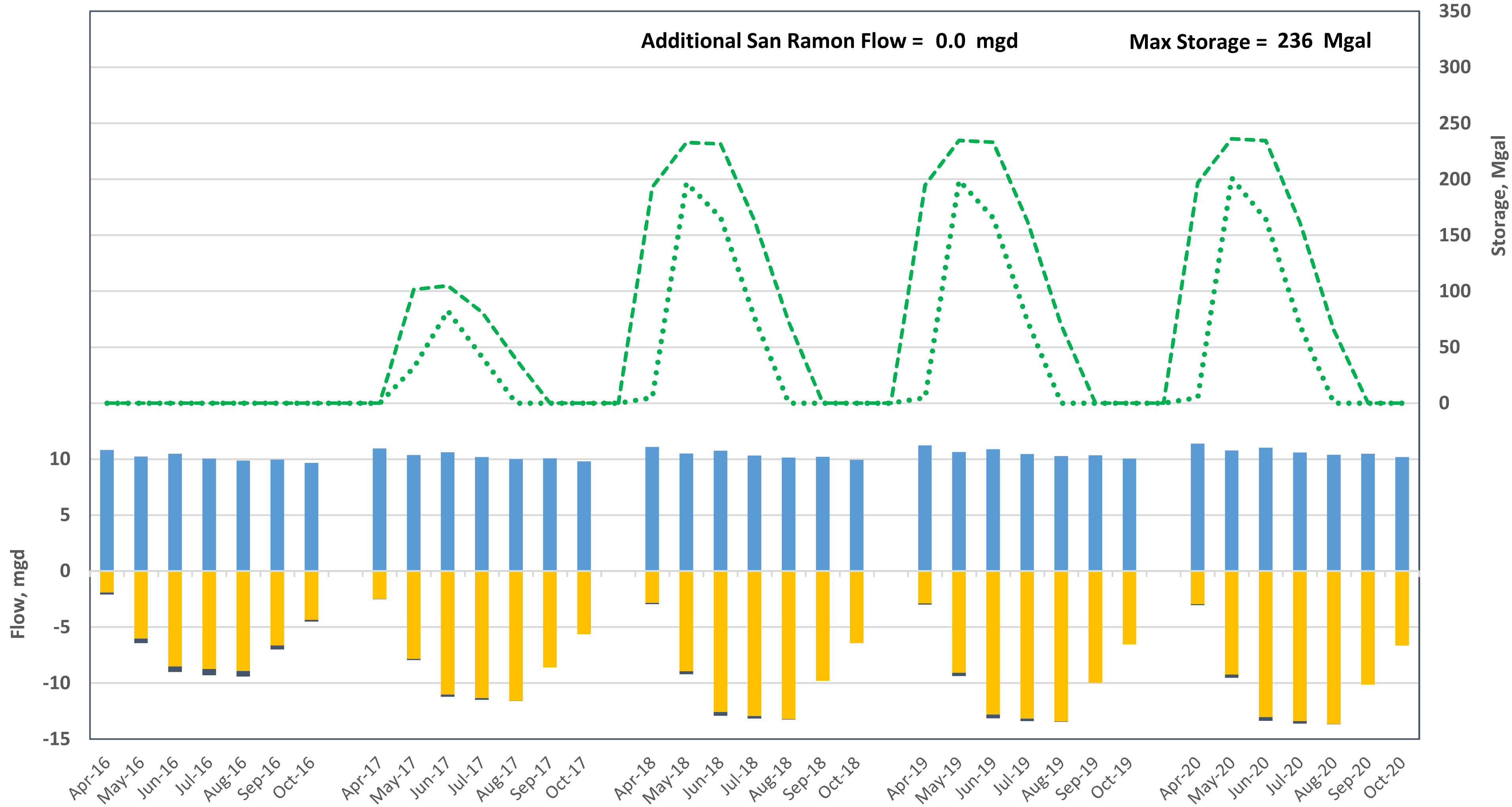


WEST YOST ASSOCIATES

Figure 12

Post-Primary Treatment Capacity versus Primary Effluent Storage

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan



Flow to Filters

	2016	2017	2018	2019	2020
Max In:	12.7 mgd	13.1 mgd	14.2 mgd	14.8 mgd	15.4 mgd
Max Out:	11.4 mgd	11.8 mgd	12.8 mgd	13.3 mgd	13.9 mgd

- Average Influent Flow
- Average Effective Evaportranspiration
- Average Recycled Water Demand
- Maximum Day Storage
- Minimum Day Storage

WEST YOST ASSOCIATES

Figure 13

Storage Needed to Meet Projected Recycled Water Demands Through 2020

Dublin San Ramon Services District
Wastewater Treatment and
Biosolids Facilities Master Plan

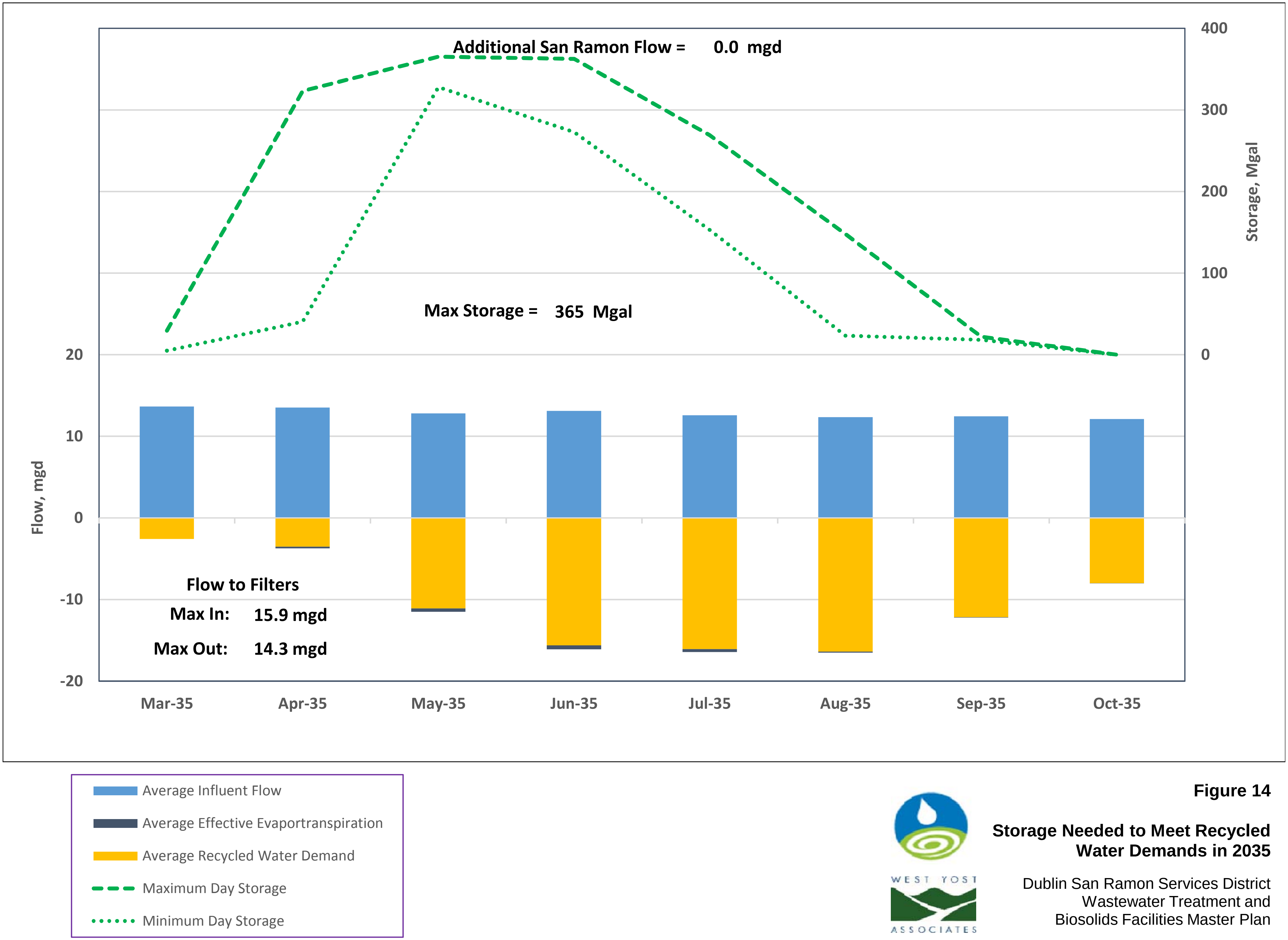
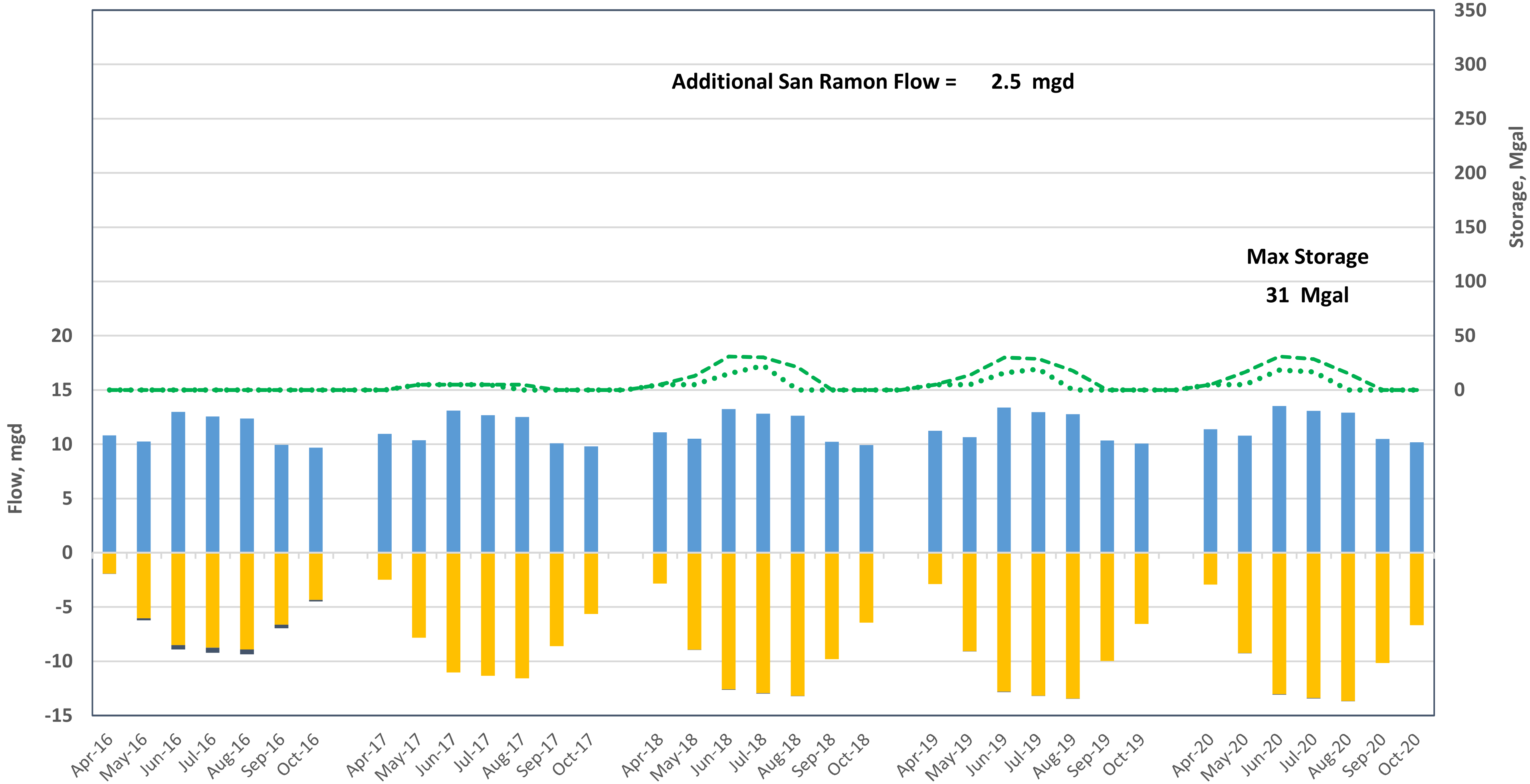


Figure 14

Storage Needed to Meet Recycled Water Demands in 2035

Dublin San Ramon Services District
Wastewater Treatment and
Biosolids Facilities Master Plan

Last Revised: 10/14/2016; W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx



Flow to Filters

Max In:	**14.8 mgd**	**14.3 mgd**	**16.2 mgd**	**16.7 mgd**	**17.2 mgd**
Max Out:	**13.3 mgd**	**12.8 mgd**	**14.5 mgd**	**15.0 mgd**	**15.5 mgd**

Figure 15

Storage Needed to Meet Recycled Water Demands through 2020 w/San Ramon Flow

Dublin San Ramon Services District
Wastewater Treatment and
Biosolids Facilities Master Plan

Last Revised: 10/14/2016; W:\Clients\406 DSRSD\19-15-39 WWT-BF Master Plan\ENGR\05_Storage Needs\RW production-storage (REV2a).xlsx

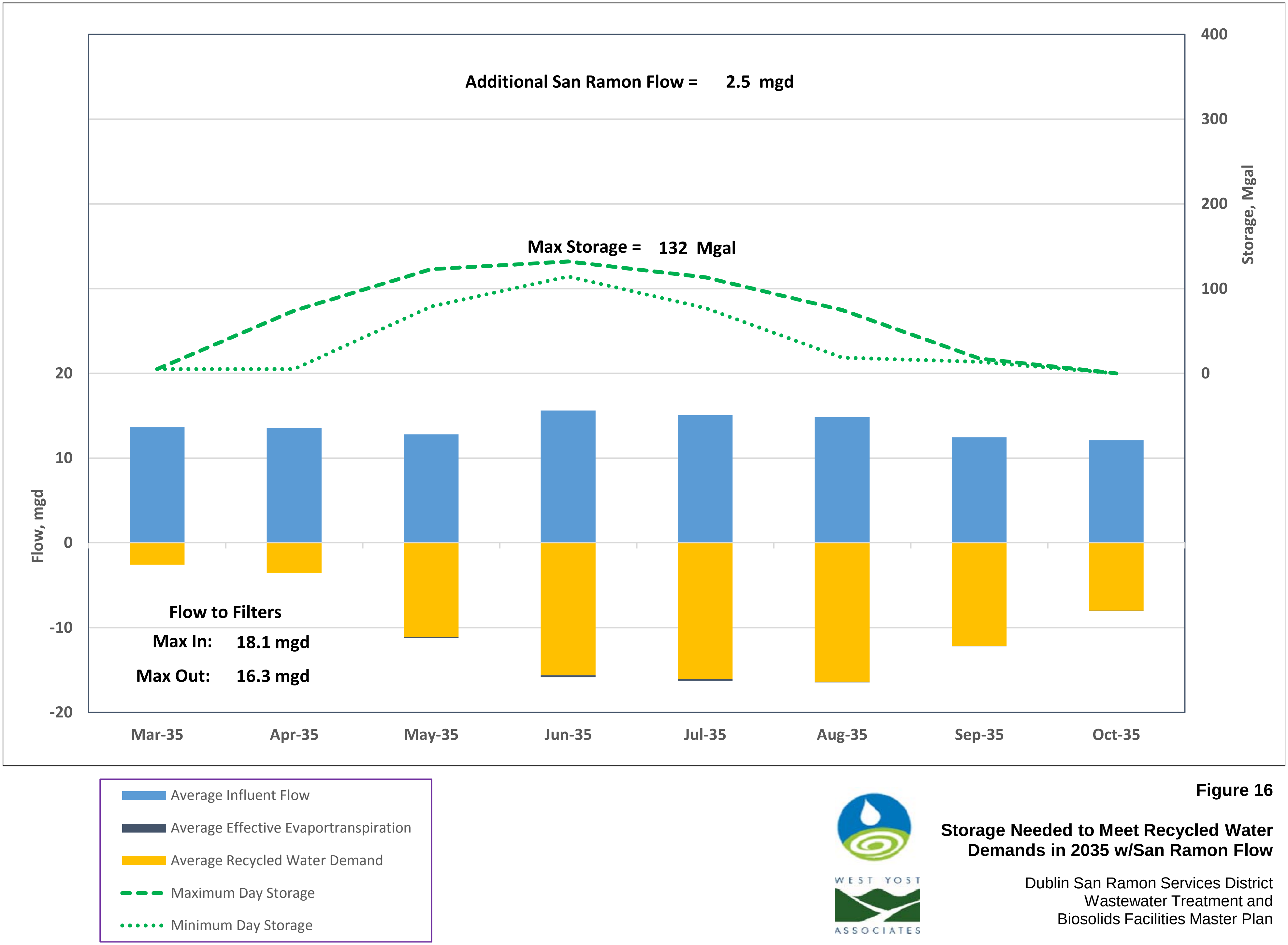
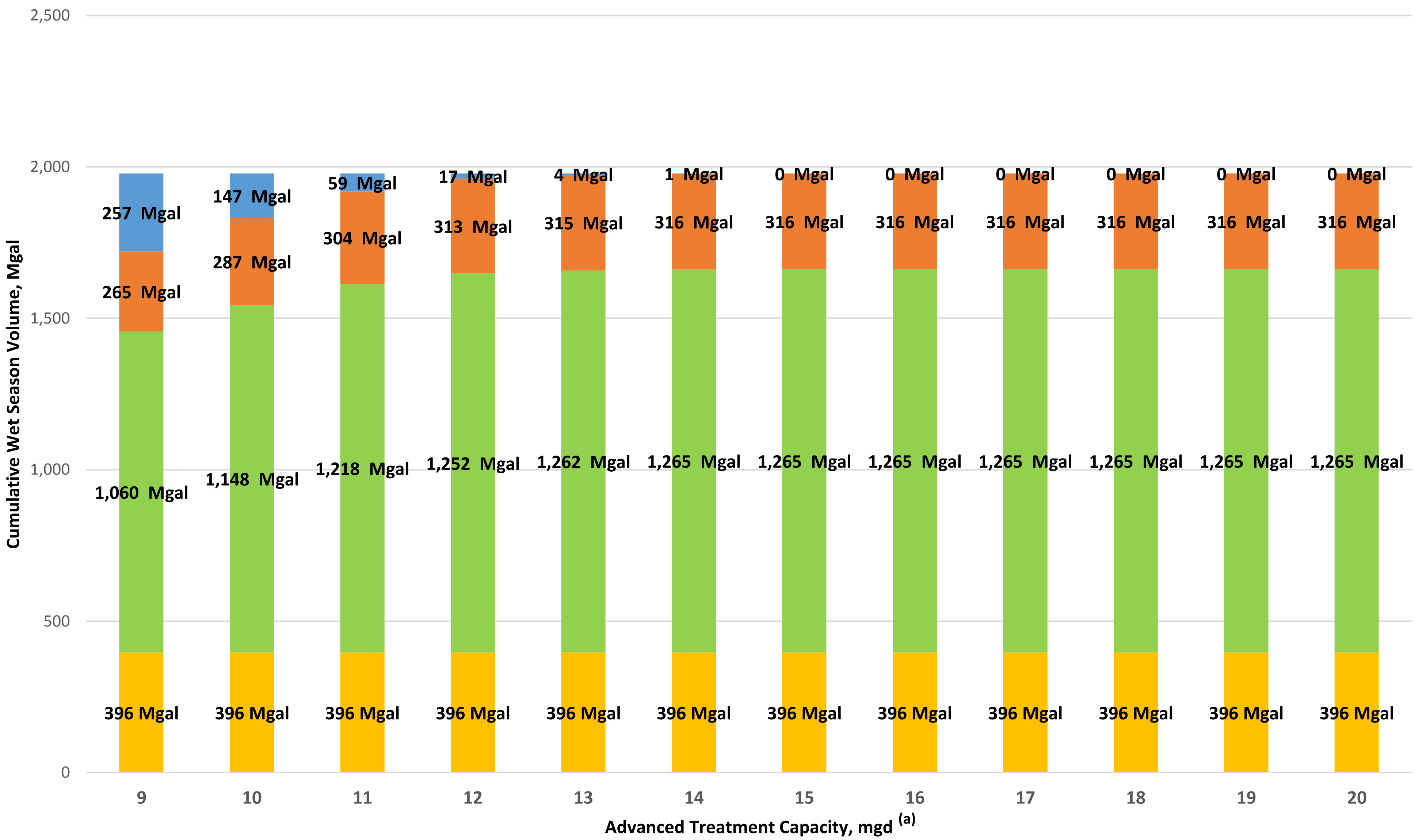


Figure 16

Storage Needed to Meet Recycled Water Demands in 2035 w/San Ramon Flow

Dublin San Ramon Services District
Wastewater Treatment and
Biosolids Facilities Master Plan



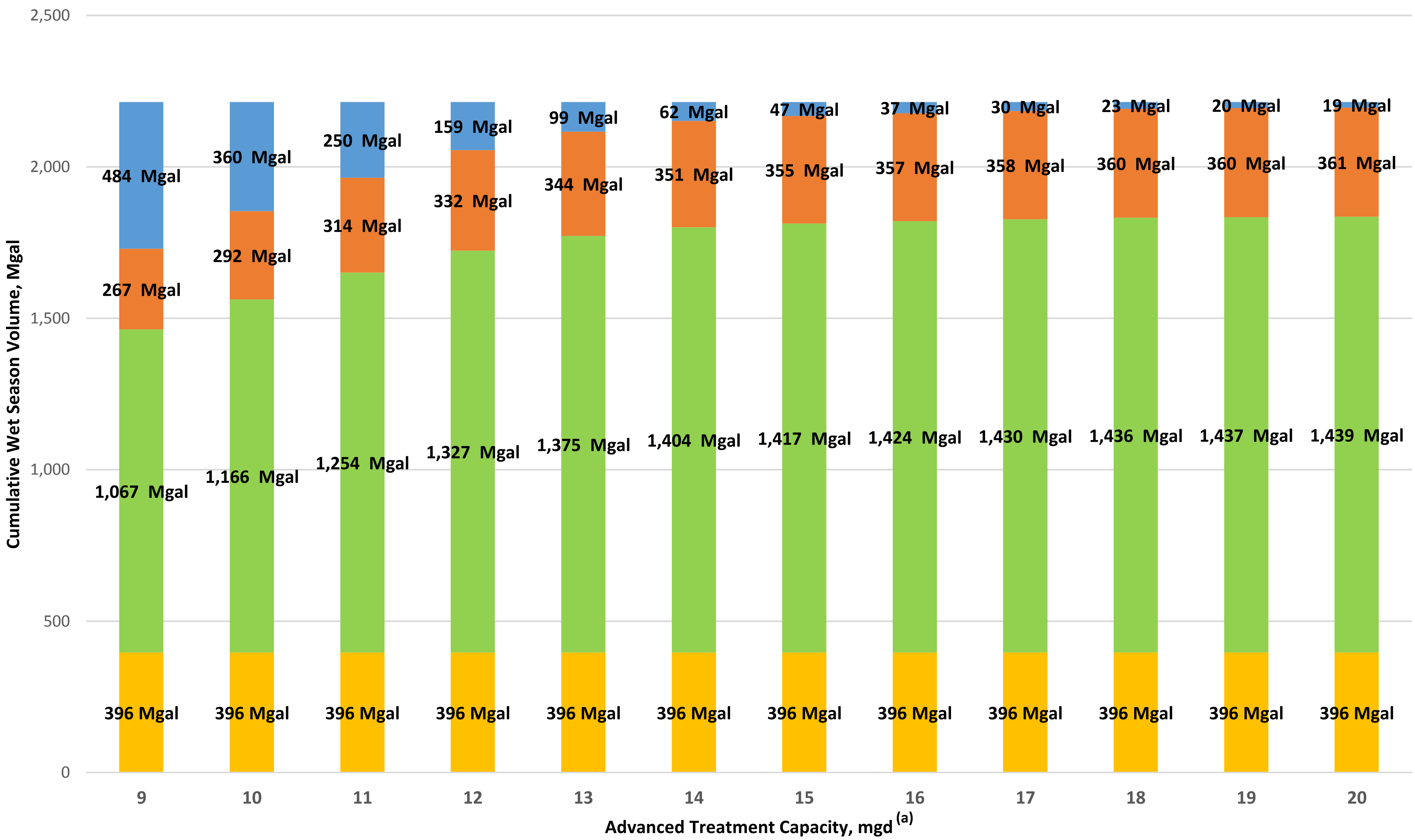
Notes:

(a) Represents the flow into advanced treatment. The flow out equals the indicated flow less 20 percent to the reject stream.

Figure 17

Wet Season Potable Reuse with No Storage, 2035 Conditions, Average Rainfall Year

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan



Notes:

(a) Represents the flow into advanced treatment. The flow out equals the indicated flow less 20 percent to the reject stream.

WEST YOST ASSOCIATES

Figure 18

Wet Season Potable Reuse with No Storage, 2035 Conditions, Above-Average Rainfall Year

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

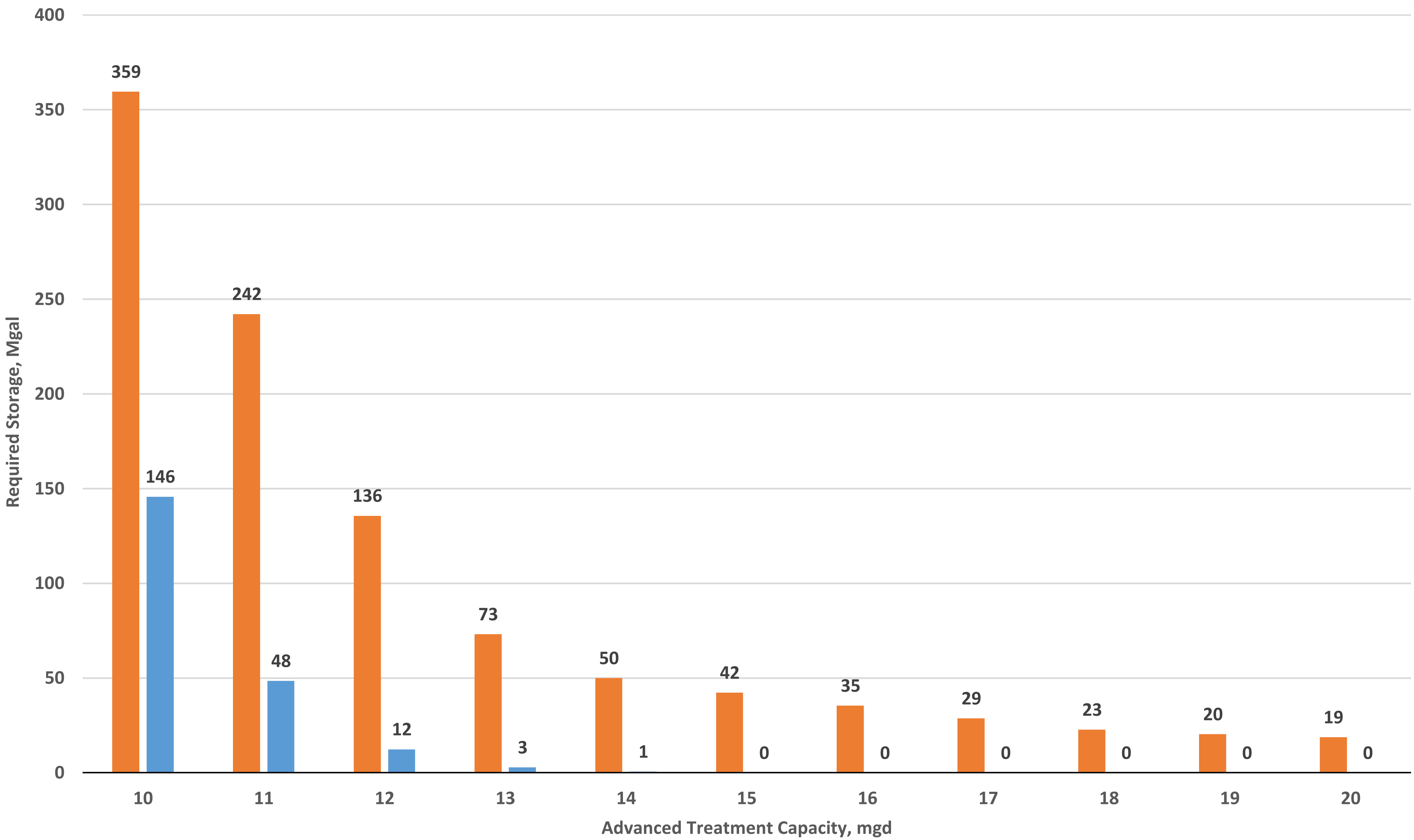


Figure 19

Secondary Effluent Storage Needed for Zero Efluent Dicharge, 2035 Conditions

Dublin San Ramon Services District
Wastewater Treatment Plant
Master Plan

APPENDIX D

Odor Control Improvements/Expansion
Recommendations Technical Memorandum

WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM No. 2

DATE: September 25, 2017 Project No.: 406-19-15-39
SENT VIA: EMAIL

TO: Judy Zavadil, PE

FROM: Charles Hardy, PE, RCE #71015

REVIEWED BY: Kathryn Gies, PE, RCE #51009

SUBJECT: Odor Control Improvements/Expansion Recommendations

The purpose of this technical memorandum (TM) is to present an assessment of the current and potential future odor control needs for the Dublin San Ramon Services District (DSRSD or District) Wastewater Treatment and Biosolids Facility (WWTP). The analysis presented is based on the information provided in the Odor Control Plan that was prepared by Environmental Management Consulting (see Attachment 1 to this TM). The attached Odor Control Plan provides an evaluation of existing WWTP odor control facilities, identifies recommended improvements, and presents alternatives for expanding the odor control system to the primary sedimentation basins and the aeration basin inlet channel. The topics specifically addressed in this TM are as follows:

- Existing odor control improvements
- Odor control facilities expansion
- Estimated capital costs for recommended projects
- Recommended next steps

EXISTING ODOR CONTROL FACILITY IMPROVEMENTS

The Odor Control Plan provides the following information regarding the existing odor control system:

- The existing 10,000 square feet (ft^2) headworks facility biofilter has recently undergone a rehabilitation process to improve its operational viability. If the poor performance of this system cannot be eliminated, this facility should be replaced with a BioRem BioSorbens® biofilter, which would have a surface area of approximately 3,500 ft^2.
- The existing odor reduction tower (ORT) does not adequately remove odors. A replacement system that would increase hydrogen sulfide removal rates from 96 percent to 99 percent, or greater, is recommended.
- The biofilter used for odor control for the dissolved air flotation thickener and the center well of two clarifiers is operating successfully and is expected to be adequate for the next 20-year period.

1777 Botelho Drive, Suite 240 Walnut Creek, CA 94596 Phone 925-949-5800 Fax 925 949-5845 westyost.com

The District is in the process of assessing the recent improvements to the headworks facility biofilter. For purposes of the Master Plan, this facility is assumed to not require wholesale replacement in the next 20-year period.

For the ORT, potential options to address the performance issue are:

- Replacing the existing media with a high-performance media
- Replacing the entire system with a bio-trickling filter.
- Replacing the entire system with an alternative technology, like a sodium hypochlorite packed tower
- Replacing the entire system with an activated carbon installation

Replacing the existing ORT media or installing a bio-trickling filter would require approximately the same footprint as the ORT (12 ft x 16 ft). Given the potential need to expand the odor control system and the limited footprint available at the WWTP site, using either a chemically based packed tower (10-ft diameter) or activated carbon filter (12-ft diameter) is preferred. This approach would provide space for installing additional odor control systems, if needed, as discussed below. Therefore, for purposes of developing a planning-level capital cost for the Master Plan, the ORT is assumed to be replaced with either a sodium hypochlorite packed tower or an activated carbon filter.

Additional analysis, as described later in this TM, is needed to further compare the capital and operating costs of the sodium hypochlorite packed tower and activated carbon filter before selecting a preferred technology. Such an analysis would also need to consider whether replacement of the headworks biofilter is ultimately needed, thus making a single, whole plant system at the existing headworks biofilter site a viable approach. For purposes of developing a planning-level capital cost in the Master Plan, an activated carbon filter system is assumed. Because the activated carbon system is the more expensive approach, it provides a reasonably conservative estimate for planning purposes.

ODOR CONTROL EXPANSION

Previous odor control studies, as discussed in the Odor Control Plan, have indicated additional odor control could be provided at the WWTP by adding covers to, and providing odor control for, the primary sedimentation basins, the aeration basin inlet channel, and the unaerated anaerobic selector. Based on discussions with District staff during preparation of the Master Plan, the next logical expansion of the odor control system would be limited to the primary sedimentation basins and the aeration basin inlet channel only.

Each primary sedimentation basin has a surface are of approximately 2,000 ft^2. Assuming a total of five or six basins will ultimately be installed, the total surface area of primary sedimentation basins that will need to be covered is 10,000 ft^2 to 12,000 ft^2. For purposes of developing a planning-level cost and layout in the Master Plan, the larger 12,000 ft^2 is assumed. The inlet channel has a surface area of approximately 900 ft^2. Ducting would also be needed to route air to the new odor control unit.

To provide odor control for the ORT sources, the primary sedimentation basins, and the aeration basin inlet channel, two sodium hypochlorite packed towers (10-ft diameter each) or two activated carbon filters (12-ft diameter each) would be needed. Although either of these technologies would have a slightly longer footprint than the existing ORT (12 ft x 16 ft), two chemically based packed towers or activated carbon facilities could approximately fit within the area where the ORT is currently located.

ESTIMATED CAPITAL COSTS FOR RECOMMENDED PROJECTS

Capital costs have been estimated for the two odor control projects, based on the analyses described above and details included in the Odor Control Plan based on unit material cost of:

- $150,000 for an activated carbon filter, with a 50 percent installation factor. No electrical or instrumentation costs are needed for this installation.
- $100,000 for demolition of the existing ORT.
- $100,000 for ducting between the primary clarifiers and the aeration basin inlet channel and the new carbon filters, with a 40 percent installation factor.
- $50,000 for two fans, with an additional $20,000 for installation.
- $1.3 million for covers for the primary sedimentation basins and aeration basin inlet channel, including installation costs.

The total estimated capital costs for the ORT replacement and expansion of the odor control system are summarized in Table 1. Additional cost estimate details are provided in Attachment 2.

Table 1. Estimated Capital Costs for Recommended Odor Control Projects

	Estimated Costs, million $	
Cost Component	Replace ORT	Odor Control Expansion
Demolition of ORT	0.23	N/A
Carbon Filter	0.48	0.5
Ducting, Covers and Fans	N/A	3.1
OPCC	**0.71**	**3.6**
Construction Contingency, 10%	0.07	0.4
Total Estimated Construction Costs	**0.78**	**4.0**
Engineering, Legal and Administrative Costs, 35%[a]	0.25	1.3
Total Project Costs	**1.0**	**5.3**

[a] Calculated as a percentage of the OPCC.

RECOMMENDED NEXT STEPS

Two technology options have been identified for replacement of the ORT: sodium hypochlorite packed tower or activated carbon filter. Additional analysis of these options is needed to determine which is the most cost-effective long-term strategy.

The sodium hypochlorite packed tower option is potentially a lower cost option than an activated carbon filter from both a capital and operating costs standpoint. However, the cost of the sodium hypochlorite packed tower option is contingent on the cost to convey sodium hypochlorite from the District's existing chemical storage facilities to the ORT site. Given the existing sodium hypochlorite storage facility is located on the opposite side of Holding Basin 1, piping from the storage facility would likely need to be routed around this basin. In addition, an assessment of whether the existing sodium hypochlorite storage is adequately sized to accommodate both the WWTP odor control and disinfection needs would be needed. Finally, operating costs for both options would need to be defined based on site specific information from local suppliers.

The space requirements for either odor control option should also be confirmed. Specifically, a layout of the facilities required for each option would need to be developed for the expanded system. This analysis would confirm that either option would reasonably fit within the area taken up by the existing ORT footprint, and not impinge upon other existing or planned facilities/operations at the WWTP.

Finally, if it is determined that the headworks facility biofilter requires significant additional improvements or replacement, the District should consider a third "whole plant" option. Under this third option, the District would install a deep bed Biosorbens® biofilter where the existing headworks biofilter is currently located. This filter would initially be sized to accommodate the headworks area and to replace the ORT, and would be expandable to accommodate the primary clarifiers and aeration basin inlet channels. Sizing estimates presented in the Odor Control Plan indicate that such a facility would have a smaller footprint than the existing headworks biofilter, and would be the most sustainable, long term approach. However, as noted in the Odor Control Plan, the largest obstacle for this option would be the routing of large ducts from the ORT, primary sedimentation basins, and aeration basin inlet channel to the headworks biofilter location. The costs and feasibility of installing this ducting would need to be carefully evaluated.

ATTACHMENT 1

DSRSD Planning Odor Control Revision 2 Technical Memorandum,
prepared by Environmental Management Consulting,
July 23, 2017

Technical **Memorandum** Environmental Management Consulting
41125 278th Way SE, Enumclaw, WA 98022 USA
Phone: 360-802-5540 Fax: 360-802-5541
E-Mail: trcard@earthlink.net

TO: Kathryn Gies/West Yost

FROM: Tom Card

DATE: July 23, 2017

SUBJECT: DSRSD Planning
Odor Control
Final Version

Background

The Dublin-San Ramon Services District (DSRSD) is currently is a facility planning effort to map out future treatment and capacity requirements. This memo covers potential existing and future odor issues that may affect those planning decisions.

Overview

The Dublin-San Ramon Services District has extensively assessed and managed odors generated at their wastewater treatment facilities. They have progressed so far with limited dedicated odor control devices by optimizing work practices to minimize process odor generation and release. They do have two different odor control technologies.

The first technology, a biological odor removal tower (ORT) is a mature technology that has since gone out of favor because of wide spread marginal performance. This technology is essentially a conventional wastewater treatment biotrickling filter slightly optimized to remove odors from the supplied ventilation air. However, at DSRSD this technology performs better than almost any other comparable installation. It currently achieves 90% (or perhaps even better) hydrogen sulfide removal. Unfortunately, that still makes it a major odor source and it needs to be closer to 99% removal to make the source a non-issue. Due to the location of the process, and the limited available nearby space, modifying or replacing this technology will be a major undertaking, and likely not quite necessary at this time.

The other technology used at the plant are sand media biofilters. This is currently the best technology available for wastewater treatment plant odor control, but DSRSD's biofilters have been plagued with a combination of operational problems and less then acceptable performance. The larger biofilter is currently undergoing a rehabilitation process to improve its operational viability. This still places a cloud over this technology and it is not recommended that future projects include similar technologies until the poor performance of the existing system is thoroughly diagnosed.

The smaller biofilter was recently installed and is currently providing adequate odor control for the dissolved air flotation thickener and the center well of two clarifiers. This newer system is operating successfully and is expected to be adequate for the next 20-year period. Therefore, it is not addressed in this TM.

Summary

Whole Plant Odor Control

Start from scratch whole plant odor control (with the exception of the smaller biofilter, which is expected to remain in place) was looked at in the form of the following alternatives. These alternatives are for the control of:

- New Headworks Bldg (17,000 cfm), replacing existing sand biofilter
- Existing ORT sources (11,100 cfm)
- Primary Sedimentation Basins (14,000 cfm ultimate)
- Aeration Basin inlet channel and Selector Tank (6,000 cfm)

Technology	Total Project Costs	Comments
Covers for Primary Sed Basins and Aeration Inlet Channel, Selector	$1,400,000	Common to all alternatives
Biorem Biosorbens® biofilter at existing Headworks Biofilter Location	$3,200,000 (plus covers)	Tricky Duct Routing On the edge of historical system performance for such a small space.
Local Sodium Hypochlorite Packed Towers	$1,200,000 - $1,600,000 (plus covers)	More expensive to operate than the biofilter. Chemical handling required.
Local Activated Carbon	$1,500,000 to $2,000,000 (plus covers)	Highest operating costs, but simpler overall.

Headworks Biofilter

The Headworks Biofilter was installed in 2001. The fan air flow rate at design is 15,000 cfm. The biofilter has a process area of about 32 ft x 300 ft for an area of about 10,000 ft2 providing a unit flow rate of about 1.5 cfm/ft2.

This biofilter has had performance problems and a congealed mineral deposit has been found at the interface of the inlet plenum and sand media. These issues have yet to be fully understood at this time.

ORT

The biological odor removal tower (ORT) is performing better than any other similar technology installed today. It can be upgraded to perform even better, but it is over 30 years old and the structure would need to be inspected to assure that it had significantly more design life left in it. In addition, it is possible that in the near future, more performance will be needed than what biotrickling filter technology can provide. Changing technologies would likely require substantially more footprint that is likely not available. The best approach for the next five years would be to plan for a replacement system that could accommodate the headworks screenings conveyors and screenings compaction and storage room (currently directed to a biofilter), the influent pumping room, the old bar screen channels, the grit building, the influent diversion structure, and the aerated grit tanks, primary sedimentation basins, the aeration basin inlet channel and the aeration basin anaerobic selector.

Primary Sedimentation and Aeration Basin Odor Control

Appropriate odor control technologies for the sedimentation basins (in order of preference) would be:

1. A soil biofilter (7,000 ft2)
2. A BioRem BioSorbens® biofilter (3,500 ft2)
3. A chemically based packed tower (500 ft2)
4. Activated carbon (800 ft2)

To include the all of the facilities (aeration basin inlet channel and aeration basin selector tank), these values should be increased by approximately 50%.

Given the limited footprint available at the site, either a chemically based packed tower or activated carbon process may be preferred. For example, the existing biofilter used for the headworks and is approximately 10,000 square feet. Therefore, the odor control for all of these system could fit within the footprint provided by the biofilter alone.

Past Odor Assessment/Control

Four documents were reviewed that covered the odor assessment and planning effort since 1999. Those documents are summarized here.

1999 Odor Control Master Plan

This was a comprehensive odor control master planning effort. Major odor sources that were identified included, in order of contribution to total site odor:

1. Facultative Sludge Lagoons
2. Aeration Tank Settled Sewage Channel
3. Odor Reduction Tower
4. Dedicated Land Disposal
5. Holding Basin 1
6. Primary Sedimentation Tanks
7. Anaerobic Digesters
8. Aeration Tanks
9. Waste Gas Flare
10. Secondary Sedimentation Tanks
11. Chlorine Contact Tank.

For controls, mostly work practice improvements were recommended for existing processes. New control devices were recommended for the DAFT and the proposed new Headworks and Bar Screen Building.

2004 Odor Control Master Plan Update

The odor source ranking was revised to:

1. Facultative Sludge Lagoons
2. Aeration Tank Settled Sewage Channel
3. Odor Reduction Tower
4. Dedicated Land Disposal
5. Aeration Tanks
6. Secondary Sedimentation Tanks
7. Anaerobic Digesters
8. Headworks Screening conveyor
9. Waste Gas Flare
10. Chlorine Contact Tank.

The changes in the ranking from 1999 are highlighted. For the most part, further refinements in work practices were recommended for control. The report identified several focus areas that are presented in the next section.

2004 Odor Control Focus Areas

From the Master Plan Update, six focus areas were identified. The included:

1. **Biofilter Operation** – Several operational issues were identified with recommendations for improvement.

2. **ORT Optimization** – Continued monitoring and media replacement were recommended. Technology replacement was found not to be recommended at this time.

3. **Aerated Grit Chamber Evaluation** – Improvements for odorous air capture were presented.

4. **Aeration Basin Evaluation** – More detailed evaluation of source air emissions, but results indicated no additional need for controls.

5. **Collection System Evaluation** – Higher than expected level of hydrogen sulfide were found with recommendations for further study and possible liquid phase controls.

6. **Cogen Engine Odor Evaluation** – No results were available in the report provided.

2008 Odor Control Focus Areas Update

Odor sources were re-sampled with atmospheric dispersion modeling. Based on these results four sequential odor control projects were recommended:

1. Replacing or refurbishing the ORT.

2. Covering and controlling the settled sewage channel and anaerobic section of secondary treatment.

3. Routing the headworks biofilter exhaust to a stack.

4. Covering the primary sedimentation basins and Pleasanton Junction Structure and routing to a new biofilter.

Evaluations in this Report

The following presents an analysis of the historical data along with recommendations as to future planning.

Summary of Historical Quantitative Results

The following table presents a summary of the historical quantitative results. This table will be referenced in the analysis sections below.

Table 1 Summary of Historical Quantitative Results

	Odor (D/T)				Hydrogen Sulfide (ppmv)				Ammonia (ppmv)			
Process	**1999**	**2004**	**2005**	**2008**	**1999**	**2004**	**2005**	**2008**	**1999**	**2004**	**2005**	**2008**
FSL	15	120		60	0.000	0.020		0.000	5.00	3.00		10.00
DLD	10				0.000				60.00			
ORT In	354		1,100	4,700	0.090		0.180	2.000	0.00			
ORT Out	178		380	1,700	0.020	0.030	0.015	0.200	0.00			
Screenings Conveyor		1,100		500		0.980		0.500		0.05		
Headworks Biofilter		45		830		0.010		0.010		1.00		
Primary Clarifier	1,300	150		1,600	1.000	0.140		0.400	0.50	0.60		1.00
Primary Clarifier Weirs	1,300	1,300		3,000	1.000	1.100		0.600	0.50	0.40		
Settled Sewage Channel	4,023	7,800		9,600	2.400	9.200		7.000	0.40	0.60		
Aeration Basin Anaerobic		3,500	1,200	5,000		0.320	0.075	0.120		0.10		
Aeration Basin Aerated	149		480	330	0.000	0.040	0.000	0.012	0.00	0.10		

ORT

The Odor Reduction Tower (ORT) is a heterotrophic biological trickling filter designed for gas phase odor control. It is one of the last of its kind in existence and operates remarkably well. It was built in 1985 and is approximately 12' x 16' with 20' of conventional packed tower media. It was extensively rehabilitated in 2007. It had an original design total air flow of 17,460 cfm from the following sources:

- Grit Tanks (2,330 cfm)
- Grit Classifier (9,250 cfm)
- Screen Room/Diversion Structure/Pump Room (5,880 cfm)

During its last sampling event it was removing 90% of the hydrogen sulfide. This sampling event was for a flow rate of 21,360 cfm. In addition, the ORT had a significant odor concentration in the exhaust (1,700 D/T) and is therefore a likely major source of offsite odor impacts. The 2008 analysis had the ORT contributing to about one half of the off-site odor impacts. As such it is one of the leading opportunities to further reduce offsite odor impacts.

The District now operates the ORT at lower flow rate of 11,100 cfm. Therefore, the likely performance is even better. In December 2012 and January 2013, following this change, the District completed additional sampling of the ORT inlet and outlet. Inlets samples averaged 0.271 ppmv, and outlet measurements averaged 0.01 ppmv, which calculates to a 96 percent removal rate. The measurements off of the ORT were similar to those measured above the aeration basin, The ORT, as it sits today, is performing the best that the its technology can provide. Further increases in odor control performance will have to come from the following alternatives:

1. Put high performance media in the ORT that represents state of the art for current odor control Biotrickling filters along with current technology controls for moisture maintenance.
2. Replace the ORT with a new Biotrickling filter in the existing footprint.
3. Replace the ORT with a new control technology located elsewhere on the plant site.

If possible, Option 1 is recommended, but only if no further odor projects (primary sedimentation basin covering, aerated channel, aeration basin selector) are planned for the near future. This option is contingent on the structure still being suitable for another 20 years of service life. It will have to thoroughly inspected to determine its likely longevity. If it fails inspection, the Option 2 is recommended. This could either be a vendor supplied system or a custom designed system that would be very similar to the existing. A custom designed system, with the same footprint, is the recommended approach. Option 3 would only be recommended if either Option 1 or Option 2 proved to be not feasible.

If further plant odor control for additional facilities (primary sedimentation basin covering, aerated channel, aeration basin selector) is planned, then Option 3 combining all the planned sources is recommended.

Primary Sedimentation Basin Odor Scrubbing

DSRSD has four primary sedimentation basins (see Figure 1), with each basin approximately 100’ x 20’ of liquid process area. For planning purposes, the cover for this type of process is designed to contain odors (not provide a safe interior environment. The design criteria for containment is to maintain a minimum inlet velocity of 100 feet per minute (fpm). For this process, this normally translates into an under-the-cover ventilation rate of 1 cfm/per ft2 of liquid process area. For this 8,000 ft2 area, it would require 8,000 cfm. Ultimately, there will be 7 sedimentation basins resulting in a final flow of 14,000 cfm.

Note that some extremely tight covers can have vent rates as low as 10% of this value. However, tight covers often result in poor process access.

Appropriate odor control technologies (in order of preference) would be:

1. A soil biofilter (7,000 ft2)
2. A BioRem BioSorbens® biofilter (3,500 ft2)
3. A chemically based packed tower (500 ft2)
4. Activated carbon (800 ft2)

As discussed in the Overview section, this facility has had problems with soil/sand biofilters in the past, and further using this technology without fully diagnosing the existing systems problems is not recommended. All these technologies will have an installed equipment cost between $300,000 and $600,000.

Future Odor Control

The only other recommended control technology presented in the previous Odor Master Planning documents is the control of the inlet channel and selectors for the aeration basins. Figure 2 shows the existing aeration basin configuration with the inlet channel on top and the common selector in Basin 3. The channel is approximately 180’ x 5’ and the selector is 210’ x 24’ for a total process square footage of about 6,000 ft2. Using the previously discussed planning ventilation factor of 1 cfm/ft2 this would be about 6,000 cfm of vent air to provide odor containment under a cover. It would be recommended to combine this with the primary sedimentation basin system if at all possible. This would increase footprint and costs by about 50% above the values provided previously.

Discussion

Whole Plant Odor Control

For the whole plant to have odor control, the following sources need to included (not including the thickener biofilter):

- New Headworks Bldg (17,000 cfm)
- Existing ORT sources (11,100 cfm)
- Primary Sedimentation Basins (14,000 cfm ultimate)
- Aeration Basin inlet channel and Selector Tank (6,000 cfm)

For a total of 48,100 cfm. This airflow requirement would preclude the use of a single sand biofilter, and likely eliminate the feasibility of sand biofilters completely.

Covers

For all alternatives the primary sed basins and aeration basin components would need to be covered. The recommended approach would be flat aluminum sandwich panels (eg Halston®). This would cost about $100 per ft2 for an installed system. For the Primary Sed Basins this is $800,000 and for the aeration basins this would be $600,000, for a total of $1,400,000. Single plate exposed truss systems may be slightly cheaper, but offer less access and are more difficult to disassemble for heavy maintenance. Note that occasionally the process has to modified to be covered (corrosion control, access requirements) that may significantly impact total costs. The design of a covering system and the selection of cover type is critical to the successful future operation of the facility.

Alternative 1 – Biosorbens® Biofilter at current Headworks Biofilter Location.

The most sustainable, long term approach would be to install a deep bed Biosorbens® biofilter designed for 5 - 6 cfm ft2. This would likely be six feet of bed depth. This would require an 8,000 ft2 footprint, and could be placed where the existing headworks biofilter is now. Note that this design criteria needs to be verified with Biorem, the Biosorbens® manufacturer.

It would not have to be built initially for the final flow rates, but could be designed to be incrementally increased in size as required. The largest obstacle for this option would be the routing of large ducts from the ORT, primary sed basins, and aeration basin to this location.

The installed equipment cost for the biofilter only, would be about $600,000. Ductwork from the processes could be as much as $200,000. Using a total project cost multiplier of four (the most common for these types of retrofit projects) the total project cost should be anticipated to be $3,200,000 (plus covers). This last cost includes planning, design, construction, and administration.

Alternative 2 – Activated Carbon or Sodium Hypochlorite Scrubbers Locally.

This alternative would include three local systems:

- New Headworks Building (17,000 cfm)
- ORT Sources/Sed Basins (25,100 cfm)
- Aeration Tank (6,000)

Sodium Hypochlorite Packed Towers

Each of these locations could be serviced by a single column (5’ to 10’ diameter) packed tower. The footprint would vary from 25’ x 15’ to 15’ x 15’. A central chemical storage facility would be recommended that would include a 10,000 gallon sodium hypochlorite storage tank and a 2,000 gallon sodium hydroxide tank. The chemicals would then be distributed in 2” total diameter double wall PVC pipe to each system. These systems could be placed on top of either (or both) the sed basins or the aeration basin selector.

Installed equipment costs for this would be:

- New Headworks Building $120,000
- ORT Sources/Sed Basins $150,000
- Aeration Tank $100,000
- Chemical Storage $50,000

Total project cost would range from $1,200,000 to $1,600,000 (plus covers) depending on how complicated (whether or not they are built over the basins) the installation is. Operating costs would be about $50,000 per year more than the Biosorbens® system for chemical costs.

Activated Carbon

For an activated carbon installation, the following equipment would be needed:

- New Headworks Building (two – 10' diameter vessels)
- ORT Sources/Sed Basins (two – 12' diameter vessels)
- Aeration Tank (one – 8' diameter vessel)

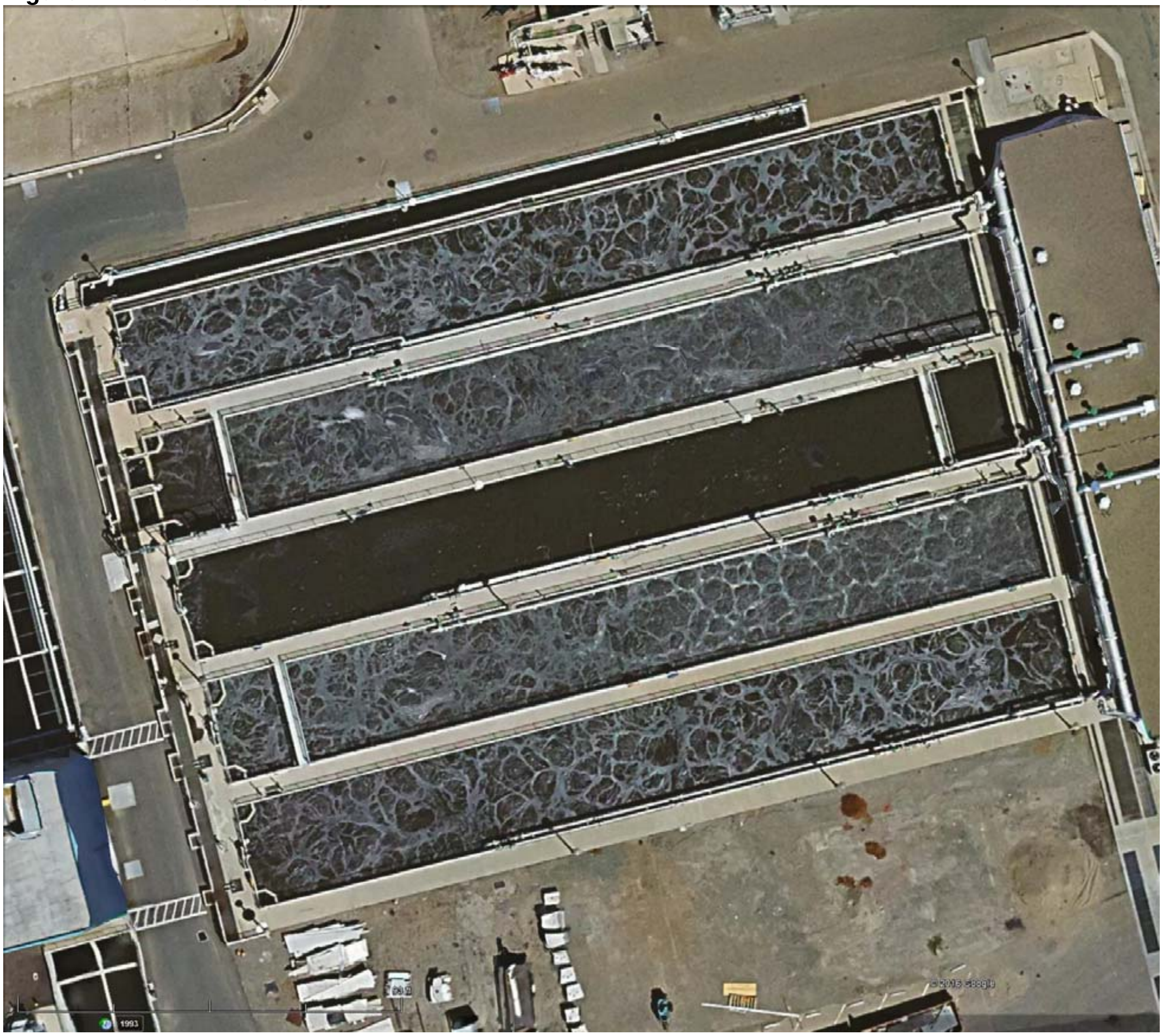
This would require a foot print varying from 35' x 20' to 12' x 20'. The installed equipment costs would be:

- New Headworks Building $180,000
- ORT Sources/Sed Basins $200,000
- Aeration Tank $100,000

Total project cost would range from $1,500,000 to $2,000,000 (plus covers) depending on how complicated (whether or not they are built over the basins) the installation is. Operating costs would be about $100,000 per year more than the Biosorbens® system for carbon costs.

Figure 1. DSRSD Primary Sedimentation Basins

Figure 2. Aeration Basins



ATTACHMENT 2

Additional Cost Estimate Details

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**KEG**
DESCRIPTION OF WORK:	**Replace ORT**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/26/2017**

ELEMENT #	DESCRIPTION		COST
1	Odor Control Facility Improvements		$480,000
2	Demolition of ORT		$230,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$710,000**
	Construction Contingency	10%	$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$250,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,030,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: KEG
DESCRIPTION OF WORK: Odor Control Expansion

TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 6/26/2017

ELEMENT #	DESCRIPTION		COST
1	New Carbon Filter		$500,000
2	Covers, Ducting and Fans		$3,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$3,600,000**
	Construction Contingency	10%	$400,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$1,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$5,300,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Carbon Filter
ELEMENT #: 1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 6/26/2017
REVIEWED BY: KEG

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Odor Control Equipment	1	LS	$150,000	$150,000	$75,000	$75,000	$230,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$230,000**
	Plant Paving, Grading, and Yard Piping			10%				$20,000
	Mechanical and Piping			5%				$10,000
	Electrical			0%				$0
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$260,000**
	Project Phase-Level OPCC Contingency			30%				$80,000
	SUBTOTAL							**$340,000**
	Tax on Materials			9.5%				$20,000
	Contractor's Markup on Sub-Contractors' Work			10%				$0
	Contractor's Overhead and Profit, Mob/Demob			25%				$90,000
	Contractor's General Conditions			10%				$30,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$480,000**
	Construction Contingency			10%				$50,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$170,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$700,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Demolition of ORT**
ELEMENT #:	**2**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 6/26/2017
REVIEWED BY: KEG

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Demolition of Existing ORT	1	EA	$100,000	$100,000	$0	$0	$100,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$100,000**
	Plant Paving, Grading, and Yard Piping			10%				$10,000
	Mechanical and Piping			5%				$10,000
	Electrical			0%				$0
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$120,000**
	Project Phase-Level OPCC Contingency			30%				$40,000
	SUBTOTAL							**$160,000**
	Tax on Materials			9.5%				$10,000
	Contractor's Markup on Sub-Contractors' Work			10%				$0
	Contractor's Overhead and Profit, Mob/Demob			25%				$40,000
	Contractor's General Conditions			10%				$20,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$230,000**
	Construction Contingency			10%				$20,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$80,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$330,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Covers and Ducting**
ELEMENT #:	**3**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 6/26/2017
REVIEWED BY: KEG

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Covers for Primary Sedimentation Basins and Inlet Channel	12,900	SF	$100	$1,290,000	$0	$0	$1,290,000
2	Fans	2	EA	$25,000	$50,000	$10,000	$20,000	$70,000
3	Ducting	1	LS	$100,000	$100,000	$40,000	$40,000	$140,000
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,500,000**
	Plant Paving, Grading, and Yard Piping			10%				$150,000
	Mechanical and Piping			5%				$10,000
	Electrical			15%				$30,000
	Instrumentation and Controls			15%				$20,000
	SUBTOTAL							**$1,710,000**
	Project Phase-Level OPCC Contingency			30%				$510,000
	SUBTOTAL							**$2,220,000**
	Tax on Materials			9.5%				$110,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$560,000
	Contractor's General Conditions			10%				$220,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$3,120,000**
	Construction Contingency			10%				$310,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,090,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$4,520,000**

Note: Material cost for covers includes installation.

APPENDIX E

Visioning Panel Workshops Meeting Notes

APPENDIX E-1

Visioning Panel Workshop No. 1
Meeting Notes

Subject: External Drivers Affecting DSRSD Facilities Master Planning

Location: WWTP Ops Admin Training Room, 7315 Johnson Dr, Pleasanton, CA

	Participants	Representing	Email	Phone
JZ	Judy Zavadil	DSRSD	zavadil@dsrsd.com	(925) 875-2272
DM	Dan McIntyre	DSRSD	mcintyre@dsrsd.com	(925) 875-2241
DG	Dan Gallagher	DSRSD	gallagher@dsrsd.com	(925) 875-2345
LF	Levi Fuller	DSRSD	fuller@dsrsd.com	(925) 875-2300
BM	Bert Michalczyk	DSRSD	michalczyk@dsrsd.com	
JP	Jeff Pelz	West Yost	jpelz@westyost.com	(530) 792-3259
KG	Kathryn Gies	West Yost	kgies@westyost.com	(925) 949-5815
GC	Greg Chung	West Yost	gchung@westyost.com	
TH	Tracy Heidersbach	West Yost		
JBN	JB Neethling	PANEL -- HDR	JB.Neethling@hdrinc.com	
DR	Dave Reardon	PANEL -- HDR	Dave.Reardon@hdrinc.com	
BW	Bob Whitley	PANEL -- Whitley Burchett	bwhitley@whitleyburchett.com	
GK	Greg Kester	PANEL -- CASA Renewable Resource Prog.	gkester@casaweb.org	
BP	Brian Pecson	PANEL -- Trussell Technologies	brianp@trusselltech.com	
LL	Leo Lopez	City of Pleasanton	LLopez@cityofpleasantonca.gov	

Notes

Project Objectives and Work Plan for Visioning Workshop:

- BM: Wants DSRSD to take the first steps towards becoming the utility of the future. Possible external drivers that he sees include:
    - Nutrient limits in the bay
    - Possible ban on biosolids land discharge
    - Planning ahead to anticipate future needs
    - Possible increase in value of plant inputs (ie Phosphorus, ash, …)
- BW: Plant was built in the 60's when oil prices were stable. Not the case anymore. DSRSD has a great opportunity to expand wisely because they are not going to be capacity limited in the immediate future. Thinks the priorities should be:
    - Utilizing the resources coming into the plant and refining what is being done to recover those resources.
    - Looking at what to do to capture water in particular (including going to satellite facilities).
- JZ: Thinks another workshop objective should be looking at Energy/Green/Sustainability concerns.
- KG: Won't focus on Energy in particular today but the resource recovery discussion will touch on sustainability issues.
- JBN: Should also identify the trigger points that would lead to the implementation of different design alternatives.
- BW: Should focus on community/public perception triggers in addition to regulatory triggers.

Overview of Existing Facilities:

- BM: RO membranes have been sold, but pressure vessels are still there.
- JBN: What are the plant inputs?
  - KG: Inputs from Dublin, Pleasanton, South of San Ramon. Not major industrial inputs. Right now we are at about 10.3 mgd ADWF and are planning for about 12.3 mgd ADWF.
  - BM: There is also an army base and 3 jails.
  - JZ: Industrial sources are about 5 percent, including the jails and Camp Parks. There is Clorox, a biotech, and one other company.
- BW: Have we looked at what we can do to reduce flows outside of the fence?
  - KG: The master plan is not really an I&I or collection system plan. But we could maybe look at options for converting storage areas within the plant. DSRSD peaking factors are not large (3.5 to 4, unlike other Bay Area plants that can be at 10-12).
  - BW: We should at least bring up the issues in our scope, even if the answers aren't necessarily developed.
  - DM: The discussion could be in the format of, 'If I&I was reduced X% then facility "A" would not be needed…'
  - JZ: She would like back of the envelope numbers and percentages of how feasible the different alternatives are so that panel members can be informed.
- KG: Limited space is available for expansion within plant boundaries.
  - BM: We need to look at technological drivers to handle these constraints, not just the community perception drivers that were mentioned earlier.
- LF: Wants alternatives to include bigger-picture solutions. For instance, DSRSD agreed to get rid of equalization for odor control purposes, but equalization is good for energy resources usage. We could potentially keep equalization if we addressed the real issue, which is odor.
- What are the Recycled Water (RW) customers?
  - DG: ¾ DSRSD ¼ EBMUD.
  - BM: The residential and industrial fill stations each account for about 17 million gallons a year each.
- BP: Is there space for more RW facilities?
  - KG: Maybe across the street.
- KG: No biosolids groundwater (GW) contamination has been documented but monitoring well setup may be lacking.
  - BW: But the setup was approved by the Board. There is saline water below the clay which is not pumped anyway.
  - DG: The clay layer is natural clay so there could be potential penetration pathways.
- BM: Biosolids are a cheap disposal option, but that is the only current option. If the biosolids facilities had to be shut down (Due to monitoring well issues, community odor objections, etc…) DSRSD wouldn't have other options. The biosolids disposal setup is a single point of fail system. Everyone is in agreement, including the board of directors, that better sludge disposal options are needed.
- DR: Have there been odor issues with neighbors historically?
  - LF: There was the Stockyard Stink case in 2000. They had 80 odor complaint calls a day (versus 5 a year which is typical). This event could have been due to organic overloading of the digesters. At the time they only had 2 digesters that were at capacity and did not have screening. Now they have 3 digesters and screening. However, luck is a factor in not having any big odor events (No algae blooms, etc..).

  - BM: During the odor event there were complaints all the way to Livermore.
  - BW: It is also important to note that if there is a wet winter the operational period when you can apply biosolids in the summer would be shorter because of saturation issues.
  - JZ: They haven't had odor complaints during the actual solids injection process.
  - LF: Injecting sludge in the dedicated land disposal (DLD) site is harder when it rains. So they won't be able to hit capacity solids injection.
- BW: Facultative sludge lagoons (FSL) are a failsafe for LAVWMA and gives the valley a few extra hours of effluent storage.
  - DG: Don't think that is allowed now.
  - LF: Heard that last el nino the FSLs were only a few inches from overflow.
  - KG: Now discharge to Alamo Creek is allowed.
- DM: Livermore has a 9 mgd buildout capacity, but will likely only get to 8 mgd. Could DSRSD potentially take their excess capacity and create a regional facility?
  - BM: Not a bad idea, but there were strong objections to this idea in the past.
- KG: A regional biosolids facility could be an option though. Livermore could pump liquid solids to the DSRSD site.

<u>Recycled Water:</u>

- KG: Sand filters were originally rated at 10.1 mgd but operationally only provide a capacity of about 7.3 mgd. MF provides another 3 mgd.
- DG: MF has not been able to produce water at stated capacity either.
- BW: Should we look at how much water is being used for cooling that could be converted to Title 22 water?
  - DG: There is too much ammonia for cooling water (Was the case for Chevron.).
  - BW: Could treat at the tertiary stage for different/new uses.
  - KG: As you will see on coming slides, there is a supply issue. We shouldn't worry about finding new users.
- KG: The operational cost of the microfiltration (MF) system is about 4 times the cost of the sand filtration (SF) system. Currently, we have space to double the sand filtration bay and are looking at how the SF UV could be expanded. Potential that the MF UV system needs rehab because it is old.
- KG: One option for additional supply is to take an extra 3 mgd of raw wastewater from Central San in summer months.
- JBN: Why do we use Max Day demand for recycled water on the slide figures?
  - JZ: Max day is about the same as max month in this case.
- JBN: Have we considered demand management? Scheduling customers.
  - KG: Not part of the scope of this effort; however, it could be mentioned.
  - JZ: Not currently part of contracts.
- KG: Could we take Livermore secondary effluent?
  - Livermore about ~6 mgd ADWF ~3 mgd is currently recycled
- JBN: What are the current contracts/agreements.
  - DG: Agreements: 1) Water coming in, Pleasanton not part of the district, on contract. 2) EBMUD on DERWA agreement, 1st come 1st serve. Supply doesn't have to meet demand. It is not a great option be can always top off with potable water.
- JBN: What about storage?
  - JZ: Storage in Coke Lake has come up, but algae would be an issue. Would treatment need to be through MF.

  - BP: Algae would still be an issue for MF.
- DR: Do tertiary facilities have to be onsite?
  - DG: no
  - KG: Don't want RO facilities too far from LAVWMA if discharge line to be used for brine. EBDA can provide dilution of brine
  - BW: Not all RW needs to be made onsite:
    - Additional Central San flow could be handled by satellite facility
    - Could be a satellite for Pleasanton demand
    - Could have a bunch of smaller satellites to get around the space limitations onsite
  - JZ: They did a study a while back to determine if a Central San satellite was feasible. It was determined not to be feasible because they would still have to treat the biosolids.
  - KG: Again we can reverse engineer. If can produce @ X acre-ft offsite then …
- GC: Should consider greywater impacts on supply (GW~40% in MP).
  - DG: Will be releasing long term water management plan which will call for reduction to 70 gal/cap/day.
  - JZ: People already have greywater storage in their yards.
  - KG: Not really possible to account for this at this time.
- JBN: What are the winter conditions?
  - DG/BM: Winter is from November to March/April. Demand decreases to about 0.5 mgd.
- DR: Why bring in more raw WW for supply when we could treat more of our secondary effluent off-site?
- JZ: There is a study planned on IPR in the valley.
  - DM: Worked on the scope. Cheaper to do initial phase of IPR in Livermore than DSRSD based on ability to size. Livermore is more economics driven than RW demand driven.
- JZ/DM: For DPR several reservoirs have been considered: Patterson Pass would be about 2 acre-ft, Del Valle potable reservoir 12-13,000 acre-ft
  - DG: Patterson Pass treatment about 10-12 mgd, Del Valle treatment about 30 mgd
- BW: Should identify the in-fence maximum limits for how much RW could conceivably be produced, then use that.
- DG: Should have the goal of using all water at least 2 times, whether IPR or DPR.
- JP: For MP scope, should we identify capacity 'thresholds' to what could be accommodated onsite?
  - JZ: Yes, we want no water going over the hill
  - KG: Mike Conner @ BACWA said we could treat to tertiary and increase discharge to Alamo.
  - BW: The old view was that discharge to Alamo should be eliminated.
  - JBN: We shouldn't really be thinking about the site space as a main constraint. You can always just spend more money to increase onsite capacity by building on top of the existing basins.
  - KG: There is limited discharge to LAVWMA. Would need WW storage.
  - BM: If have IPR then need less storage.
  - KG: What about nutrient limits on the bay? If have an RO process, nutrients would go to the bay
- BP: There are tons of water quality side benefits associated with nitrification (even denitrification to a lesser extent).
  - KG: more cost effective to nit/denite through a brine stream treatment?

    - JBN: No, because then you would lose the water quality benefits/filtration benefits. And if you do nitrification, you might as well do denite. Can look at Orange County nit example. In this example, nit/denit was not intended to meet specific limit. Allowed for more flexibility
  - BP: Hyperion facility uses ozone to improve water quality.
    - KG: Is ozone cheaper than nit/denite?
    - BP: Ozone still doesn't solve the nitrogen problem.
    - KG: But it does oxidize, then provide nitrogen removal in brine.
- JZ: For GMP and granular media filters, what is the cost/benefit of nite/denite prior to tertiary treatment?
  - LF: 4.7 to 3.4 gal/sf for SF, but 2.2 gal/sf for secondary effluent. Estimates we could be ~25% better performance of existing tertiary facilities with incoming water quality improvement.
  - BP: 5-10% increase in cost to take out ammonia. He can send case studies. One case study showed 15% more energy costs, but less polymer had to be used, which approximately led costs to break even.
  - JBN: When this decision is not driven by regulatory requirements, the safety factor can be very low. Warmer temperatures help for nit/denite.
- KG: Is it worth it to do a feasibility/economic evaluation of the different options? Or should we blanket-assume that we need nit/denite before RO.
  - BW: If N removal is important for RO membrane why not just remove N on a side stream?
  - BP: All potable reuse would have to go through a membrane.
  - BW: Brine has to go to the bay, but not if there is a dual membrane system. (Forward RO)
  - BP: If looking at DPR like surface water supplement, nutrient removal will ultimately be required prior to membranes.
  - JP: If had 100% reuse would have less drivers for NDN. But do we agree that we can drop scenarios that do not include NDN?
  - JBN: Except for irrigation. There are benefits of leaving N in irrigation water for golf courses, local lawns etc…
  - BW/DM: There have been studies that N in water does improve grass quality.
- BM: Doesn't want to create a treatment system with different treatment requirements to maintain for different uses.
  - BW: What if we used a satellite for agricultural uses?
  - BM: Is hesitant about this. We have already invested onsite.
  - JBN: The simplest way to reuse nutrients is not to take it out of the water in the first place.
  - KG: Given seasonal component maybe nit/denite or ozone could just operate on the MF feed.
  - JZ: Yes, maybe.

<u>Biosolids & Resource Recovery:</u>

- GK: WWTPs used to be considered as part of the problem. Now they are considered to be part of the solution. Co-digestion is a win-win, decreases landfill inputs and increases energy yield. The state has several state regulations that could serve as design drivers:

  -AB 32 – greenhouse gas reduction to 1999 levels
  -75 % Recycling goal
  -50% reduction of energy by 2030
  -Methane reduction

-Healthy soils initiative
-Short-lived climate pollutants reduction

Many areas are reconsidering their ban on land application of Class B biosolids:
-San Bernadino has a hearing to allow biosolids.
-Frezno, Kern and Imperial County also would like to revise their biosolids bans.

The bay is more accepting of biosolids. Within the bay Solano, Merced, Alameda and Sonoma accept biosolids application.

- KG: There is the perception that the Bay's acceptance of biosolids will diminish. Is that true?
  - GK: This perception came out of the 2012 Solano County Ordinance, which allows land application contingent on Class A status. But there are some benefits to Class B. He sees the state opening up more on this.
  - GK: There is one potential DLD issue that is worth keeping tabs on. The ARB showed high Nitrous oxide readings in the Sac Regional DLD as part of a study. The ARB mistakenly thought these findings were typical for all land application. The ARB was talked off the ledge on this issue, but he is concerned that this misperception will creep back up.
- BW: Should we invest in energy or agricultural reuse? It is hard to tell. For now we should consider both.
- BM: Right now, DSRSD is part of the SCFI (Super Critical Fluid …) pilot.

DSRSD was identified as a possible site for BAB2E.
-The tech comes out of Cork Ireland and is licensed to Synegro. The process is like Zimpro on steroids (high pressure/temperature).
-The output is pure water, ash and a little CO_2.
- Requires 15% solids, DSRSD liquid solids would be used for dilution. Might reduce need for dewatering in the near term.
-Would be located on LAVWMA south of the storage ponds taking up some of the DLD.
-Is construction at that site viable given its historic use as a DLD?

  - BW: FYI Reggie Miller at Stanford is willing to contribute to the project if there is interest?
  - BM: That would be great. Also they are saying 'pilot' but the proposed project will involve a 10 ton/day facility and possibly include SFPUC and San Jose inputs.
- KG: How important is it in general to DSRSD to be cutting edge on this?
  - JZ: They want to be a first follower and avoid the trough of disillusionment.
  - BM: The DLD is a single point of failure. So the board of directors wants diversification and has endorsed the SCFI project. In September DSRSD will bring a reimbursement agreement to the board.
  - KG/BM: These types of partnerships are important for reducing liability. More acceptance for new technology when DSRSD is not the sole investor.
- GK: The product coming straight out of the digesters would already be Class B. So new tech might not be needed to bring the product to the DLD. But there are some good technologies out there like Lystek and BioForceTech.
- BM: SCFI involvement doesn't preclude other tech investments at this point.
- GC: There are already a lot of places out there willing to take biosolids: Recology, Synegro, etc…
  - BM: The Board is ok with the idea of taking other institutions biosolids. In fact they kind of like the idea.
  - JZ: There was one example of a tech that produced a granular slow release product. Can't recall the name.
    - GK: All biosolids are slow release.

- LF: might want to change the FSL loading factor from 20 to 15 because of the previous odor issue.
- DR: Is methane an issue for the FSLs?
  - DG: They haven't seen any methane bubbling out of the lagoons.
  - BP: In theory, if the lagoons are facultative, then bugs should be eating up the methane.
  - BW: The methane is also converted to CO_2 as it rises.
- LF: They only flush the FSL during the winter (about 3-5,000 gal/day flushing) so that influent water quality is high during the summer for recycled water purposes.
  - BP: If we switch to potable reuse the return stream will need to be revisited. The return stream would be bad for the filters. We might have to consider another discharge point of return flow.
  - KG: We couldn't discharge this flow to LAVWMA because the discharge would have to be secondary at minimum.
- BW: Return flows from the FSL contain struvite and high phosphorus and ammonia concentrations. Could we recover these resources before return?
  - KG: Phosphorus recovery is not feasible because of cap water/etc.. But maybe recovery would be feasible if done upstream of the DAFT, or if we added dewatering.
  - JP: Are we concluding that we can't have nutrient recovery of FSL return?
    - JZ: There is not enough phosphorous. If recovery was going to be done we would want to do it upstream of the digesters, not after.
    - GC: Price point doesn't support phosphorus extraction right now. But we know where the phosphorous is stored and could do recovery in the future.
    - JBN: It depends on the driver.
    - JZ: The drivers are 1) Struvite 2) Being green
    - JBN: If we are land-applying biosolids that is already green. We could remove struvite and bring it back to the land
    - BW: FSL return flow should be addressed in master plan.
- Co-Digestion
  - KG: Creating a FOG receiving station by the 4th digester could cause issues w/space and crossing truck traffic between FOG trucks and the filling station trucks.
  - BW: There is already lots of organic carbon coming in through the pipe. We should remove that first. Trucking is successful at EBMUD because they have the extra capacity. That is not the case at DSRSD.
  - GK: Recommends co-digestion. Would reduce truck emissions and increase energy production. There is a LCFS and Federal credit. Also, the state promotes methane pipeline injection. But pipeline standards (From the Utility Commission) are difficult to meet. But he thinks requirements will be eased in the near future.
  - KG: For the master plan, adding digesters & bringing solids onsite is an option on the table.
  - JZ/GK: It is difficult to find offsite solids contributions.
  - BW: Should focus on improving efficiency of current digesters.
  - GC: The 4th digester already has to be added, but we don't necessarily need the 5th.
  - KG: Is the 5th digester off the table?
    - BM: Maybe don't include the 5th digester in the master plan but leave space for it in case the digester is needed in the future.
    - DR: Tipping fee of the FOG is the biggest factor to consider. Tipping fees should not be overstated. FOG is only cost-feasible if cogeneration and other facilities are already setup.
    - GC: The 4th digester will be another 70 footer.

- JB: EBMUD has taught us that if you accept food waste for digestion, ammonia and phosphorus will come back in the recycled stream in much higher concentrations (about doubled). These concentrations would make nutrient removal more difficult.
- BW: Accepting FOG also requires the need to build other expensive facilities (pre-treatment storage, etc…).
- JP: So the master plan conclusion is to not build for co-digestion?
  - KG: It sounds like the 70 footer will have some capacity for FOG/other things but addition co-digestion design considerations will only include space planning.
- JZ/LF: FOG stations are only getting bad quality grease.

Resource Recovery (Heat Energy/Carbon Energy)

- KG: We should discuss Heat recovery. Incoming WW has associated heat that could be harvested. How much heat is there?
  - JBN: Can use a water-source heat pump on effluent. There are examples of this working in King County Seattle.
  - DR: Power is needed to run the pump, so economics must be considered. The heat would be enough to heat digesters.
    - BW: Research has been done on this. Can contact George Tchobanoglous for numbers.
  - JBN: Just googled, Dave Clark in the 1980's, a heat pump was able to service digesters.
  - BW: Need to consider basic calcs of heat recovery given high temperatures in the area.
  - SD: Right now they already waste a lot of heat from the co-gen. They capture too much and can't use the heat. The fuel cell no longer exists.
    - BW: It should be an objective of the MP to keep produced heat energy in balance.
- JZ: Warmer WW can improve treatment performance. What would happen if we removed the heat?
  - BP: Knows there was a study using cooling water on the effect of heating water to RO filters.
  - BP: Warmer water may improve membrane filtration
  - KG: can we use existing heat look to work effluent going to membranes?
  - KG: If we remove the heat, where should it be removed?
    - BP: First would have to evaluate the physical ramifications: viscosity, etc…
- BW: What are the techniques to utilize the carbon that is already coming in?
  - BP: You can't make as much methane from raw WW as you can from food waste.
  - BW: What is being done with screenings?
    - JZ: Right now they have 2 washer/compactors and the waste goes to a dumpster.
    - BW: Maybe we should look at reusing what is in the dumpsters.
    - BP: But most of this carbon is cellulose – not easily accessible.
    - KG: These seem more like industry-related questions versus DSRSD-related questions.
  - DR: You need to remove carbon before secondary treatment to get the best yield.
  - KG: There are ways to remove solids/organics before aeration but you need carbon for nutrient removal.
  - JBN: There is a tipping point between carbon removal efficacy and availability for nutrient removal, but this point is different for each tech/system. Newer nutrient removal tech tends

to want more carbon. Taking screenings and creating a compressed log that can be incinerated has been done.
- BP: If you have a lot of C you will end up with a lot of N.
  - JBN: Used to think you couldn't remove N without C. But annamox has proven this possible (just need CO_2). Annomox is not viable on a full scale at this point.
- BW: How do we remove as much carbon as possible before we need to burn it up? Not sure if he would have recommended activated sludge so highly earlier in his career if he knew what he knows now.
- KG: When would payoff start?
  - JZ/GC: Lystek return source carbon has had some pay off.
    - JBN: Hesitant to use Lystek. A carbon liquid stream is bad for turbidity.
    - KG: Does not make sense to take carbon out and then return it again.
  - GC: We know carbon is important, but we don't know what for yet: energy versus nutrient removal
- JP: Fine screens/logs are off the table?
  - JBN: No, he had a bad experience with an emerging company. But that is not necessarily always the case.

<u>Nutrient Limitations:</u>

- JBN: Limitation option overview is as follows:

  -Level 1: Optimization with what you have

  -Level 2: Garden variety nutrient limitation but can be met without adding carbon or filtration.

  -Level 3: need to add some carbon/filtration processes

  Thinks chances are good that the limitation will be mass-based on the discharge zone.
- JZ: And the limitation would be seasonal?
  - JBN: Don't know. The first step would most likely be no net increase.
  - KG: In DSRSD's case this could entail increasing RW needs to match increasing growth rate. Otherwise, aside from stopping discharge, would have to do nutrient removal (Assuming discharge to the bay would require level 2.).
  - JBN: Thinks annual or seasonal timeframe. Maybe summer only at first, then annual, with 10 years before required compliance. BACWA thinks seasonal will survive. One possible arrangement would be by total discharge to the bay, with trading being allowed.
- KG: It would likely be another 5-10 years before limits actually have to be met. Would likely need no net increase with their next permit in 3 years. There could be cost saving associated with IPR/DPR associated with not having to do nutrient removal.
- JZ: Wants the master plan to include pound units so calculations can be compared to DPR/IPR options.
  - JP: So have we decided to use pounds in the master plan?
  - JBN: He would include concentration also because we don't know where the Board will fall. The questions that we should address are, should we add methanol/filtration?
- JP: Is the plan laid out on the slide acceptable?
  - BW: Does this include energy requirements?
  - KG: Yes.
  - GC: Costs will be conservative on the higher side.

  - KG: Will have a low-end cost (level 2) and a high end cost (level 3). Offset will be affected by seasonality of limits. IPR/DPR periods will be in comparison to year-round limit. Nutrient limits are not pertinent to seasonal limits because would reuse all the water in summer.
- BM: Do we not get credit for recycled water that is already being made when setting the baseline?
  - KG: Couldn't get confirmation on that. Does JB know?
  - JBN: Doesn't know for sure either.
- BW: When there is more reuse, less water goes to the bay which complicates looking at nutrient limits by mass.
- BM: You had mentioned that nutrient removal is all or nothing, but couldn't you split your process train?
  - KG: Yes, but treatment downstream of secondary is more complicated.
- State point analysis of secondary processes and SVI discussion:
  - BW: Are there additional ways to increase settling is the existing facilities?
    - GC: Like Biomag?
    - BW: Or even something old school like a tube settler.
    - KG: Exactly, in-place settling needs to be improved.
    - BW: A satellite could be a solution to reduce flows.
    - SD/KG: Yes, but not in winter during peaks.
  - KG: We could convert the entire plant to MBR, but we have sand filters.
  - BW: Primary mechanical microscreens are an option that focuses on solids capture prior to activated sludge.
  - JZ: Are there other options, like enhanced primary?
    - JBN: There is AB Process. This tech doesn't use tradition primary treatment, but BOD is reduced substantially (to ~50%). The first stage consists of a half-day high rate activated sludge process. (Basically return RAS to primaries)
  - JBN: AB Process can produce more gas. Would we need more primaries?
    - KG: Yes, right now detention time is about an hour.
    - JZ: More interested in screening than enhanced primary.
    - KG: Even with 2 additional primaries we couldn't get to a typical detention time of about 1.5 hours.
    - JZ: Does AB Process have a large footprint?
      - JBN: The footprint was about $1/9^{th}$, or lets say 20 percent, of the clarifiers. So you would need an additional 20% of clarifier space.
    - JZ: Is the process time faster?
      - JBN: No.
  - LF: What if you had pure oxygen?
    - JBN: You get pH change. There are lots of negative impacts, including possible potable reuse impacts. Not viable for nutrient removal.
  - KG: Our options so far are AB, IFAS, MBR sidestream. Are there any others we want to include? Anammox?
    - BP: MLE? (nitrification with partial denite).
      - KG: With footprint issues we wouldn't get to level 2.
    - JBN: We should include a conventional BNR option. Then we could stray from historical SVI numbers because SVI would improve. Could also think about a denite filter. Screening was an interesting idea.

- KG: What comes out isn't pumpable. It is a cake.
  - BW: Actually, you can get a pumpable slurry.
- BW: Biggest bang for your buck is primary removal.
  - BP: Not necessarily for potable reuse.
- DG: Would conventional BNR take up even more space?
  - KG: Yes, so this would be a good worst case scenario example for footprint.
- BW: There is the option to shut off a primary if we want more carbon for nutrient removal.
- JBN: Since you don't actually need primaries, we don't have to worry about overloading. We should identify if primaries are not expanded, BNR would be XX size. If primaries are expanded BNR would be YY size. We should also define what we consider to be carbon-short.
- KG: What if BNR won't fit? Then we would consider the others?
- JBN: IFAS then MBR.
- JP: What about emerging technologies like Anammox?
- JBN: Anammox is already in use on the sidestream. Anammox on the mainstream would be an emerging technology. We should design for simultaneous NDN, something that could be converted to mainstream Anammox later on.
- DR: Could we store water, so we don't necessarily have to go to IPR for irrigation in the winter?

BM: We have looked at nearby lakes (Zone 7, Cope Lake discussion) but withdrawal would require a title 22 process.

APPENDIX E-2

Visioning Panel Workshop No. 2
Meeting Notes

Subject: Alternative Approaches / Mapping of Relationships Between Drivers

Location: WWTP Ops Admin Training Room, 7315 Johnson Dr, Pleasanton, CA

	Participants	Representing	Email	Phone
JZ	Judy Zavadil	DSRSD	zavadil@dsrsd.com	(925) 875-2272
DM	Dan McIntyre	DSRSD	mcintyre@dsrsd.com	(925) 875-2241
DG	Dan Gallagher	DSRSD	gallagher@dsrsd.com	(925) 875-2345
LF	Levi Fuller	DSRSD	fuller@dsrsd.com	(925) 875-2300
SD	Steve Delight	DSRSD	delight@dsrsd.com	
RB	Rhodora Biagtan	DSRSD	biagtan@dsrsd.com	
BV	Brian Vannatter	DSRSD	vanatter@dsrsd.com	
VS	Virgil Sevilla	DSRSD	sevilla@dsrsd.com	
RP	Rudy Portugal	DSRSD	rportugal@dsrsd.com	
RM	Robyn Mutobe	DSRSD	mutobe@dsrsd.com	
JP	Jeff Pelz	West Yost	jpelz@westyost.com	(530) 792-3259
KG	Kathryn Gies	West Yost	kgies@westyost.com	(925) 949-5815
GC	Greg Chung	West Yost	gchung@westyost.com	
CT	Craig Thompson	West Yost	cthompson@westyost.com	
JBN	JB Neethling	PANEL -- HDR	JB.Neethling@hdrinc.com	
DR	Dave Reardon	PANEL -- HDR	Dave.Reardon@hdrinc.com	
GK	Greg Kester	PANEL -- CASA Renewable Resource Prog.	gkester@casaweb.org	
BP	Brian Pecson	PANEL -- Trussell Technologies	brianp@trusselltech.com	
LL	Leonard Olive	City of Pleasanton	lolive@cityofpleasantonca.gov	

Notes

Nutrients

- Don't necessarily need to limit to 5 clarifiers
  - Building in HB1 could be considered
- BACWA Limits
  - Level 1 limits were selected (by BACWA team) by looking at what all of the 37 plants can reasonably achieve without wholesale replacement of existing secondary processes
  - Level 2 "Technology based" without lots of chemical addition and without filtration
- Level 3: Add filters, add chemical treatment
- Noted actual limits may end up being loading limits, or seasonal, (or not)
- Level 2 vs. Conditioning needed for potable reuse:

  - GW recharge could have less stringent vs. delivery to a reservoir
  - So far, we're assuming there is more flexibility under Treatment Level 2 in providing potable reuse conditioning vs. TL3
  - Sand Filter Performance: Effort to date, including sand replacement in 2 of the 5 existing filters, produced no reliable, substantive increase in practical limit to filter loading rate (<<5 gpm/sf)
- DECIDED: Master Plan Treatment Level 1B: District has decided to install Actiflo system between 2° clarifiers and filters, so eliminate MP TL 1B
  - Except: will additional digesters/solids handling be needed due to increased primary solids (offset by 2° solids redirection, partially?)
  - Need to check digester capacity; may be ok for solids (they are hydraulically limited)
- Run analysis without IFAS and with a sixth clarifier
- With 6th clarifier, is 4,000 mg/L really ok?
- Is one of the options (IFAS) better for wet weather?
- Hydraulics and media movement/bunching can limit effectiveness if IFAS
- Note: peak flow variations are subject to change – collection system maintenance is important – peak flow data is limited
- Note: Dry weather diurnal variation is substantial
- Alum addition for P control at FSLs
  - "When you add alum, the P is bound in solids and therefore removed with biosolids"
  - Increases solids loading
  - Can be added to FSL decant return -or- upstream of a (future) dewatering process
- MP TL 2A: could add 6th (and 7th?) clarifier in lieu of ABs
  - OR could replace DAFT w/ 6th 2° clarifier

IDEA: Future Cogen location could be the former fuel cell pad

- If denitrifying filters are used, must disinfect downstream of the filters (abandon existing chlorination); disinfection could be UV or chlorine.

Potable Reuse

- GW injection is a possibility, but some indication District may wait for DPR
- Is it reasonable to plan for surface water augmentation?

- RO is required for GW injection, may be required for spreading-basin recharge
- Craig's train:
  - — suitable for GW injection, spreading, or surface water augmentation with 6 month barrier
  - — Minimum treatment requirements
- GW recharge capacity may be limiting in wet years
  - — Has happened in past that GW basin was full
  - — Basin may eventually create a surface storage reservoir (after 2050)
  - — Can GW limitation be quantified?
- Nutrient limits not likely to be peak limits, but long term limits
- Might be able to have less denitrification the MP Nutrient TL 2 and still get same conditioning benefit for potable reuse
  - — Will affect amount of N in brine as well, unclear which cost (2° NDN vs. brine N removal) would control
- Noted: technology for brine treatment for N removal is uncertain
- Level 1B and 1C: NDN pretreatment has advantages
  - — Lower maintenance, less fouling (so does O_3, but band-aide)
  - — N removed sooner, easier?
- Should we split 2° process so only NDN treat the portion to be reused?
- Need to explain drivers vs cost
  - — Policy: willing to pay a premium for reuse
    - ▪ This analysis will help inform the decision with cost estimates
  - — Value in getting operational experience before Level 2 capacity investment.
    - ▪ Better to run with upstream NDN if that is the planned end point
  - — Phased implementation
- Note: 2D-2F don't need to disinfect, except flows that bypass the advanced treatment system
- Note: May not need chlorine contactors
  - — In pipe contact time
  - — Less CT, since RO will remove viruses

- Level 1: Where would water go? Is there additional cost outside the fence?
- Zone 7: 8,000 ac ft can be put in GW
- Need study: How would GW injection and 6 mo. detention affect capacity of gw basin?
- Operational Costs: "Elec could be $4 million/year"

Biosolids

- FSL Ops:
  - — 6 month rest before harvest gets Class A
  - — Recent 2 month rest also produced Class A, but only one data point
  - — Harvest takes ~3 months, following the rest
- Would FSLs be a source of GHGs? (Methane) –Maybe.
- What DLD acreage/capacity should we use?
- Could eliminate DAFT with "omnivore", probably – consider "WAS" is actually ML @ < 2%
- Without 4th digester, cleaning of largest removes ½ of capacity out of service
- Return stream from recuperative thickening would be significant load
  - — Also P source if alum isn't added
- Consider odor control needs (e.g. with omnivore)
- Note: District saw struvite accumulation within digesters (implies pH wasn't as low as would be expected; [typically pH precludes or minimizes struvite accumulation])
- What nutrients will be present in SCFI return stream?
- Is MBR useful as an 2°, solids alternative? At least mention as option.
- Options that include return streams into FSLs are troubling to District due to the risk of upset/odors
  - — Might need additional side stream treatment of return, even if going to FSLs
  - — Or tank, enclosed, to allow off peak return to HW (rather than via FSLs)
  - — Note: FSL cap water EC needs to be <2500, limit to allow growth of important algae
- Need matrix of return streams
- Options to add to dewatered solids disposal/recovery list
  - — Class 2 direct to ag. reuse

- Alternative daily cover (tenuous, due to legislation focusing on lower organics to landfills)
- Lystek: some claim now odors, some claim high ammonia
- Dewater and haul to Fairfield regional facility
- Pyrolysis: definitely early tech use
  - Encina may not be working anymore
  - Biochar from Biosolids (vs wood), is not well known
    - Could be odor-control media ~ activated carbon

- Note: previous Biosolids MP said to pilot dewatering and composting
  - District doesn't see value in piloting yet
  - Need to do something to address DLD limits currently
- Are we comfortable not diversifying now? All eggs in one basket currently. Board has directed staff to explore diversification options. Need to state the anticipated "reaction time" available if DLDs are "lost"

Mapping

- Should look at combined cost of 3A/B Nutrients + 2D/E/F reuse
  - Does cost of 2/DEF reuse decrease?
  - Is there added value of water with this train, vs. 2A Nut + 2/DEF reuse?
- If 2 D/E/F isn't realistic cost-wise, might do 1B reuse and 3A/B Nut
- Nut limits may be seasonal, but really can't tell yet
- Note: Increased MF flux assumptions are based on limited data
- Rule out Nut 1B
- DECISION: We can commit to adding primaries/baffles to improve 1° removals
  - 1 or 2?
  - Alternative: divert flow to a new MBR train
  - SUGGESTED: Commission a study (Hany Gerges) - 1 week, get confident evaluation of attainable 1° removal
- Additional alternative: MBR partial train, 2B
- Operation Staff opinions:
  - Don't provide a split stream, or if we do, need to better understand fate of effluent, and peak storm operations
  - Omnivore:

  - On the fence. Consider, but not if cost savings is minor
  - Having 1 as ½ capacity is a vulnerability
  - Need to visit with existing owners, will wait for paper evaluation results

- Potable Reuse
  - Pleasanton led way in IPR study
    - Public Opinion Poll is being evaluated, looks like public favors
    - Round Table will commission next phase: Feasibility Study

▪	DSRSD
▪	Pleasanton
▪	Livermore
▪	Cal Water – Livermore
▪	Zone 7

- DECIDED: Eliminate Reuse 2A/B/C: Chemical treatment, brine treatment
  - Risky to assume brine treatments possible
  - Would need to assume…?

Evaluation of Alternatives

- Use 2016 dollars
- Level 2 estimates
- Add: Contract costs

  Cost per acre-foot produced (so can compare to cost of other water supplies)

  Revenue opportunities

  Energy (net)
- Qualitative – add:
  - Flexibility of footprint – future space
  - Quantity of storage lost (Preservation of flow equalization, frequency of flow equalization)
  - Potential for cost reduction through technology/analysis
- Odor: Include odor reduction facilities to equalize: [No new odor source]
- Note: Waste stream could change in future (e.g., diversion of food wastes to compost)
- If reducing winter discharge (via potable reuse) then ok to reduce storage; not ok to take storage without reducing storm flows

APPENDIX E-3

Visioning Panel Workshop No. 3
Meeting Notes

Subject: Alternative Approaches / Mapping of Relationships Between Drivers

Location: WWTP Ops Admin Training Room, 7315 Johnson Dr, Pleasanton, CA

	Participants	Representing	Email	Phone
JZ	Judy Zavadil	DSRSD	zavadil@dsrsd.com	(925) 875-2272
DM	Dan McIntyre	DSRSD	mcintyre@dsrsd.com	(925) 875-2241
DG	Dan Gallagher	DSRSD	gallagher@dsrsd.com	(925) 875-2345
LF	Levi Fuller	DSRSD	fuller@dsrsd.com	(925) 875-2300
SD	Steve Delight	DSRSD	delight@dsrsd.com	
RB	Rhodora Biagtan	DSRSD	biagtan@dsrsd.com	
BV	Brian Vannatter	DSRSD	vanatter@dsrsd.com	
VS	Virgil Sevilla	DSRSD	sevilla@dsrsd.com	
RP	Rudy Portugal	DSRSD	rportugal@dsrsd.com	
RM	Robyn Mutobe	DSRSD	mutobe@dsrsd.com	
DL	Dan Lopez	DSRSD	lopez@dsrsd.com	
JA	John Archer	DSRSD	archer@dsrsd.com	
MA	Maurice Atendido	DSRSD	atendido@dsrsd.com	
JY	Jaclyn Yee	DSRSD	yee@dsrsd.com	
JP	Jeff Pelz	West Yost	jpelz@westyost.com	(530) 792-3259
KG	Kathryn Gies	West Yost	kgies@westyost.com	(925) 949-5815
GC	Greg Chung	West Yost	gchung@westyost.com	
CT	Craig Thompson	West Yost	cthompson@westyost.com	
BW	Bob Whitley	PANEL -- Whitley Burchett & Associates	bwhitley@whitleyburchett.com	
JBN	JB Neethling	PANEL -- HDR	JB.Neethling@hdrinc.com	
MF	Mike Falk	PANEL -- HDR	Mike.Falk@hdrinc.com	
DR	Dave Reardon	PANEL -- HDR	Dave.Reardon@hdrinc.com	
MM	Mary Martis	PANEL -- HDR	Marty.Martis@hdrinc.com	
GK	Greg Kester	PANEL -- CASA Renewable Resource Prog.	gkester@casaweb.org	
BP	Brian Pecson	PANEL -- Trussell Technologies	brianp@trusselltech.com	
LL	Leonard Olive	City of Pleasanton	lolive@cityofpleasantonca.gov	

Notes

Overview:

What is the Vision for the Future:

- JZ: Wants new GM to help set vision
- LF: Wants to know what the options are
- BW: If Resource Recovery part of the vision?
- JBN: Need to set the vision but have an adaptive management strategy

- District will need to decide how to describe the District's vision for the plant, specifically related to resource recovery, in addition to the goal of preparing the District to accommodate and adjust to the uncertainty associated with external drivers.
- Concept of the process to the date: Ask and answer a series of what-if questions. For this workshop, the Visioning Panel is asked "have we asked all appropriate what-if questions?"
- BW: What if: Current testing treatment upgrades are not adequate to address secondary effluent water quality info. – JBN: Risk is low
- What if flows/loads are higher?
- Satellite treatment: An option for future; mention qualitative impacts on plant, and decision considerations.

Liquids Treatment:

- Systematic Progression of Treatment
    - Add more primaries
    - Current discharge limits: winter settleablity issues
    - Future nutrient removal and issues related to expansion
        - Progression 1: Rely on Existing Flow EQ
        - ~~Progression 2: Eliminate Flow EQ~~
- Treatment levels of interest for 2035 projected flows and loads
    - Water Conditioning for Potable Reuse (Increase SRT)
    - Discharge Nutrient Limits
        - BACWA Level 2 (15 mg/L of N; 1 mg/L of P)
        - BACWA Level 3 (6 mg/L f N; 0.3 mg/L of P)

Primary Improvements:

- Design Criteria:
    - Maximum hydraulic loading of 3,600 gpd/sf for peak flows
    - Minimum hydraulic retention time of 1.5 hrs at ADWF
- Primaries: Chemical enhancements, baffling and fine screening are alternatives to more concrete tanks
    - — Recommend a more detailed analysis of options.
    - — Consider an incremental approach, through preliminary design process, by evaluating the above alternatives
    - — Need to look at energy balance and carbon capture (impacts on second degree process), also, benefit of avoiding additional chemical storage/handling
    - — How far should the MP take the above evaluation?
        - Say:
            - Need more primary treatment
            - List what the options are
            - Those options could have the following impacts on the MP vision (i.e. adversely affect or change the MP)
            - Give the objective criteria

    To be constructed as soon as possible

Secondary Process

- Alternatives for Addressing Secondary Clarification Capacity Limitations:
  - Additional Secondary Clarifier
  - Year Round Bio-P
  - Membrane Bioreactor
- Membrane Biorector
  - Produces high quality product water amendable to advanced treatment
  - MBR: Consider reducing peak capacity of MBR by maximizing use of secondary clarifiers [more cost effective than assuming 2x pkg on MBR]
  - These are options for MBR effluent disinfection
    - Direct to clean water revival and overflow to CCB
    - Send all toward CWR, but divert portion to exist UV
    - Add UV at MBR location (lower dose)
  - Costs:
    - Check MBR staffing costs
    - Show FTE's when showing staffing
    - MBR capital cost seems high
    - Check MLE (H_2O) cost for level 3 + IFAS, 2 basins plus retrofit of old may not be covered
- Second degree Process/Reuse: Surface water augmentation could require 1 mg/L TN; groundwater recharge could be <10 mg/L TN.
- Timetable: either 10 years out for primary clarifier or Seasonal Bio P alternative. MBR could be driven by 3 mgd potable reuse system.
- Noted: If MBR remains viable, will want to defer building secondary clarifiers as long as possible
- For Board: Need to present complete costs, not bits and pieces; or at least be very clear about what other costs will be triggered for all alternatives

Nutrient Removal:

Nutrient Removal Requirements:

- Reuse Conditioning
  - Secondary Clarifier Effluent Turbidity: 2-5 NTU
  - Nitrogen: <10 mg N/L
  - Timetable still evolving
- BACWA Level 2
  - Secondary Clarifier Effluent Turbidity: 2-5 NTU
  - Nitrogen: <15 mg N/L AMEL
  - <1 mg P/L AMEL
- BACWA Level 3
  - Secondary Clarifier Effluent Turbidity (2-5 NTU)
  - Nitrogen: <6 mg N/L AMEL
  - <0.3 mg P/L AMEL

Additional Phosphorus Removal for BACWA Level 3

- Modify Pumping Station
- Filtration and Disinfection Expansion (16 MGD)

- Actiflo and chemicals to remove particles and P

Sidestream Treatment:

- Sidestream Treatment will not save on liquid stream facilities
- Governed by solids loadings to secondary clarifiers
- Flow EQ will provide for adequate nutrient removal except for BACWA Level 3
- Recommendations:
- Thickening: Sidestream treatment not recommended
- Dewatering (Partial): Conventional nitrification recommended due to cool FSL water contribution
- Dewatering (Full): Deammonification recommended due to warm dewatering water coupled with benefits of deammonification.

Direct/Indirect Potable Reuse

- Go slow. Don't make assumptions about political/social/regulating feasibility. This MP is only trying to support the water reliability vision. It is a 20-year MP, so we are making assumptions only so we can accommodate whatever might end up needed
- Brine could be a significant issue
- Zone 7 has already cautioned retailers that brine may be a limiting factor
- Regulatory Status of Potable Reuse is uncertain
  - Indirect Potable Reuse regulations based on a 6-month buffer are expected to be out by December 2016
  - Direct Potable Reuse regulations are uncertain. The expert panel on DPR Feasibility is expected to occur in December 2016.
- Goals of IPR:
  - Create layout with approximate sizing of facilities needed for IPR and DPR.
  - Identify synergies with other related improvements to be made (such as nutrient removal)
  - Capitalize on Clean Water Revival Facilities
    - May not want to put initial increment at plant, rather than across street to hedge that won't go beyond initial
- Capacity Objectives
  - 3 MGD: maximizing the reuse of existing available infrastructure (clean water revival facilities)
  - 10.5 MGD: Achieve almost zero discharge
- 3 MGD Pretreatment Alternatives
  - No Pretreatment
  - Ozone
  - Nitrify All Secondary Effluent
  - MBR Pretreatment
- 10.5 MGD Pretreatment options
  - Nitrify All Secondary Effluent Given
  - Additional may be Ozone or Ozone plus Biologically Activated Filtration (BAF)

Discussion of Costs

- Cost tales for reuse are extremely important
  - Need thorough critique, peer reviewed
  - Could ultimately be used to establish cost sharing
- For cost comparison to Zone 7, view this water as raw water, at a location, to be conveyed to Zone 7 treatment plant
- Present cost as $/ac-ft

Biosolids

- Solids treatment options
  - High solids digestion
    - Little impact on lifecycle costs
    - More digestion capacity in existing tanks
    - Return stream treatment needed
    - Additional flexibility in space planning
  - Fourth digester
- Solids Disposal (FSLs and DLDs)
  - DLD at capacity for hydraulic loadings
  - FSL VS reduction 50-55 percent
  - No new odor generation
  - Thickening and Dewatering facilities are flexible to go to full dewatering.
- Options for Meeting DLD Limitations
  - All Solids to DLDs
    - Thicken solids to DLDs
    - Omnivore (high solids digestion and thicken solids to DLDs
    - Dewatering portion of solids, rest to DLDs
    - Omnivore, dewatering portion of solids, rest to DLDs
  - SCFI and DLD
    - SCFI, thicken solids to DLDs
    - Omnivore, SCFI, rest to DLDs
    - Thickening to SCFI, rest to DLDs
    - Undigested Sludge to SCFI, rest to DLDs
  - All Solids to Dewatering
    - ~~Dewatering all at WWTP Site~~
    - ~~Omnivore, dewater all at WWTP Site~~
    - Dewatering at FSL Site

Cost Comparisons

- Items needed for District's Considerations:
  - Annual Operating Costs is more important to the existing rate payers
  - Subtract out portion of cost allocation to growth
  - Annualize capital cost of non-growth related improvements

Non-Cost Evaluations

- Resource recovery
  - Water
  - Nitrogen
  - Phosphorous
  - Biosolids
- Ancillary environmental impacts
- Chemical use
- Odor generation potential
- Technology status
- Non-cost evaluation
- Flexibility of footprint
- Quantity of storage lost
- Potential future cost reduction
- Weighing non-cost factors – see m/u of handout

	Operations Priority
Flex of Footprint	1st
Ease of Operation	2nd
Odor Gen	3rd
Chemical Use	4th

- Idea:
  - Just offers a professional opinion about ranking without presenting the detailed table (table is only a working tool)
  - Qualitative discussion:
    - Use energy on writing the justification for Board
  - Team will review table/simplify/weighting

APPENDIX E-4

Visioning Panel Workshop No. 4
Meeting Notes

Subject: Alternative Approaches / Mapping of Relationships Between Drivers

Location: WWTP Ops Admin Training Room, 7315 Johnson Dr, Pleasanton, CA

	Participants	Representing	Email	Phone
JZ	Judy Zavadil	DSRSD	zavadil@dsrsd.com	(925) 875-2272
DM	Dan McIntyre	DSRSD	mcintyre@dsrsd.com	(925) 875-2241
DG	Dan Gallagher	DSRSD	gallagher@dsrsd.com	(925) 875-2345
LF	Levi Fuller	DSRSD	fuller@dsrsd.com	(925) 875-2300
SD	Steve Delight	DSRSD	delight@dsrsd.com	
RB	Rhodora Biagtan	DSRSD	biagtan@dsrsd.com	
BV	Brian Vannatter	DSRSD	vanatter@dsrsd.com	
VS	Virgil Sevilla	DSRSD	sevilla@dsrsd.com	
RP	Rudy Portugal	DSRSD	rportugal@dsrsd.com	
RM	Robyn Mutobe	DSRSD	mutobe@dsrsd.com	
JP	Jeff Pelz	West Yost	jpelz@westyost.com	(530) 792-3259
KG	Kathryn Gies	West Yost	kgies@westyost.com	(925) 949-5815
GC	Greg Chung	West Yost	gchung@westyost.com	
CT	Craig Thompson	West Yost	cthompson@westyost.com	
BW	Bob Whitley	PANEL – Whitley Burchett & Associates	bwhitley@whitleyburchett.com	
JBN	JB Neethling	PANEL -- HDR	JB.Neethling@hdrinc.com	
MF	Mike Falk	PANEL -- HDR	Mike.Falk@hdrinc.com	
DR	Dave Reardon	PANEL -- HDR	Dave.Reardon@hdrinc.com	
GK	Greg Kester	PANEL -- CASA Renewable Resource Prog.	gkester@casaweb.org	
BP	Brian Pecson	PANEL -- Trussell Technologies	brianp@trusselltech.com	

Notes

Primaries:

- Space planning needs to take into account the following:
  - Truck-crane access
  - Chemical truck access
- Primary screening not a desirable technology
- Are baffles warranted?
- If so, possibly consider phased construction:
  - First build new primaries optimized with baffles;
  - Later modify old primaries, if new design proves cost effective
- Preliminary design should include analysis of alum floc removal optimization (in addition to primary solids)

Secondary Process

- Year-round bio P/Alum Addition:
  - — Year-round FSL return flows
  - — Need to bind phosphorous in cap water return piping
  - — Confirm chemistry of recycle streams with new chemical addition won't have unintended consequences (e.g., other precipitates/crystal formation)
    - Phosphate released in digesters will get sucked up
  - — What would cause phosphorus to resolubilize?
    - Hydroxide (alum hydrox) forms and is complexed with phosphate
    - Scott Smith research shows that phosphate remains insoluble (low solubility) between a pH of ~3 and 8
    - Durham and Delta Diablo are examples where phosphate removal chemistry is stable
  - — Struvite formation in FSL cap water return is a problem, therefore a driver for alum now (beyond year-round bio P)
  - — Ferrous addition may be already addressing struvite
    - Need to check phosphate in return stream now (with ferrous to digesters) to see
    - Might be able to maintain or increase ferrous in lieu of adding alum system
  - — Any special improvements needed to ensure primary settling?/Is there a better way to remove floc (better than in primaries)?
    - Lowest cost option is to use primaries
    - Removing in primaries provides additional opportunity w/in digesters to capture more phosphate
- WAS Stripping
  - — WAS Stripping and recovery could also be applied to stabilize bio P process
  - — Overall recovery of influent phosphorous is likely limited to ~40%
  - — Provides phosphorus in reusable form
  - — What capital investment planning is warranted for future phosphorus recovery?
    - As tech advances for phosphorus recovery, could be a game changer and warrant future re-evaluation
    - Space planning is a concern

Nutrient Removal

- Year-round bio P is needed now, and the District either need a 5th secondary clarifier or alum to address secondary capacity, so alum should be added now
- Seasonal Nutrient Removal: Would nutrient removal be needed if reuse is in play?
- Seasonal Limits:
  - — If no potable reuse is in effect, 70 MG of storage
  - — If 3 MGD PR System: 10 MG of storage (No cost)

Reuse

- Reuse: Irrigation reuse needs to be clearly included
  - — Pretreatment Options are a major areas of consideration
  - — 3.0 MGD IPR includes FAT system with the following pretreatment options
    - No Pretreatment
    - Ozone
    - Ozone with BAC
    - Full-Stream Nitrification
    - MBR Pretreatment

    Qualitative comparison shows that Full Scale Nitrification/denitrification should be chosen over parallel MBR (if ozone pretreatment is not chosen)
  - — 10.5 MGD IPR includes FAT system with Full Scale Nitrification/Denitrification and the following pretreatment options
    - Ozone
    - Ozone with BAC
  - — DPR Alternatives add additional chlorine disinfection and storage

Solids Treatment

- Fourth Digester
  - — 15 HRT (days) Drivers:

    = FSL odor control

    = optimized gas production

    ≠ regulatory requirement upstream of FSL
  - — Date of Last Clearing: Digesters 1 and 2 in 2012, Digester 3 in 2013
  - — Next clearing: 5-year interval
  - — Size of 4th Digester
    - Based on solid, loading
    - Now provide capacity when one is out?

        - With CEPT (high prime solids removal, solids local)
    - Conclusion: Build 70-foot Digester with similar Operations to other digesters

- High solids digestion
    - Only on two smaller digesters
    - Requires some different ops
    - Does not eliminate the need for thickening prior to DLD
    - Does not save space
- Comparison of 4th Digester to High Solids Digestion
    - Additional unit cost of hydraulic capacity is higher for high solids digestion system
    - Additional unit cost of VS capacity is lower for the high solids digestion system
    - Recommended to move forward with fourth digester as soon as possible

DLD Capacity

- Solids Handling Considerations:
    - Reuse/recycling vs disposal
    - Where will dewatered solids go: Land application will be increasingly viable
    - Organic diversion from landfills = must do land application (or incineration, but this is unlikely)
    - Increased change to organic farming reduces potential land application
    - U.S.-wide, only 0.2% of ag land receives biosolids [~0.1% is used now]?
    - Some limitations on "wet weather" application
    - Regardless of end point, dewatering is likely first step
- Major Assumptions for All Solids Alternatives
        - DLD at capacity for hydraulic loadings
        - FSLs can accommodate some accumulation while SCFI and other opportunities are further evaluated.
        - Thickening and Dewatering facilities should have flexibility to go to full dewatering
    - Alternatives:
        - Thicken all FSL Solids to DLD
        - Dewater a Portion of Digested Solids
    - Going to Full Dewatering starting with:
        - Partial Thickening
        - Full Thickening
        - Partial Dewatering
    - Considerations:

        - Starting with Partial Dewatering has lowest overall capital costs

    - Implementation Strategy
        - FSL # 6 is estimated to reach the Target max solids percent between the years of 2022 and 2029.
        - By 2018 figure how timeframe to asses FSL Storage capacity
- Consider additional options for dewatering from FSLs
    - FSLs reduce overall volume
    - FSLs reduce volatile content/odors
    - Solids from FSLs to re-use: Could get Synagro to test

SCFI

- Sending SCFI unprocessed solids (no benefits to DSRSD)
- Work with SCFI to determine lowest-cost solids content
- Evaluate the costs compared to other off-site options on per dry ton basis.
- SCFI viability decision should be made by 2018
- Assets and excess capital costs should be easily paid for by avoided costs

Codigestion with FOG:

- Include cost of gas cleaning
- Benefits of FOG Co-Digestion
    - Provides Digester solids reduction, reduce solids generation
    - Study needed to confirm the benefits
    - May buy some time if implemented right away (reduced solids generation)
    - Additional Digester Gas

Solids Return Stream Treatment

- Assuming $10 mil capital Placeholder for Master Plan
- 3 different nitrogen removal options to consider with highly variable advantages/disadvantages (conventional nitrification, deammonification, ammonia recovery)
- Located on Main Plant Site or DLD site
    - Need to consider potential future annamox treatment options

Timeline

- Timeline of Project Decision Points:
  - Liquid Treatment Train:
    - Primary Treatment and Potable Reuse Conditioning (2016-2020)
    - Bay Area Nutrient Limits will be Adopted in 2024
    - Secondary clarifier or alum addition decision can be made after nutrient requirements are better understood. However, there are benefits to implementing alum addition now. Very low cost, so why not?
    - Nutrient Removal (2025-2030)
    - BACWA Level 2 and 3 both require new clarifier AND alum
    - Only one additional aeration basin and alum needed, if potable reuse project has been implemented
  - Potable Reuse:
    - 3.0 MGD IPR (~2018-2020)
    - DPR or Larger IPR (2025-2030)
  - Solids:
    - Digester Capacity (2016-2018)
    - SCFI?
    - DLD/FSL Capacity (2025)
    - Full Dewatering (~2035)
- Evaluation Timeline
  - 0-5 Years:
    - Evaluate Alum Addition, Potable Reuse, FSL Capacity, SCFI
    - Keep eye on emerging nutrient regulations, potable reuse regulations, Co-Digestion opportunities and associated issues
  - 5to 10 Year Recommended Plan:
    - Evaluate: Requirements for nutrient removal, opportunities for Direct Potable Reuse
    - Keep and eye on: emerging nutrient removal technologies
  - 10 to 20 Years:
    - Evaluate: Additional Co-Digestion opportunities
    - Keep an eye on: emerging nutrient recovery technologies.

APPENDIX F

Secondary Process Modeling Approaches:
ENVision and State Point Analysis

HDR's ENVision steady state mass balance program was used to calculate the flows and loads within the plant. A screen capture of the custom-built model for DSRSD is provided in Figure 2. The program provides a mass balance for total suspended solids (TSS), biochemical oxygen demand (BOD), nitrogen species, and phosphorus species throughout the treatment plant using computer models for each process. It provides a reasonable estimate for the process performance, and an accurate measure of the flows and mass balances at various points throughout the plant.

The sub-sections below discuss the calculations associated with each major process element in ENVision. Alkalinity is calculated for processes that impacts alkalinity: nitrification, denitrification, and chemical addition.

1.0 LIQUID STREAM MASS BALANCE APPROACH

This sub-section will describe the calculations associated with each of the unit processes that impact the steady state mass balance liquid stream.

1.1 Raw Influent

The user inputs the influent flow, biochemical oxygen demand (BOD), soluble BOD (sBOD), total suspended solids (TSS), ammonia (NH4), total kjeldahl nitrogen (TKN), and alkalinity. These species are divided in to soluble and particulate components. For example, based on the input values, the particulate BOD (pBOD) is calculated as follows:

$$pBOD = BOD - sBOD \quad (1)$$

1.2 Primary Clarifiers

The Primary Clarifier (PC) steady state mass balance has a single input and two outputs as shown in the simplified Figure 1. The PC feed can exit the primary clarifiers as either liquid or solids. Solids not removed across the primaries leave as primary effluent, whereas solids captured leave as primary sludge. Scum is not accounted for.

Figure 1. Primary Clarifier Inputs/Outputs

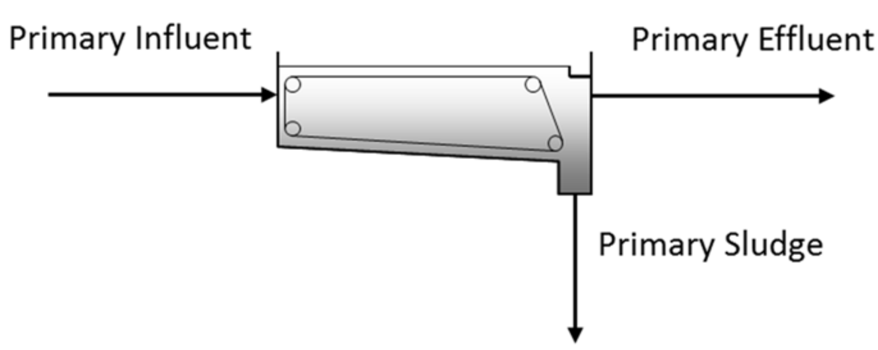


Figure 2. ENVision Steady State Mass Balance Screen Capture

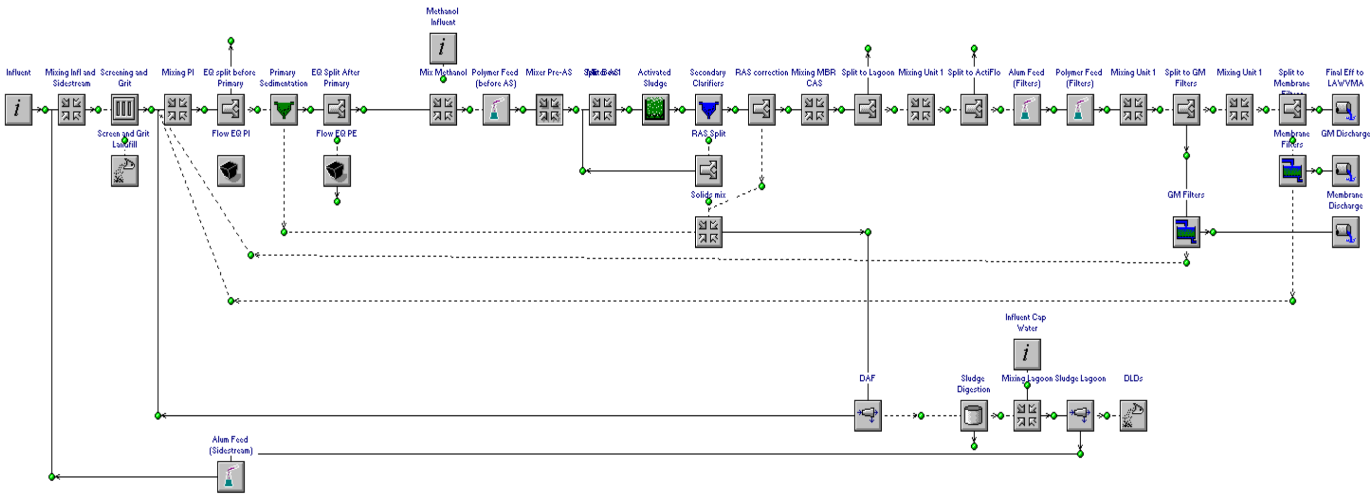
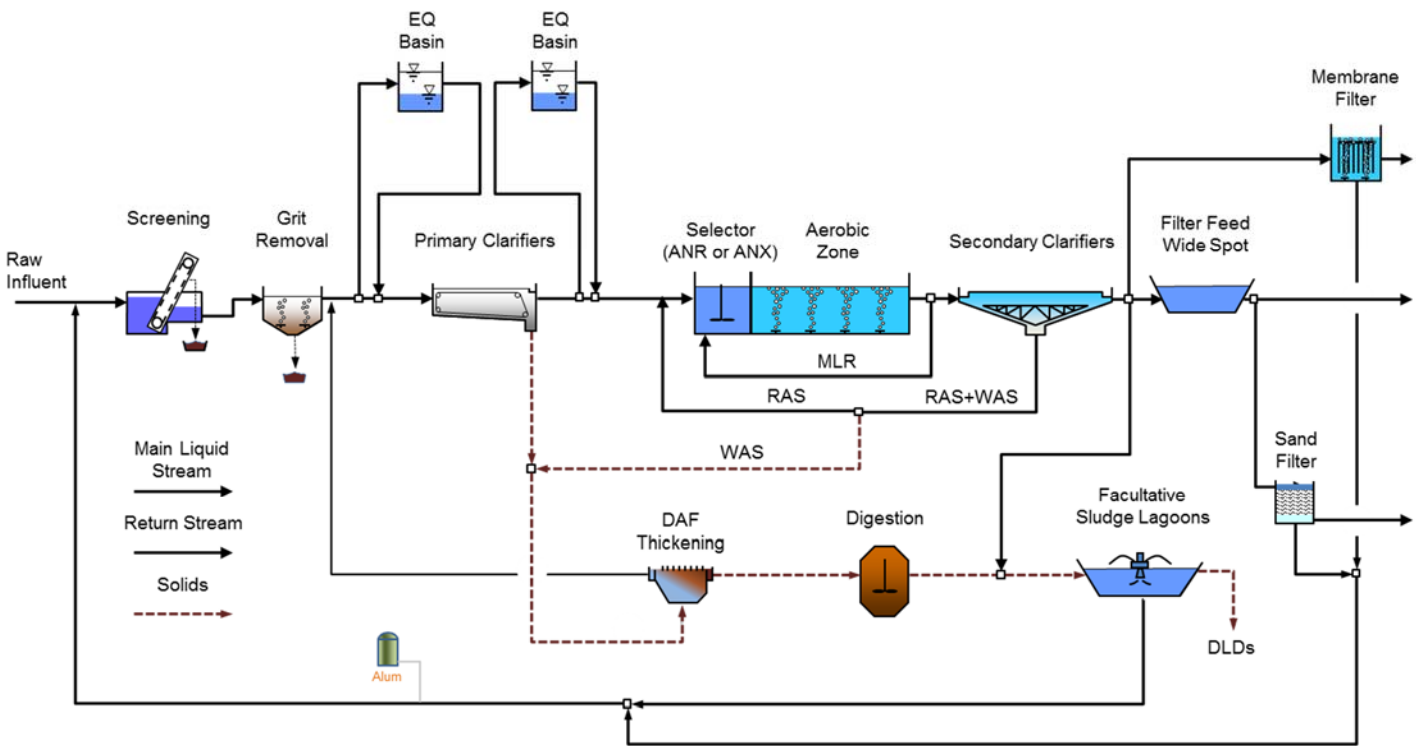


Figure 3. DSRSD Existing Process Schematic



The mass balance calculation requires the following input:

- Dimensions (hydraulic and solids loading rates can be calculated)
- Solids removal percentage across the primaries (based on actual data)
- Primary solids thickness (i.e., % solids) (based on actual data)

  The primary effluent BOD value is determined by the amount of pBOD removed. The model calculates the percentage of pBOD removed based on the solids removal across the primaries.

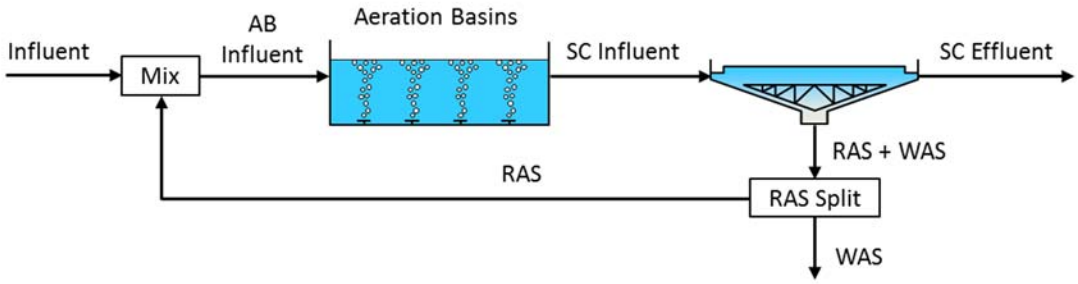
  The primary sludge flow is calculated based on the solids thickness as follows and the solids removal efficiency:

$$Flow = \frac{Primary\ Sludge\ Load\ (\frac{lb}{d})}{Primary\ Sludge\ Thickness\ (mg/L)*8.34} \quad (2)$$

1.3 Secondary Process

The secondary process includes the following elements: aeration basins, secondary clarifiers (SCs), and the return activated sludge (RAS) and waste activated sludge (WAS) pumps as shown in Figure 3. All these elements are interrelated.

Figure 3. Secondary Process Elements



1.3.1 Aeration Basins

The McKinney activated sludge model, introduced in the 1960's by Ross McKinney[1] is used to predict the performance of the activated sludge process. The McKinney model is based on Monod growth kinetics and modified to account for nitrogen and phosphorus removal. This model is well suited for mass balance calculations.

[1] McKinney, R. E. (1962). J. Sanitary Engineering Division, ASCE, 88, 87.

The mass balance calculation requires the following input:

- Dimensions (depth and total volume)
- Anaerobic and anoxic zone fractions
- Aerobic solids residence time (SRT)
- Growth kinetic coefficients (see McKinney1)
- Temperature
- Nitrogen removal is included if the aerobic SRT exceeds the minimum SRT required for nitrification. If so:
  - — Effluent ammonia is set (if aerobic SRT is sufficient for nitrification).
  - — Denitrification percentage (if nitrification and anoxic zone is included) is calculated as a set percentage.
  - — Nitrogen requirements for cell growth are accounted for.
- Aeration requirements are calculated based on the McKinney model predictions for BOD and TSS. Nitrification demand and denitrification credits are accounted for.

  The mixed liquor suspended solids (MLSS) is calculated from the model predictions, SRT, and basin volumes. Alkalinity is adjusted based on the extent of nitrification/denitrification.

1.3.2 Secondary Clarifiers

The SC mass balance calculations calculation requires the following input:

- Dimensions (hydraulic and solids loading rates can be calculated)
- Secondary effluent performance are set by specifying the effluent TSS concentration

The secondary effluent BOD value is determined based on the sBOD and pBOD not removed in the process. The amount of sBOD is based on the McKinney Model calculations, whereas the pBOD is directly related to the amount of TSS in the secondary effluent.

1.3.3 RAS/WAS Pumps

The RAS pump inputs are the RAS rate of return and whether the pumps are flow- or constant-paced flow. The solids, BOD, and other constituent concentrations are based on the RAS rate of return. For example:

$$RAS\ TSS\ Concentration = \frac{1+RAS\ Rate}{RAS\ Rate}(Mixed\ Liquor\ Suspended\ Solids) \qquad (3)$$

An example calculation where the TSS in activated sludge = 2,500 mg/L and the RAS Rate = 50% is as follows:

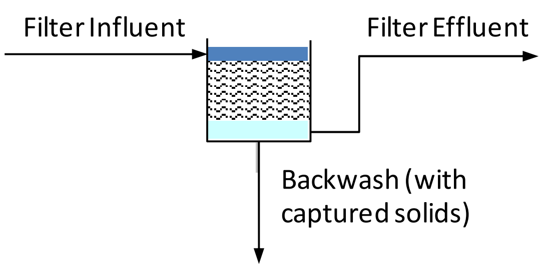
$$\frac{1+0.5}{0.5}\left(2{,}500\,\frac{mg}{L}\right) = 7{,}500\,\frac{mg}{L} \qquad (4)$$

The WAS mass is calculated are directly related to the solids residence time (SRT) as predicted by the McKinney model. Secondary effluent TSS is included in the total waste calculation.

1.4 Filtration

The filtration steady state mass balance has a single input and two outputs as shown in the simplified Figure 4. The filtration feed can exit the process element as either liquid or solids. Solids not removed across the primaries leave as filtration effluent, whereas solids captured leave as filter backwash.

Figure 4. Filtration Inputs/Outputs



The mass balance calculation requires the following input:

- Number of units
- Dimensions (depth and area)
- TSS effluent
- Backwash:
  - Frequency
  - Duration
  - Flow rate

The effluent BOD value is calculated by the amount of pBOD and sBOD. The model calculates the percentage of pBOD removed based on the solids removal across the filter.

1.5 Chlorine Disinfection and Dechlorination

The disinfection (chlorination) and dechlorination (sulfur dioxide) steady state mass balance process elements each has a single input and a single output. The mass balance calculation requires the following input:

- Number of units
- Volume of each unit
- Chlorine or sulfur dioxide dose

The effluent load values for the other constituents (e.g., TSS) should remain the same as the feed values. Alkalinity is adjusted based on the chemical dose.

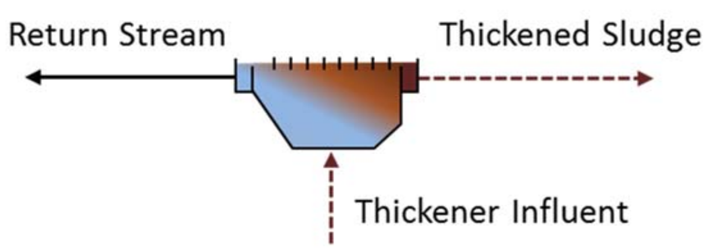
2.0 SOLIDS STREAM MASS BALANCE APPROACH

This sub-section describes the calculations associated with each of the unit processes that impact the steady state mass balance solids streams.

2.1 Waste Activated Sludge Thickeners

The thickener steady state mass balance has a single input and two outputs as shown in the simplified Figure 5. The thickener feed can exit the process element as either liquid or solids. Solids not captured across the thickeners leave as a return stream, whereas solids captured leave as thickened sludge. The DAF model does not account for underflow (settled) solids – typically heavy grit-like particles.

Figure 5. Thickener Inputs/Outputs



The mass balance calculation requires the following input:

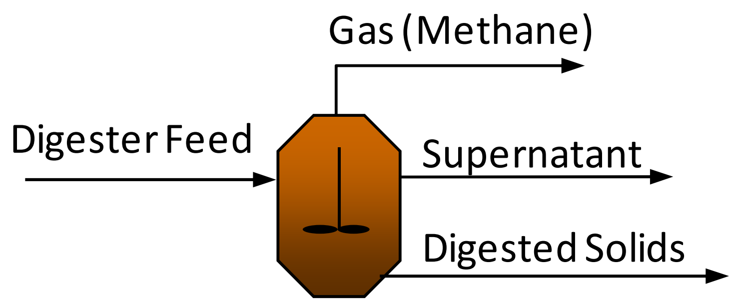
- Number of units
- Dimensions
- Solids capture percentage
- Thickened sludge concentration (percentage of solids)

The thickener return stream effluent BOD value is determined by the amount of pBOD. The model calculates the percentage of pBOD removed based on the solids capture percentage.

2.2 Anaerobic Digestion

The anaerobic digestion steady state mass balance has a single input and three outputs as shown in Figure 6. The digester feed can exit the process element as liquid, solids, or gas. Some digesters include decanting to thicken the solids in the digester. The amount and solids concentration in decant can be specified. The generated gas is calculated as a fraction of the VS destruction. The generated gas is utilized to make energy in the Sacramento Municipal Utility District cogeneration facility on-site.

Figure 6. Anaerobic Digestion Inputs/Outputs



The mass balance calculation requires the following input:

- Number of units
- Dimensions
- Volatile solids (VS) destruction percentage (based on actual data)
- Decant fraction and solids concentration
- Gas production rate and methane composition

2.3 Post-Digestion Solids Handling (Lagoon and Disposal)

The Facultative Sludge Lagoon (FSL) steady state mass balance has a single input and two outputs. The FSL feed can exit the process element as a liquid or solid stream. The liquid stream is a return stream which is only operated under wet weather conditions to control FSL water levels. The mass balance calculation requires the following input:

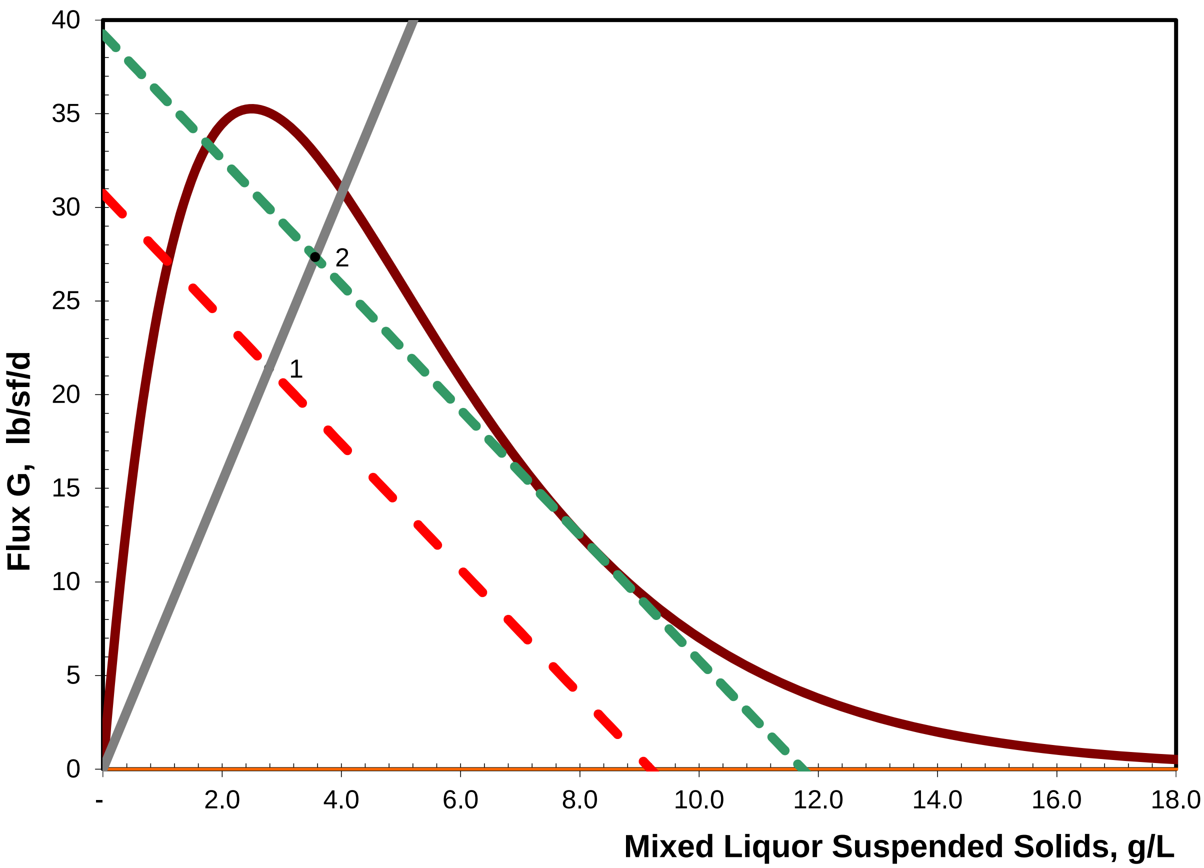
- VS destruction percentage (based on limited actual data)
- Nutrient reduction percentage (based on limited actual data)

The solids stream is sent from the FSL to the Dedicated Land Disposal (DLD) site. The steady state mass balance on the DLD site has a single input and no output, as it is the endpoint for the solids stream.

Performing a mass balance around a secondary clarifier is challenging as mass balances by and large do not consider solids flux that occurs within each clarifier. The tool to analyze the relationship between solids loading rate on the secondaries and the sludge blanket is state point analysis (SPA) model.

SPA is a well-documented and accepted tool for evaluating secondary clarifiers at the Master Planning level. SPA was performed for the alternatives to consider the implications of sludge blanket under all conditions. A plot of a sample SPA is provided in Figure 1. The curved line represents how the solids loading (lb/sf/d) on the clarifier rises and falls as the solids concentration increases. This curved line represents the point in which solids would 'blow' out of the secondaries. The two dashed lines represent the solids and hydraulic loading rates at various concentrations. The solid grey line represents the state point results, whereby the result is determined by where it crosses the dashed lines. In this example, the green dashed line and grey solid cross (listed as 2) represents the critical state point results for this example plot as it is closest to the curved line. The distance between this intersection (listed as 2) and the curved solid line is the safety factor.

Figure 1. Sample State Point Analysis to Determine Secondary Clarifier Capacity

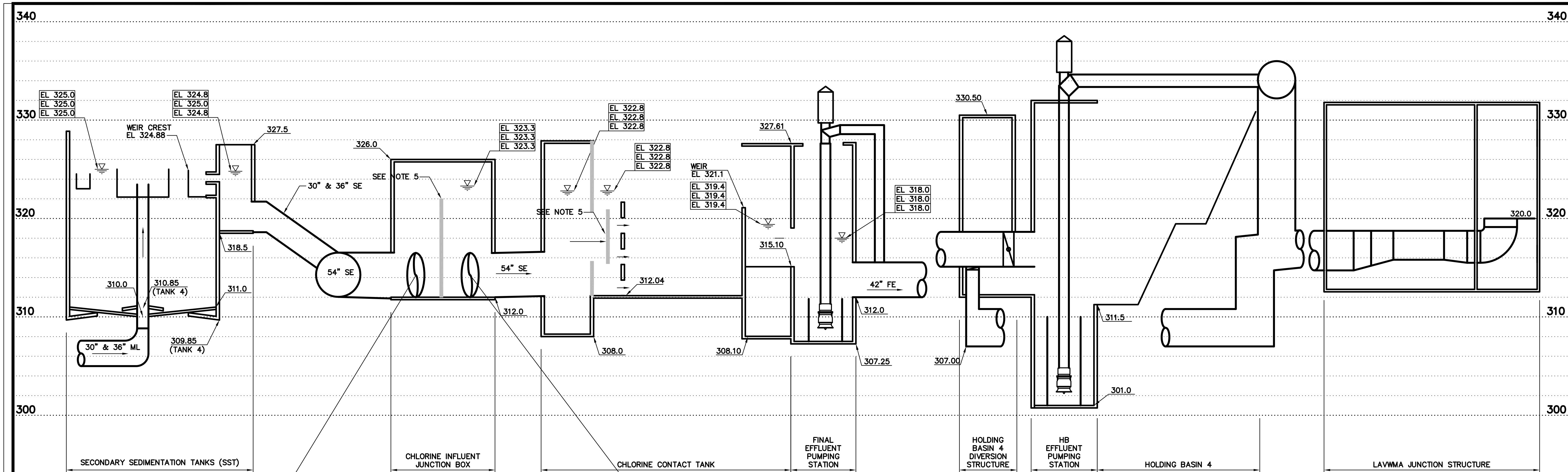


The SPA results provide the following information:

- A “safety factor” which represents the ratio between the solids loading capacity when the clarifier reaches solids limitation and the applied solids loading.
- If the clarifier is solids limited, MLSS is transferred to the clarifier, and the sludge blanket rises. The estimated sludge blanket depth increase is calculated and included in the tabular output.

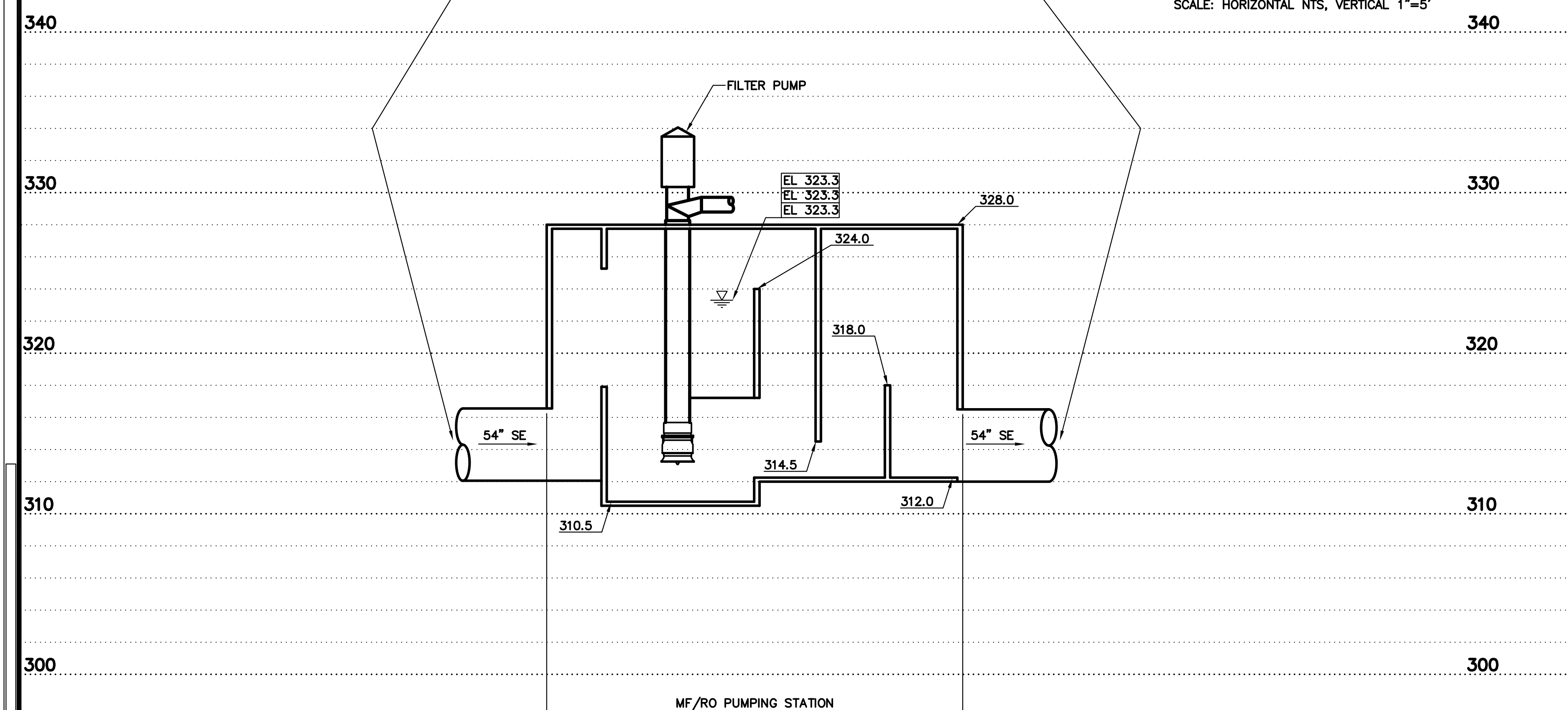
APPENDIX G

WWTP Hydraulic Profile with Hydraulic Constraints Removed



TREATMENT PLANT

SCALE: HORIZONTAL NTS, VERTICAL 1"=5'



NOTES:

1. HYDRAULIC GRADE LINE ELEVATION (IN FEET) ARE AS FOLLOWS:

   PEAK HOUR WET WEATHER FLOW (PWWF5) = 46.7 MGD
   PEAK HOUR WET WEATHER FLOW (PWWF4) = 46.7 MGD
   PEAK FLOW WITH (CLARIFIER) FREE DISCHARGE (PFFD4) = 46.1 MGD

2. THE PWWF5 CONDITION IS BASED ON FIVE SST'S IN SERVICE WITH SE FLOW FROM SST 5 TO THE EXISITING 54" SE PIPING THROUGH A NEW 36" PIPE. UNEQUALIZED PEAK HOUR WET WEATHER FLOW OF 46.7 MGD FROM DRAFT WWTP MASTER PLAN.

3. THE PWWF4 CONDITION IS BASED ON FOUR SST'S IN SERVICE WITH THE EXISTING SE PIPING CONFIGURATION. UNEQUALIZED PEAK HOUR WET WEATHER FLOW OF 46.7 MGD FROM DRAFT WWTP MASTER PLAN.

4. THE PFFD4 CONDITION IS BASED ON FOUR SST'S IN SERVICE WITH THE EXISTING SE PIPING CONFIGURATION. FLOW OF 46.1 MGD MODELED WITH 1-INCH OF FREE OVERFLOW AT THE SECONDARY CLARIFIER WEIRS.

5. THE FOLLOWING HYDRAULIC RESTRICTIONS WERE REMOVED TO MODEL THE FLOWS DETAILED IN NOTE 1: WALL BETWEEN CHLORINE CONTACT TANK INFLUENT CHANNEL AND TANK AND CHLORINE JUNCTION BOX WEIR

6. PWWF5 AND PFFD4 CONDITIONS SHOW FREE OVERFLOW AT THE CLARIFIER EFFLUENT WEIRS. MODEL ASSUMPTIONS SUCH AS PIPE MATERIALS, FRICTION FACTORS, AND MINOR LOSS K-VALUES MAY AFFECT RESULT. GIVEN THE ACCURACY OF HYDRAULIC CALCULATIONS, EFFLUENT WEIRS COULD BECOME SUBMERGED DURING THESE CONDITIONS.

RMC water and environment

DUBLIN SAN RAMON SERVICES DISTRICT

MASTER PLAN HYDRAULIC PROFILE

RText (RText)

APPENDIX H

Cost Estimate Details

APPENDIX H-1

Hydraulic Capacity Related Improvements

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**CMT/CBM**
REVIEWED BY:	**KEG**
DESCRIPTION OF WORK:	**Hydraulic Capacity Related Improvements**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**12/13/2016**

ELEMENT #	DESCRIPTION		COST
1	Remove Wall at CCT Inlet		$60,000
2	Remove Chlorine Junction Box Weir		$40,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$100,000**
	Construction Contingency	10%	$10,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$40,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$150,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Remove Wall at CCT Inlet**
ELEMENT #:	**1**

OPPC PROVIDED BY: TDD
OPPC PREPARATION DATE: 12/13/2016
REVIEWED BY: KEG

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Concrete Wall Demolition	1	LS	$8,000	$8,000	$125	$2,500	$10,000
2	Sluice Gate Demolition	1	LS	$1,500	$1,500	$125	$750	$2,000
3	Target Baffle Demolition	1	LS	$500	$500	$125	$250	$1,000
4	Bypass Pumping	4	days	$3,000	$12,000	$125	$1,000	$10,000
5	Concrete Repair and Coating	1	LS	$1,000	$1,000	$125	$1,500	$3,000
6								
7								
8								
9								
10								
	SUBTOTAL							**$30,000**
	Plant Paving, Grading, and Yard Piping			0%				$0
	Mechanical and Piping			0%				$0
	Electrical			0%				$0
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$30,000**
	Project Phase-Level OPCC Contingency			30%				$10,000
	SUBTOTAL							**$40,000**
	Tax on Materials			9.5%				$2,000
	Contractor's Markup on Sub-Contractors' Work			10%				$0
	Contractor's Overhead and Profit, Mob/Demob			25%				$10,000
	Contractor's General Conditions			10%				$4,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$60,000**
	Construction Contingency			10%				$10,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$20,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$90,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Remove Chlorine Junction Box Weir
ELEMENT #: 2

OPPC PROVIDED BY: TDD
OPPC PREPARATION DATE: 12/13/2016
REVIEWED BY: KEG

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Concrete Wall Demolition	1	LS	$10,000	$10,000	$125	$4,000	$10,000
2	Bypass Pumping	3	days	$3,000	$9,000	$125	$1,000	$10,000
3	Concrete Repair and Coating	1	LS	$1,000	$1,000	$125	$2,000	$3,000
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$20,000**
	Plant Paving, Grading, and Yard Piping			0%				$0
	Mechanical and Piping			0%				$0
	Electrical			0%				$0
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$20,000**
	Project Phase-Level OPCC Contingency			30%				$10,000
	SUBTOTAL							**$30,000**
	Tax on Materials			9.5%				$1,000
	Contractor's Markup on Sub-Contractors' Work			10%				$0
	Contractor's Overhead and Profit, Mob/Demob			25%				$10,000
	Contractor's General Conditions			10%				$3,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$40,000**
	Construction Contingency			10%				$0
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$10,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$50,000**

APPENDIX H-2

Primary Diversion Improvements

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**TDD**
DESCRIPTION OF WORK:	**Primary Flow Diversion Improvements**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/9/2017**

ELEMENT #	DESCRIPTION		COST
1	Primary Flow Diversion Improvements		$135,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$135,000**
	Construction Contingency	10%	$14,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$47,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$196,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Primary Flow Diversion Facilities**
ELEMENT #:	**1**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 6/9/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	24" Rosemount 8750W Utility Magnetic Flow Meter	1	EA	$13,000	$13,000	$5,000	$5,000	$18,000
2	24" DeZurik Eccentric Plug Valve with Rotork Electric Actuator	1	EA	$32,000	$32,000	$6,000	$6,000	$38,000
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$56,000**
	Plant Paving, Grading, and Yard Piping			10%				$6,000
	Mechanical and Piping			5%				$3,000
	Electrical			15%				$8,000
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$73,000**
	Project Phase-Level OPCC Contingency			30%				$22,000
	SUBTOTAL							**$95,000**
	Tax on Materials			9.5%				$5,000
	Contractor's Markup on Sub-Contractors' Work			10%				$1,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$24,000
	Contractor's General Conditions			10%				$10,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$135,000**
	Construction Contingency			10%				$14,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$47,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$196,000**

APPENDIX H-3

Primary Sedimentation Basin Expansion

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Primary Sedimentation Basin Expansion**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1	Primary Sedimentation Basins (3)		$5,400,000
2	Primary Solids Pumps (3)		$1,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$6,700,000**
	Construction Contingency	10%	$700,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$2,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$9,700,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Primary Sedimentation Basins (3)
ELEMENT #: 1

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$470	$40,300	$0	$67,200	$0	$110,000
Division 3	Concrete	$359,400	$423,000	$0	$9,800	$0	$790,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$24,200	$6,300	$0	$300	$0	$30,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$38,900	$0	$0	$40,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$282,600	$47,800	$5,700	$8,700	$0	$340,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$70,800	$0	$0	$70,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$336,800	$154,000	$0	$21,100	$0	$510,000
Division 16	Electrical	$0	$0	$212,500	$0	$0	$210,000
SUBTOTAL		$1,000,000	$670,000	$330,000	$110,000	$0	$2,100,000
Plant Paving, Grading, and Yard Piping				21%			$440,000
Mechanical and Piping				5%			$110,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$320,000
SUBTOTAL							**$2,970,000**
Project Phase-Level OPCC Contingency				30%			$890,000
SUBTOTAL							**$3,860,000**
Tax on Materials				9.5%			$100,000
Contractor's Markup on Sub-Contractors' Work				10%			$30,000
Contractor's Overhead and Profit, Mob/Demob				25%			$970,000
Contractor's General Conditions				10%			$390,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$5,350,000**
Construction Contingency				10%			$540,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$1,870,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$7,760,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Primary Solids Pump (1)
ELEMENT #: 2

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

DESCRIPTION		MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$0	$100	$0	$300	$0	$400
Division 3	Concrete	$900	$900	$0	$100	$0	$2,000
Division 4	Masonry	$4,300	$7,400	$0	$100	$0	$10,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$1,100	$1,000	$0	$0	$0	$2,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$19,300	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$13,600	$3,900	$2,900	$200	$500	$20,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$7,700	$0	$0	$10,000
Division 14	Conveying Systems	$33,400	$3,400	$0	$200	$0	$40,000
Division 15	Mechanical	$40,500	$11,600	$0	$900	$0	$50,000
Division 16	Electrical	$0	$0	$23,000	$0	$0	$20,000
SUBTOTAL		$90,000	$30,000	$50,000	$0	$0	$170,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$30,000
SUBTOTAL							**$230,000**
Project Phase-Level OPCC Contingency				30%			$70,000
SUBTOTAL							**$300,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$80,000
Contractor's General Conditions				10%			$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$430,000**
Construction Contingency				10%			$40,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$150,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$620,000**

APPENDIX H-4

Alternatives for Addressing Secondary Clarifier Capacity Limitations

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alternatives For Addressing Secondary Clarifier Capacity Limitations: Additional Secondary Clarifier**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$9,100,000**
	Construction Contingency	10%	$900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$3,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$13,200,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alternatives For Addressing Secondary Clarifier Capacity Limitations: Alum Addition for Year-Round Anaerobic Selector Operation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
2	Alum Addition at FSLs		$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$500,000**
	Construction Contingency	10%	$50,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$800,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alternatives For Addressing Secondary Clarifier Capacity Limitations: Parallel Stream MBR**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
3	MBR Membrane Tanks		$25,100,000
4	MBR Aeration Basin		$4,400,000
5	MBR Air Supply		$2,900,000
6	Screens for MBR		$2,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$35,000,000**
	Construction Contingency	10%	$3,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$12,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$50,800,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Secondary Clarifier**
ELEMENT #:	**1**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$3,900	$111,500	$0	$171,000	$0	$290,000
Division 3	Concrete	$653,900	$785,000	$0	$28,300	$0	$1,470,000
Division 4	Masonry	$2,700	$6,000	$0	$100	$0	$10,000
Division 5	Metals	$49,400	$17,900	$0	$1,100	$0	$70,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$5,600	$2,700	$0	$0	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$53,300	$6,800	$0	$0	$0	$60,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$607,100	$55,600	$9,800	$14,800	$0	$690,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$133,000	$0	$0	$130,000
Division 14	Conveying Systems	$8,900	$1,500	$0	$0	$0	$10,000
Division 15	Mechanical	$609,900	$113,400	$0	$30,200	$300	$750,000
Division 16	Electrical	$0	$0	$399,000	$0	$0	$400,000
SUBTOTAL		$1,990,000	$1,100,000	$540,000	$250,000	$300	$3,890,000
Plant Paving, Grading, and Yard Piping				10%			$390,000
Mechanical and Piping				5%			$190,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$580,000
SUBTOTAL							**$5,050,000**
Project Phase-Level OPCC Contingency				30%			$1,520,000
SUBTOTAL							**$6,570,000**
Tax on Materials				9.5%			$190,000
Contractor's Markup on Sub-Contractors' Work				10%			$50,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,640,000
Contractor's General Conditions				10%			$660,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$9,110,000**
Construction Contingency				10%			$910,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$3,190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$13,210,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Alum Addition at FSLs**
ELEMENT #:	**2**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$800	$1,300	$0	$1,300	$0	$3,000
Division 3	Concrete	$10,700	$10,800	$0	$300	$0	$20,000
Division 4	Masonry	$9,200	$16,600	$0	$200	$0	$30,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$9,500	$1,300	$0	$0	$0	$10,000
Division 7	Thermal & Moisture Protection	$5,400	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$300	$1,700	$16,700	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$53,900	$7,000	$4,900	$0	$400	$70,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$9,600	$0	$0	$10,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,300	$4,400	$6,600	$0	$0	$30,000
Division 16	Electrical	$0	$0	$28,700	$0	$0	$30,000
SUBTOTAL		$100,000	$50,000	$70,000	$2,000	$400	$230,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$30,000
SUBTOTAL							**$290,000**
Project Phase-Level OPCC Contingency				30%			$90,000
SUBTOTAL							**$380,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$100,000
Contractor's General Conditions				10%			$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$540,000**
Construction Contingency				10%			$50,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$780,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: MBR Membrane Tanks
ELEMENT #: 3

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$42,700	$37,600	$0	$41,300	$0	$120,000
Division 3	Concrete	$115,800	$164,800	$0	$6,100	$0	$290,000
Division 4	Masonry	$43,200	$84,700	$0	$1,100	$0	$130,000
Division 5	Metals	$219,300	$14,500	$0	$2,400	$0	$240,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$21,100	$13,500	$0	$500	$0	$40,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$1,500	$8,500	$15,100	$0	$0	$30,000
Division 10	Specialties	$10,600	$6,700	$0	$0	$0	$20,000
Division 11	Equipment	$5,402,200	$158,300	$0	$16,300	$595,800	$6,170,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$438,100	$0	$0	$440,000
Division 14	Conveying Systems	$123,500	$16,500	$0	$1,000	$0	$140,000
Division 15	Mechanical	$1,379,200	$313,700	$0	$12,100	$0	$1,700,000
Division 16	Electrical	$0	$0	$1,314,200	$0	$0	$1,310,000
SUBTOTAL		$7,360,000	$820,000	$1,770,000	$80,000	$600,000	$10,630,000
Plant Paving, Grading, and Yard Piping				10%			$1,060,000
Mechanical and Piping				5%			$530,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$1,590,000
SUBTOTAL							**$13,810,000**
Project Phase-Level OPCC Contingency				30%			$4,140,000
SUBTOTAL							**$17,950,000**
Tax on Materials				9.5%			$700,000
Contractor's Markup on Sub-Contractors' Work				10%			$180,000
Contractor's Overhead and Profit, Mob/Demob				25%			$4,490,000
Contractor's General Conditions				10%			$1,800,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$25,120,000**
Construction Contingency				10%			$2,510,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$8,790,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$36,420,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**MBR Aeration Basin**
ELEMENT #:	**4**

OPPC PROVIDED BY:	**MWF and GL**
OPPC PREPARATION DATE:	**6/6/2016**
REVIEWED BY:	**JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$2,800	$62,400	$0	$84,800	$0	$150,000
Division 3	Concrete	$385,600	$563,800	$0	$16,800	$0	$970,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$105,300	$19,400	$0	$1,100	$0	$130,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$85,700	$35,700	$4,400	$0	$14,500	$140,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$17,900	$4,100	$76,300	$0	$0	$100,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$103,100	$46,800	$0	$2,600	$0	$150,000
Division 16	Electrical	$0	$0	$228,800	$0	$0	$230,000
SUBTOTAL		$700,000	$730,000	$320,000	$110,000	$10,000	$1,890,000
Plant Paving, Grading, and Yard Piping				10%			$190,000
Mechanical and Piping				5%			$90,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$280,000
SUBTOTAL							**$2,450,000**
Project Phase-Level OPCC Contingency				30%			$740,000
SUBTOTAL							**$3,190,000**
Tax on Materials				9.5%			$70,000
Contractor's Markup on Sub-Contractors' Work				10%			$30,000
Contractor's Overhead and Profit, Mob/Demob				25%			$800,000
Contractor's General Conditions				10%			$320,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,410,000**
Construction Contingency				10%			$440,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$1,540,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,390,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**MBR Air Supply**
ELEMENT #:	**5**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$200	$2,400	$17,900	$2,500	$0	$20,000
Division 3	Concrete	$19,000	$16,600	$0	$1,600	$0	$40,000
Division 4	Masonry	$33,700	$57,400	$0	$800	$0	$90,000
Division 5	Metals	$33,300	$3,500	$0	$1,000	$0	$40,000
Division 6	Woods & Plastics	$1,600	$2,600	$0	$0	$0	$4,000
Division 7	Thermal & Moisture Protection	$10,400	$7,100	$0	$100	$0	$20,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$24,200	$0	$0	$0	$0	$20,000
Division 10	Specialties	$15,600	$9,900	$0	$0	$0	$30,000
Division 11	Equipment	$602,400	$56,500	$0	$26,200	$0	$690,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$50,800	$0	$0	$50,000
Division 14	Conveying Systems	$34,400	$4,300	$0	$200	$0	$40,000
Division 15	Mechanical	$13,500	$4,000	$20,600	$100	$0	$40,000
Division 16	Electrical	$0	$0	$152,300	$0	$0	$150,000
SUBTOTAL		$790,000	$160,000	$240,000	$30,000	$0	$1,230,000
Plant Paving, Grading, and Yard Piping				10%			$120,000
Mechanical and Piping				5%			$60,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$180,000
SUBTOTAL							**$1,590,000**
Project Phase-Level OPCC Contingency				30%			$480,000
SUBTOTAL							**$2,070,000**
Tax on Materials				9.5%			$80,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$520,000
Contractor's General Conditions				10%			$210,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,900,000**
Construction Contingency				10%			$290,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$1,020,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$4,210,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Screens for MBR**
ELEMENT #:	**6**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

DESCRIPTION		MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$80,600	$35,700	$0	$34,400	$0	$150,000
Division 3	Concrete	$28,200	$45,900	$0	$1,400	$0	$80,000
Division 4	Masonry	$8,000	$14,700	$0	$200	$0	$20,000
Division 5	Metals	$4,800	$1,700	$0	$100	$0	$10,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$2,600	$2,100	$0	$100	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$33,200	$0	$0	$0	$0	$30,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$558,600	$24,600	$0	$2,800	$0	$590,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$46,700	$0	$0	$50,000
Division 14	Conveying Systems	$31,300	$3,200	$0	$200	$0	$30,000
Division 15	Mechanical	$3,900	$6,800	$0	$1,500	$0	$10,000
Division 16	Electrical	$0	$0	$112,000	$0	$0	$110,000
SUBTOTAL		$750,000	$130,000	$160,000	$40,000	$0	$1,080,000
Plant Paving, Grading, and Yard Piping				10%			$110,000
Mechanical and Piping				5%			$50,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$160,000
SUBTOTAL							**$1,400,000**
Project Phase-Level OPCC Contingency				30%			$420,000
SUBTOTAL							**$1,820,000**
Tax on Materials				9.5%			$70,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$460,000
Contractor's General Conditions				10%			$180,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,550,000**
Construction Contingency				10%			$260,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$890,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,700,000**

APPENDIX H-5-i

Potential Future Nutrient Removal Improvements:
Potable Reuse Conditioning

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Additional Secondary Clarifier → Potable Reuse Conditioning**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (2)		$13,100,000
2	MLE/IFAS Air Supply		$2,700,000
3	Chlorination System Improvements		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$15,900,000**
	Construction Contingency	10%	$1,600,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$5,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$23,100,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alum Addition for Year-Round Anaerobic Selector Operation → Potable Reuse Conditioning**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (2)		$13,100,000
2	MLE/IFAS Air Supply		$2,700,000
3	Chlorination System Improvements		$100,000
4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$25,000,000**
	Construction Contingency	10%	$2,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$8,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$36,300,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Parallel Stream Membrane Bioreactor (MBR) → Potable Reuse Conditioning**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-2	Aeration Basin (1)		$8,500,000
3	Chlorination System Improvements		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$8,600,000**
	Construction Contingency	10%	$900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$3,000,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$12,500,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Aeration Basins (2)
ELEMENT #: 1-1

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$1,300	$93,300	$0	$154,700	$0	$250,000
Division 3	Concrete	$898,000	$1,379,600	$0	$40,100	$0	$2,320,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$73,600	$17,400	$0	$1,000	$0	$90,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$1,010,200	$170,800	$77,300	$0	$9,800	$1,270,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$227,800	$0	$0	$230,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$555,900	$170,100	$0	$20,400	$0	$750,000
Division 16	Electrical	$0	$0	$683,300	$0	$0	$680,000
SUBTOTAL		$2,540,000	$1,830,000	$1,000,000	$220,000	$10,000	$5,610,000
Plant Paving, Grading, and Yard Piping				10%			$560,000
Mechanical and Piping				5%			$280,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$840,000
SUBTOTAL							**$7,290,000**
Project Phase-Level OPCC Contingency				30%			$2,190,000
SUBTOTAL							**$9,480,000**
Tax on Materials				9.5%			$240,000
Contractor's Markup on Sub-Contractors' Work				10%			$100,000
Contractor's Overhead and Profit, Mob/Demob				25%			$2,370,000
Contractor's General Conditions				10%			$950,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$13,140,000**
Construction Contingency				10%			$1,310,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$4,600,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$19,050,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Aeration Basin (1)**
ELEMENT #:	**1-2**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$900	$53,500	$0	$88,600	$0	$140,000
Division 3	Concrete	$542,100	$861,600	$0	$23,800	$0	$1,430,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$47,800	$11,500	$0	$600	$0	$60,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$788,800	$119,100	$64,800	$0	$8,200	$980,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$148,000	$0	$0	$150,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$293,600	$105,200	$0	$10,700	$0	$410,000
Division 16	Electrical	$0	$0	$444,000	$0	$0	$440,000
SUBTOTAL		$1,670,000	$1,150,000	$670,000	$120,000	$10,000	$3,630,000
Plant Paving, Grading, and Yard Piping				10%			$360,000
Mechanical and Piping				5%			$180,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$540,000
SUBTOTAL							**$4,710,000**
Project Phase-Level OPCC Contingency				30%			$1,410,000
SUBTOTAL							**$6,120,000**
Tax on Materials				9.5%			$160,000
Contractor's Markup on Sub-Contractors' Work				10%			$70,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,530,000
Contractor's General Conditions				10%			$610,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$8,490,000**
Construction Contingency				10%			$850,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$2,970,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$12,310,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: MLE/IFAS Air Supply
ELEMENT #: 2

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

DESCRIPTION		MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$200	$2,200	$17,900	$2,300	$0	$20,000
Division 3	Concrete	$5,000	$5,000	$0	$1,500	$0	$10,000
Division 4	Masonry	$0	$54,600	$0	$700	$0	$60,000
Division 5	Metals	$10,000	$3,300	$0	$900	$0	$10,000
Division 6	Woods & Plastics	$1,500	$2,400	$0	$0	$0	$4,000
Division 7	Thermal & Moisture Protection	$6,000	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$10,000	$0	$0	$0	$0	$10,000
Division 10	Specialties	$14,100	$8,900	$0	$0	$0	$20,000
Division 11	Equipment	$800,000	$50,900	$0	$23,600	$0	$870,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$44,100	$0	$0	$40,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,900	$4,500	$19,400	$100	$0	$40,000
Division 16	Electrical	$0	$0	$132,300	$0	$0	$130,000
SUBTOTAL		$860,000	$140,000	$210,000	$30,000	$0	$1,220,000
Plant Paving, Grading, and Yard Piping				0%			$0
Mechanical and Piping				5%			$60,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$180,000
SUBTOTAL							**$1,460,000**
Project Phase-Level OPCC Contingency				30%			$440,000
SUBTOTAL							**$1,900,000**
Tax on Materials				9.5%			$80,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$480,000
Contractor's General Conditions				10%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,670,000**
Construction Contingency				10%			$270,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$930,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,870,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Chlorine System Improvements**
ELEMENT #:	**3**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 8/9/2016
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	3 sets of Schedule 80 PVC Pipe (3/4" Diameter) (500 LF EA)	1,500	LF	$1	$750	$1	$800	$1,500
2	PVC Fittings	1	LS	$188	$200	$188	$200	$400
3	ATI 3-electrode Probe Total Chlorine Monitor + Flow Cell + Panel	3	EA	$3,700	$11,100	$5,550	$5,550	$20,000
4	Sample Pump	3	EA	$1,000	$3,000	$1,500	$1,500	$5,000
5	Input/Output card for (E) PLC	1	EA	$500	$500	$1,500	$1,500	$1,500
6	3 sets of of Twisted Shielded Pair Signal wire & conduit (500 LF EA)	1,500	LF	$4	$5,250	$15,750	$15,750	$20,000
7								
8								
9								
10								
	SUBTOTAL							**$48,000**
	Plant Paving, Grading, and Yard Piping			10%				$5,000
	Mechanical and Piping			5%				$2,000
	Electrical			15%				$10,000
	Instrumentation and Controls			15%				$10,000
	SUBTOTAL							**$80,000**
	Project Phase-Level OPCC Contingency			30%				$20,000
	SUBTOTAL							**$100,000**
	Tax on Materials			9.5%				$5,000
	Contractor's Markup on Sub-Contractors' Work			10%				$2,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$25,000
	Contractor's General Conditions			10%				$10,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$140,000**
	Construction Contingency			10%				$10,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$200,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Secondary Clarifier**
ELEMENT #:	**4**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$3,900	$111,500	$0	$171,000	$0	$290,000
Division 3	Concrete	$653,900	$785,000	$0	$28,300	$0	$1,470,000
Division 4	Masonry	$2,700	$6,000	$0	$100	$0	$10,000
Division 5	Metals	$49,400	$17,900	$0	$1,100	$0	$70,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$5,600	$2,700	$0	$0	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$53,300	$6,800	$0	$0	$0	$60,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$607,100	$55,600	$9,800	$14,800	$0	$690,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$133,000	$0	$0	$130,000
Division 14	Conveying Systems	$8,900	$1,500	$0	$0	$0	$10,000
Division 15	Mechanical	$609,900	$113,400	$0	$30,200	$300	$750,000
Division 16	Electrical	$0	$0	$399,000	$0	$0	$400,000
SUBTOTAL		$1,990,000	$1,100,000	$540,000	$250,000	$300	$3,890,000
Plant Paving, Grading, and Yard Piping				10%			$390,000
Mechanical and Piping				5%			$190,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$580,000
SUBTOTAL							**$5,050,000**
Project Phase-Level OPCC Contingency				30%			$1,520,000
SUBTOTAL							**$6,570,000**
Tax on Materials				9.5%			$190,000
Contractor's Markup on Sub-Contractors' Work				10%			$50,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,640,000
Contractor's General Conditions				10%			$660,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$9,110,000**
Construction Contingency				10%			$910,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$3,190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$13,210,000**

APPENDIX H-5-ii

Potential Future Nutrient Removal Improvements:
BACWA Level 2

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Additional Secondary Clarifier → BACWA Level 2**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (3)		$17,600,000
2	MLE/IFAS Air Supply		$2,700,000
3	Chlorination System Improvements		$100,000
4	Alum Addition at FSLs		$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$20,900,000**
	Construction Contingency	10%	$2,100,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$7,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$30,300,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alum Addition for Year-Round Anaerobic Selector Operation → BACWA Level 2**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (3)		$17,600,000
2	MLE/IFAS Air Supply		$2,700,000
3	Chlorination System Improvements		$100,000
5	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$29,500,000**
	Construction Contingency	10%	$3,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$10,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$42,800,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Parallel Stream Membrane Bioreactor (MBR) → BACWA Level 2**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-2	Aeration Basins (2)		$13,100,000
3	Chlorination System Improvements		$100,000
4	Alum Addition at FSLs		$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$13,700,000**
	Construction Contingency	10%	$1,400,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$4,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$19,900,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Aeration Basins (3)
ELEMENT #: 1-1

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$1,700	$132,500	$0	$219,900	$0	$350,000
Division 3	Concrete	$1,245,100	$1,881,500	$0	$56,200	$0	$3,180,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$98,500	$23,100	$0	$1,300	$0	$120,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$1,223,200	$221,400	$89,100	$0	$11,300	$1,550,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$305,800	$0	$0	$310,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$820,900	$233,700	$0	$30,200	$0	$1,080,000
Division 16	Electrical	$0	$0	$917,300	$0	$0	$920,000
SUBTOTAL		$3,390,000	$2,490,000	$1,330,000	$310,000	$10,000	$7,530,000
Plant Paving, Grading, and Yard Piping				10%			$750,000
Mechanical and Piping				5%			$380,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$1,130,000
SUBTOTAL							**$9,790,000**
Project Phase-Level OPCC Contingency				30%			$2,940,000
SUBTOTAL							**$12,730,000**
Tax on Materials				9.5%			$320,000
Contractor's Markup on Sub-Contractors' Work				10%			$130,000
Contractor's Overhead and Profit, Mob/Demob				25%			$3,180,000
Contractor's General Conditions				10%			$1,270,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$17,630,000**
Construction Contingency				10%			$1,760,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$6,170,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$25,560,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Aeration Basins (2)**
ELEMENT #:	**1-2**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

DESCRIPTION		MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$1,300	$93,300	$0	$154,700	$0	$250,000
Division 3	Concrete	$898,000	$1,379,600	$0	$40,100	$0	$2,320,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$73,600	$17,400	$0	$1,000	$0	$90,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$1,010,200	$170,800	$77,300	$0	$9,800	$1,270,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$227,800	$0	$0	$230,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$555,900	$170,100	$0	$20,400	$0	$750,000
Division 16	Electrical	$0	$0	$683,300	$0	$0	$680,000
SUBTOTAL		$2,540,000	$1,830,000	$1,000,000	$220,000	$10,000	$5,610,000
Plant Paving, Grading, and Yard Piping				10%			$560,000
Mechanical and Piping				5%			$280,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$840,000
SUBTOTAL							**$7,290,000**
Project Phase-Level OPCC Contingency				30%			$2,190,000
SUBTOTAL							**$9,480,000**
Tax on Materials				9.5%			$240,000
Contractor's Markup on Sub-Contractors' Work				10%			$100,000
Contractor's Overhead and Profit, Mob/Demob				25%			$2,370,000
Contractor's General Conditions				10%			$950,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$13,140,000**
Construction Contingency				10%			$1,310,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$4,600,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$19,050,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**MLE/IFAS Air Supply**
ELEMENT #:	**2**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$200	$2,200	$17,900	$2,300	$0	$20,000
Division 3	Concrete	$5,000	$5,000	$0	$1,500	$0	$10,000
Division 4	Masonry	$0	$54,600	$0	$700	$0	$60,000
Division 5	Metals	$10,000	$3,300	$0	$900	$0	$10,000
Division 6	Woods & Plastics	$1,500	$2,400	$0	$0	$0	$4,000
Division 7	Thermal & Moisture Protection	$6,000	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$10,000	$0	$0	$0	$0	$10,000
Division 10	Specialties	$14,100	$8,900	$0	$0	$0	$20,000
Division 11	Equipment	$800,000	$50,900	$0	$23,600	$0	$870,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$44,100	$0	$0	$40,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,900	$4,500	$19,400	$100	$0	$40,000
Division 16	Electrical	$0	$0	$132,300	$0	$0	$130,000
SUBTOTAL		$860,000	$140,000	$210,000	$30,000	$0	$1,220,000
Plant Paving, Grading, and Yard Piping				0%			$0
Mechanical and Piping				5%			$60,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$180,000
SUBTOTAL							**$1,460,000**
Project Phase-Level OPCC Contingency				30%			$440,000
SUBTOTAL							**$1,900,000**
Tax on Materials				9.5%			$80,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$480,000
Contractor's General Conditions				10%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,670,000**
Construction Contingency				10%			$270,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$930,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,870,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Chlorine System Improvements
ELEMENT #: 3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 8/9/2016
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	3 sets of Schedule 80 PVC Pipe (3/4" Diameter) (500 LF EA)	1,500	LF	$1	$750	$1	$800	$1,500
2	PVC Fittings	1	LS	$188	$200	$188	$200	$400
3	ATI 3-electrode Probe Total Chlorine Monitor + Flow Cell + Panel	3	EA	$3,700	$11,100	$5,550	$5,550	$20,000
4	Sample Pump	3	EA	$1,000	$3,000	$1,500	$1,500	$5,000
5	Input/Output card for (E) PLC	1	EA	$500	$500	$1,500	$1,500	$1,500
6	3 sets of of Twisted Shielded Pair Signal wire & conduit (500 LF EA)	1,500	LF	$4	$5,250	$15,750	$15,750	$20,000
7								
8								
9								
10								
	SUBTOTAL							**$48,000**
	Plant Paving, Grading, and Yard Piping			10%				$5,000
	Mechanical and Piping			5%				$2,000
	Electrical			15%				$10,000
	Instrumentation and Controls			15%				$10,000
	SUBTOTAL							**$80,000**
	Project Phase-Level OPCC Contingency			30%				$20,000
	SUBTOTAL							**$100,000**
	Tax on Materials			9.5%				$5,000
	Contractor's Markup on Sub-Contractors' Work			10%				$2,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$25,000
	Contractor's General Conditions			10%				$10,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$140,000**
	Construction Contingency			10%				$10,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$200,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Alum Addition at FSLs**
ELEMENT #:	**4**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$800	$1,300	$0	$1,300	$0	$3,000
Division 3	Concrete	$10,700	$10,800	$0	$300	$0	$20,000
Division 4	Masonry	$9,200	$16,600	$0	$200	$0	$30,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$9,500	$1,300	$0	$0	$0	$10,000
Division 7	Thermal & Moisture Protection	$5,400	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$300	$1,700	$16,700	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$53,900	$7,000	$4,900	$0	$400	$70,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$9,600	$0	$0	$10,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,300	$4,400	$6,600	$0	$0	$30,000
Division 16	Electrical	$0	$0	$28,700	$0	$0	$30,000
SUBTOTAL		$100,000	$50,000	$70,000	$2,000	$400	$230,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$30,000
SUBTOTAL							**$290,000**
Project Phase-Level OPCC Contingency				30%			$90,000
SUBTOTAL							**$380,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$100,000
Contractor's General Conditions				10%			$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$540,000**
Construction Contingency				10%			$50,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$780,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Secondary Clarifier**
ELEMENT #:	**5**

OPPC PROVIDED BY: **MWF and GL**
OPPC PREPARATION DATE: **6/6/2016**
REVIEWED BY: **JBN**

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$3,900	$111,500	$0	$171,000	$0	$290,000
Division 3	Concrete	$653,900	$785,000	$0	$28,300	$0	$1,470,000
Division 4	Masonry	$2,700	$6,000	$0	$100	$0	$10,000
Division 5	Metals	$49,400	$17,900	$0	$1,100	$0	$70,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$5,600	$2,700	$0	$0	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$53,300	$6,800	$0	$0	$0	$60,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$607,100	$55,600	$9,800	$14,800	$0	$690,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$133,000	$0	$0	$130,000
Division 14	Conveying Systems	$8,900	$1,500	$0	$0	$0	$10,000
Division 15	Mechanical	$609,900	$113,400	$0	$30,200	$300	$750,000
Division 16	Electrical	$0	$0	$399,000	$0	$0	$400,000
SUBTOTAL		$1,990,000	$1,100,000	$540,000	$250,000	$300	$3,890,000
Plant Paving, Grading, and Yard Piping				10%			$390,000
Mechanical and Piping				5%			$190,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$580,000
SUBTOTAL							**$5,050,000**
Project Phase-Level OPCC Contingency				30%			$1,520,000
SUBTOTAL							**$6,570,000**
Tax on Materials				9.5%			$190,000
Contractor's Markup on Sub-Contractors' Work				10%			$50,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,640,000
Contractor's General Conditions				10%			$660,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$9,110,000**
Construction Contingency				10%			$910,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$3,190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$13,210,000**

APPENDIX H-5-iii

Potential Future Nutrient Removal Improvements:
BACWA Level 3

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
PROJECT #:	406-19-15-39
OPPC MANAGER	DJR
REVIEWED BY:	JBN
DESCRIPTION OF WORK:	Additional Secondary Clarifier → BACWA Level 3
TYPE OF ESTIMATE:	Conceptual Design Level Construction Cost
DATE:	6/6/2016

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (5)		$24,400,000
2	MLE/IFAS Air Supply		$2,700,000
3	Alum Addition at FSLs		$500,000
4	IFAS Media		$5,700,000
5	Methanol Addition		$1,400,000
6	Tertiary Facility Modifications		$4,200,000
	High Strength Return Stream Treatment		
8	Reactor		$7,300,000
9	Air Supply		$1,800,000
10	Pumps		$400,000
11	Alkalinity		$600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$49,000,000**
	Construction Contingency	10%	$4,900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$17,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$71,100,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Alum Addition for Year-Round Anaerobic Selector Operation → BACWA Level 3**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-1	Aeration Basins (5)		$24,400,000
2	MLE/IFAS Air Supply		$2,700,000
4	IFAS Media		$5,700,000
5	Methanol Addition		$1,400,000
6	Tertiary Facility Modifications		$4,200,000
7	Secondary Clarifier		$9,100,000
	High Strength Return Stream Treatment		
8	Reactor		$7,300,000
9	Air Supply		$1,800,000
10	Pumps		$400,000
11	Alkalinity		$600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$57,600,000**
	Construction Contingency	10%	$5,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$20,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$83,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**DJR**
REVIEWED BY:	**JBN**
DESCRIPTION OF WORK:	**Parallel Stream Membrane Bioreactor (MBR) → BACWA Level 3**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**6/6/2016**

ELEMENT #	DESCRIPTION		COST
1-2	Aeration Basins (4)		$21,000,000
3	Alum Addition at FSLs		$500,000
5	Methanol Addition		$1,400,000
6	Tertiary Facility Modifications		$4,200,000
	High Strength Return Stream Treatment		
8	Reactor		$7,300,000
9	Air Supply		$1,800,000
10	Pumps		$400,000
11	Alkalinity		$600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$37,200,000**
	Construction Contingency	10%	$3,700,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$13,000,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$53,900,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Aeration Basins (5)**
ELEMENT #:	**1-1**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$2,100	$198,800	$0	$330,400	$0	$530,000
Division 3	Concrete	$1,747,600	$2,530,700	$0	$80,600	$0	$4,360,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$126,700	$29,500	$0	$1,600	$0	$160,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$1,467,300	$299,700	$96,400	$0	$12,200	$1,880,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$422,200	$0	$0	$420,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$1,411,400	$332,700	$0	$50,000	$0	$1,790,000
Division 16	Electrical	$0	$0	$1,266,700	$0	$0	$1,270,000
SUBTOTAL		$4,760,000	$3,390,000	$1,800,000	$460,000	$10,000	$10,430,000
Plant Paving, Grading, and Yard Piping				10%			$1,040,000
Mechanical and Piping				5%			$520,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$1,560,000
SUBTOTAL							**$13,550,000**
Project Phase-Level OPCC Contingency				30%			$4,070,000
SUBTOTAL							**$17,620,000**
Tax on Materials				9.5%			$450,000
Contractor's Markup on Sub-Contractors' Work				10%			$180,000
Contractor's Overhead and Profit, Mob/Demob				25%			$4,410,000
Contractor's General Conditions				10%			$1,760,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$24,420,000**
Construction Contingency				10%			$2,440,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$8,550,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$35,410,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Aeration Basins (4)
ELEMENT #: 1-2

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$1,900	$165,700	$0	$275,200	$0	$440,000
Division 3	Concrete	$1,496,400	$2,206,100	$0	$68,400	$0	$3,770,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$112,600	$26,300	$0	$1,400	$0	$140,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$1,345,300	$260,500	$92,800	$0	$11,800	$1,710,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$364,000	$0	$0	$360,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$1,116,100	$283,200	$0	$40,100	$0	$1,440,000
Division 16	Electrical	$0	$0	$1,092,000	$0	$0	$1,090,000
SUBTOTAL		$4,070,000	$2,940,000	$1,560,000	$390,000	$10,000	$8,970,000
Plant Paving, Grading, and Yard Piping				10%			$900,000
Mechanical and Piping				5%			$450,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$1,350,000
SUBTOTAL							**$11,670,000**
Project Phase-Level OPCC Contingency				30%			$3,500,000
SUBTOTAL							**$15,170,000**
Tax on Materials				9.5%			$390,000
Contractor's Markup on Sub-Contractors' Work				10%			$156,000
Contractor's Overhead and Profit, Mob/Demob				25%			$3,790,000
Contractor's General Conditions				10%			$1,520,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$21,026,000**
Construction Contingency				10%			$2,100,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$7,360,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$30,486,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	MLE/IFAS Air Supply
ELEMENT #:	2

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$200	$2,200	$17,900	$2,300	$0	$20,000
Division 3	Concrete	$5,000	$5,000	$0	$1,500	$0	$10,000
Division 4	Masonry	$0	$54,600	$0	$700	$0	$60,000
Division 5	Metals	$10,000	$3,300	$0	$900	$0	$10,000
Division 6	Woods & Plastics	$1,500	$2,400	$0	$0	$0	$4,000
Division 7	Thermal & Moisture Protection	$6,000	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$10,000	$0	$0	$0	$0	$10,000
Division 10	Specialties	$14,100	$8,900	$0	$0	$0	$20,000
Division 11	Equipment	$800,000	$50,900	$0	$23,600	$0	$870,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$44,100	$0	$0	$40,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,900	$4,500	$19,400	$100	$0	$40,000
Division 16	Electrical	$0	$0	$132,300	$0	$0	$130,000
SUBTOTAL		$860,000	$140,000	$210,000	$30,000	$0	$1,220,000
Plant Paving, Grading, and Yard Piping				0%			$0
Mechanical and Piping				5%			$60,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$180,000
SUBTOTAL							**$1,460,000**
Project Phase-Level OPCC Contingency				30%			$440,000
SUBTOTAL							**$1,900,000**
Tax on Materials				9.5%			$80,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$480,000
Contractor's General Conditions				10%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,670,000**
Construction Contingency				10%			$270,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$930,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,870,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Alum Addition at FSLs
ELEMENT #: 3

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$800	$1,300	$0	$1,300	$0	$3,000
Division 3	Concrete	$10,700	$10,800	$0	$300	$0	$20,000
Division 4	Masonry	$9,200	$16,600	$0	$200	$0	$30,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$9,500	$1,300	$0	$0	$0	$10,000
Division 7	Thermal & Moisture Protection	$5,400	$3,900	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$300	$1,700	$16,700	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$53,900	$7,000	$4,900	$0	$400	$70,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$9,600	$0	$0	$10,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$14,300	$4,400	$6,600	$0	$0	$30,000
Division 16	Electrical	$0	$0	$28,700	$0	$0	$30,000
SUBTOTAL		$100,000	$50,000	$70,000	$2,000	$400	$230,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$30,000
SUBTOTAL							**$290,000**
Project Phase-Level OPCC Contingency				30%			$90,000
SUBTOTAL							**$380,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$100,000
Contractor's General Conditions				10%			$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$540,000**
Construction Contingency				10%			$50,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$780,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	IFAS Media
ELEMENT #:	4

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction						$0
Division 3	Concrete						$0
Division 4	Masonry						$0
Division 5	Metals						$0
Division 6	Woods & Plastics						$0
Division 7	Thermal & Moisture Protection						$0
Division 8	Doors & Windows						$0
Division 9	Finishes						$0
Division 10	Specialties						$0
Division 11	Equipment						$0
Division 12	Furnishings						$0
Division 13	Special Construction						$0
Division 14	Conveying Systems						$0
Division 15	Mechanical						$0
Division 16	Electrical						$0
SUBTOTAL		$0	$0	$0	$0	$0	$0
Plant Paving, Grading, and Yard Piping				10%			$0
Mechanical and Piping				5%			$0
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$0
SUBTOTAL							**$0**
Project Phase-Level OPCC Contingency				30%			$0
SUBTOTAL							**$0**
Tax on Materials				9.5%			$0
Contractor's Markup on Sub-Contractors' Work				10%			$0
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.				25%			$0
Contractor's General Conditions				10%			$0
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$5,660,000**
Construction Contingency				10%			$570,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$1,980,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$8,210,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Methanol Addition
ELEMENT #: 5

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$2,000	$3,200	$0	$3,200	$0	$10,000
Division 3	Concrete	$34,700	$36,500	$0	$1,000	$0	$70,000
Division 4	Masonry	$24,700	$45,200	$0	$600	$0	$70,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$29,100	$3,900	$0	$0	$0	$30,000
Division 7	Thermal & Moisture Protection	$15,000	$9,700	$0	$400	$0	$30,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$900	$4,700	$16,700	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$79,800	$11,600	$4,900	$0	$500	$100,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$21,100	$0	$0	$20,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$48,000	$14,800	$20,400	$0	$0	$80,000
Division 16	Electrical	$0	$0	$63,200	$0	$0	$60,000
SUBTOTAL		$230,000	$130,000	$130,000	$10,000	$0	$490,000
Plant Paving, Grading, and Yard Piping				41.8%			$200,000
Mechanical and Piping				5%			$20,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$70,000
SUBTOTAL							**$780,000**
Project Phase-Level OPCC Contingency				30%			$230,000
SUBTOTAL							**$1,010,000**
Tax on Materials				9.5%			$20,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$250,000
Contractor's General Conditions				10%			$100,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,390,000**
Construction Contingency				10%			$140,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$490,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,020,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Tertiary Facility Modifications
ELEMENT #: 6

OPPC PROVIDED BY: TTT
OPPC PREPARATION DATE: 10-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	LABOR HOURS	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	30-inch pipe (Onsite)	150	LF	$360	$54,000	150	$360	$54,000	$110,000
2	Shoring	2,400	SF	$15	$36,000	2400	$15	$36,000	$70,000
3	Paving	200	SF	$10	$2,000	200	$10	$2,000	$4,000
4	Concrete pavement	1,300	SF	$5	$6,000	1300	$5	$6,000	$10,000
5	Demolition	31	CY	$0	$0	0	$500	$16,000	$20,000
6	New Walls	18	CY	$500	$9,000	18	$500	$9,000	$20,000
7	New back wall	10	CY	$500	$5,000	10	$500	$5,000	$10,000
8	Painting	1	LS	$5,000	$5,000	0	$0	$0	$5,000
9	Low Head Pumps	3	EA	$94,500	$284,000	0	$21,700	$65,000	$350,000
10	High Head Pumps	3	EA	$215,000	$645,000	0	$49,450	$148,000	$790,000
11	Slide gate	2	EA	$15,000	$30,000	0	$3,450	$7,000	$40,000
12	Demolition of Piping	1	LS	$0	$0	1	$10,000	$10,000	$10,000
13	Pipe Supports	1	LS	$7,500	$7,500	1	$2,500	$2,500	$10,000
14	24" Check Valve	6	EA	$15,000	$90,000	6	$3,450	$20,700	$110,700
15	24" BFV	6	EA	$5,000	$30,000	6	$1,150	$6,900	$36,900
16	Electrical	1	PCT	$181,000	$181,000	1	$58,000	$58,000	$239,000
17	Instrumentation	1	PCT	$181,000	$181,000	1	$58,000	$58,000	$239,000
	SUBTOTAL								**$2,070,000**
	Plant Paving, Grading, and Yard Piping			5%					$100,000
	Mechanical and Piping			5%					$100,000
	Electrical			15%					
	Instrumentation and Controls			15%					
	SUBTOTAL								**$2,270,000**
	Project Phase-Level OPCC Contingency			30%					$680,000
	SUBTOTAL								**$2,950,000**
	Tax on Materials			9.5%					$150,000
	Contractor's Markup on Sub-Contractors' Work			10%					$50,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%					$740,000
	Contractor's General Conditions			10%					$300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST								**$4,190,000**
	Construction Contingency			10%					$420,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%					$1,470,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST								**$6,080,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Secondary Clarifier
ELEMENT #: 7

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$3,900	$111,500	$0	$171,000	$0	$290,000
Division 3	Concrete	$653,900	$785,000	$0	$28,300	$0	$1,470,000
Division 4	Masonry	$2,700	$6,000	$0	$100	$0	$10,000
Division 5	Metals	$49,400	$17,900	$0	$1,100	$0	$70,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$5,600	$2,700	$0	$0	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$53,300	$6,800	$0	$0	$0	$60,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$607,100	$55,600	$9,800	$14,800	$0	$690,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$133,000	$0	$0	$130,000
Division 14	Conveying Systems	$8,900	$1,500	$0	$0	$0	$10,000
Division 15	Mechanical	$609,900	$113,400	$0	$30,200	$300	$750,000
Division 16	Electrical	$0	$0	$399,000	$0	$0	$400,000
SUBTOTAL		$1,990,000	$1,100,000	$540,000	$250,000	$300	$3,890,000
Plant Paving, Grading, and Yard Piping				10%			$390,000
Mechanical and Piping				5%			$190,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$580,000
SUBTOTAL							**$5,050,000**
Project Phase-Level OPCC Contingency				30%			$1,520,000
SUBTOTAL							**$6,570,000**
Tax on Materials				9.5%			$190,000
Contractor's Markup on Sub-Contractors' Work				10%			$50,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,640,000
Contractor's General Conditions				10%			$660,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$9,110,000**
Construction Contingency				10%			$910,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$3,190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$13,210,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Return Stream Treatment: Reactor**
ELEMENT #:	**8**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$900	$45,800	$0	$75,700	$0	$120,000
Division 3	Concrete	$484,500	$785,400	$0	$20,900	$0	$1,290,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$45,700	$10,900	$0	$600	$0	$60,000
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$15,100	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$697,200	$98,900	$59,200	$0	$7,500	$860,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$126,500	$0	$0	$130,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$158,300	$73,400	$0	$8,800	$0	$240,000
Division 16	Electrical	$0	$0	$379,500	$0	$0	$380,000
SUBTOTAL		$1,390,000	$1,010,000	$580,000	$110,000	$7,500	$3,100,000
Plant Paving, Grading, and Yard Piping				10%			$310,000
Mechanical and Piping				5%			$160,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$470,000
SUBTOTAL							**$4,040,000**
Project Phase-Level OPCC Contingency				30%			$1,210,000
SUBTOTAL							**$5,250,000**
Tax on Materials				9.5%			$130,000
Contractor's Markup on Sub-Contractors' Work				10%			$60,000
Contractor's Overhead and Profit, Mob/Demob				25%			$1,310,000
Contractor's General Conditions				10%			$530,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,280,000**
Construction Contingency				10%			$730,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$2,550,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,560,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Return Stream Treatment: Air Supply
ELEMENT #: 9

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

DESCRIPTION		MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$100	$1,900	$17,900	$1,900	$0	$20,000
Division 3	Concrete	$13,600	$12,100	$0	$1,200	$0	$30,000
Division 4	Masonry	$29,200	$49,600	$0	$700	$0	$80,000
Division 5	Metals	$30,800	$2,900	$0	$800	$0	$30,000
Division 6	Woods & Plastics	$1,200	$2,100	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$8,100	$5,700	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$24,200	$0	$0	$0	$0	$20,000
Division 10	Specialties	$11,300	$7,100	$0	$0	$0	$20,000
Division 11	Equipment	$284,000	$40,700	$0	$18,900	$0	$340,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$31,900	$0	$0	$30,000
Division 14	Conveying Systems	$33,200	$4,300	$0	$200	$0	$40,000
Division 15	Mechanical	$17,400	$5,500	$17,200	$100	$0	$40,000
Division 16	Electrical	$0	$0	$95,700	$0	$0	$100,000
SUBTOTAL		$450,000	$130,000	$160,000	$20,000	$0	$760,000
Plant Paving, Grading, and Yard Piping				10%			$80,000
Mechanical and Piping				5%			$40,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$110,000
SUBTOTAL							**$990,000**
Project Phase-Level OPCC Contingency				30%			$300,000
SUBTOTAL							**$1,290,000**
Tax on Materials				9.5%			$40,000
Contractor's Markup on Sub-Contractors' Work				10%			$20,000
Contractor's Overhead and Profit, Mob/Demob				25%			$320,000
Contractor's General Conditions				10%			$130,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,800,000**
Construction Contingency				10%			$180,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$630,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,610,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Return Stream Treatment: Pumps
ELEMENT #:	10

OPPC PROVIDED BY:	MWF and GL
OPPC PREPARATION DATE:	6/6/2016
REVIEWED BY:	JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$0	$1,000	$0	$1,700	$0	$0
Division 3	Concrete	$3,900	$8,100	$0	$100	$0	$10,000
Division 4	Masonry	$0	$0	$0	$0	$0	$0
Division 5	Metals	$1,600	$400	$0	$0	$0	$0
Division 6	Woods & Plastics	$0	$0	$0	$0	$0	$0
Division 7	Thermal & Moisture Protection	$0	$0	$0	$0	$0	$0
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$0	$0	$0	$0	$0	$0
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$20,000	$2,900	$2,700	$200	$0	$30,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$7,700	$0	$0	$10,000
Division 14	Conveying Systems	$8,800	$0	$0	$0	$0	$10,000
Division 15	Mechanical	$38,600	$13,100	$0	$1,100	$0	$50,000
Division 16	Electrical	$46,300	$5,500	$18,600	$500	$0	$70,000
SUBTOTAL		$120,000	$30,000	$30,000	$0	$0	$180,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$30,000
SUBTOTAL							**$240,000**
Project Phase-Level OPCC Contingency				30%			$70,000
SUBTOTAL							**$310,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$0
Contractor's Overhead and Profit, Mob/Demob				25%			$80,000
Contractor's General Conditions				10%			$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$430,000**
Construction Contingency				10%			$40,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$150,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$620,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Return Stream Treatment: Alkalinity**
ELEMENT #:	**11**

OPPC PROVIDED BY: MWF and GL
OPPC PREPARATION DATE: 6/6/2016
REVIEWED BY: JBN

	DESCRIPTION	MATERIAL COST	LABOR COST	SUB COST	EQUIPMENT COST	OTHER COST	TOTAL COST
Division 2	Site Construction	$800	$1,300	$0	$1,300	$0	$0
Division 3	Concrete	$10,800	$10,900	$0	$300	$0	$20,000
Division 4	Masonry	$9,200	$16,600	$0	$200	$0	$30,000
Division 5	Metals	$0	$0	$0	$0	$0	$0
Division 6	Woods & Plastics	$9,600	$1,300	$0	$0	$0	$10,000
Division 7	Thermal & Moisture Protection	$5,500	$4,000	$0	$100	$0	$10,000
Division 8	Doors & Windows	$0	$0	$0	$0	$0	$0
Division 9	Finishes	$300	$1,700	$16,700	$0	$0	$20,000
Division 10	Specialties	$0	$0	$0	$0	$0	$0
Division 11	Equipment	$54,100	$7,000	$4,900	$0	$400	$70,000
Division 12	Furnishings	$0	$0	$0	$0	$0	$0
Division 13	Special Construction	$0	$0	$10,400	$0	$0	$10,000
Division 14	Conveying Systems	$0	$0	$0	$0	$0	$0
Division 15	Mechanical	$29,000	$6,000	$6,700	$0	$0	$40,000
Division 16	Electrical	$0	$0	$31,200	$0	$0	$30,000
SUBTOTAL		$120,000	$50,000	$70,000	$0	$400	$240,000
Plant Paving, Grading, and Yard Piping				10%			$20,000
Mechanical and Piping				5%			$10,000
Electrical (Included in Base Cost)				0%			$0
Instrumentation and Controls				15%			$40,000
SUBTOTAL							**$310,000**
Project Phase-Level OPCC Contingency				30%			$90,000
SUBTOTAL							**$400,000**
Tax on Materials				9.5%			$10,000
Contractor's Markup on Sub-Contractors' Work				10%			$10,000
Contractor's Overhead and Profit, Mob/Demob				25%			$100,000
Contractor's General Conditions				10%			$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$560,000**
Construction Contingency				10%			$60,000
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs				35%			$200,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$820,000**

APPENDIX H-6

CWR Treatment System FAT Facilities Improvements

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**CWR Treatment System FAT Facilities Improvements (3.0 MGD)**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with No Pretreatment (3 MGD)		$3,800,000
2	RO Membrane System (3 MGD)		$8,800,000
3	UV/AOP System (3 MGD)		$2,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$14,900,000**
	Construction Contingency	10%	$1,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$5,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$21,600,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39 — **OPPC PROVIDED BY:** BJG
PROJECT ELEMENT: MF Membrane System with No Pretreatment (3 MGD) — **OPPC PREPARATION DATE:** 3-Mar-16
ELEMENT #: 1 — **REVIEWED BY:** CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	MF/UF Pump Station	20	CuYd	$250	$5,000	$125	$2,500	$10,000
2	MF/UF System Water Supply Pumps (4 @33-1/3 % each)	1	EA	$15,000	$15,000	$3,000	$3,000	$20,000
3	MF/UF System Water Supply Pumps' Accessories (4 @33-1/3 % each)	1	EA	$13,500	$13,500	$2,700	$2,700	$20,000
4	MEMCOR PP M10C modules	580	LS	$1,000	$580,000	$200	$116,000	$700,000
5	Extra Train	1	LS	$400,000	$400,000	$80,000	$80,000	$480,000
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,230,000**
	Plant Paving, Grading, and Yard Piping			10%				$120,000
	Mechanical and Piping			5%				$60,000
	Electrical			15%				$180,000
	Instrumentation and Controls			15%				$180,000
	SUBTOTAL							**$1,770,000**
	Project Phase-Level OPCC Contingency			50%				$890,000
	SUBTOTAL							**$2,660,000**
	Tax on Materials			9.5%				$130,000
	Contractor's Markup on Sub-Contractors' Work			10%				$40,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$670,000
	Contractor's General Conditions			10%				$270,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$3,770,000**
	Construction Contingency			10%				$380,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,320,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$5,470,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	RO Membrane System (3 MGD)
ELEMENT #:	2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	RO System Equipment	1	LS	$2,600,000	$2,600,000	$260,000	$260,000	$2,860,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$2,860,000**
	Plant Paving, Grading, and Yard Piping			10%				$290,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$430,000
	Instrumentation and Controls			15%				$430,000
	SUBTOTAL							**$4,150,000**
	Project Phase-Level OPCC Contingency			50%				$2,080,000
	SUBTOTAL							**$6,230,000**
	Tax on Materials			9.5%				$300,000
	Contractor's Markup on Sub-Contractors' Work			10%				$90,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,560,000
	Contractor's General Conditions			10%				$620,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$8,800,000**
	Construction Contingency			10%				$880,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$3,080,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$12,760,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	UV/AOP System (3 MGD)
ELEMENT #:	3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	UV/AOP System Equipment	1	LS	$390,000	$390,000	$97,500	$97,500	$490,000
2	UV/AOP System Building (Construct for nominal 12 MGD future capacity	2,000	SF	$60	$120,000	$60	$120,000	$240,000
3	Outlet Pipe Manifold (14 " dia.)	150	LF	$168	$25,200	$168	$25,200	$50,000
4	Inlet & Outlet Elbows (30" dia.)	2	EA	$2,500	$5,000	$2,500	$5,000	$10,000
5	Tees (30" dia.)	2	EA	$5,000	$10,000	$5,000	$10,000	$20,000
6	30" X 10" Reducing Tees	4	EA	$2,500	$10,000	$2,500	$10,000	$20,000
7	8" dia. Isolation Valves (& Open-Closed, Motor-activated),	4	EA	$5,000	$20,000	$5,000	$20,000	$40,000
8								
9								
10								
	SUBTOTAL							**$870,000**
	Plant Paving, Grading, and Yard Piping			10%				$90,000
	Mechanical and Piping			5%				$40,000
	Electrical			15%				$130,000
	Instrumentation and Controls			15%				$130,000
	SUBTOTAL							**$1,260,000**
	Project Phase-Level OPCC Contingency			30%				$380,000
	SUBTOTAL							**$1,640,000**
	Tax on Materials			9.5%				$80,000
	Contractor's Markup on Sub-Contractors' Work			10%				$30,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$410,000
	Contractor's General Conditions			10%				$160,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,320,000**
	Construction Contingency			10%				$230,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$810,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,360,000**

APPENDIX H-7

Alternatives for 3.0 MGD FAT Facilities Pretreatment

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: Alternatives for 3.0 MGD FAT Facilities Pretreatment: Ozonation
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/3/2016

ELEMENT #	DESCRIPTION		COST
1-1	MF Membrane System with Nitrified/Denitrified Pretreatment (3 MGD)		$1,800,000
2	RO Membrane System (3 MGD)		$8,800,000
3	UV/AOP System (3 MGD)		$2,300,000
4	Ozone Pretreatment (3 MGD)		$7,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$20,300,000**
	Construction Contingency	10%	$2,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$7,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$29,400,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Alternatives for 3.0 MGD FAT Facilities Pretreatment: Ozonation plus BAC**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1-2	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (3 MGD)		$1,600,000
2	RO Membrane System (3 MGD)		$8,800,000
3	UV/AOP System (3 MGD)		$2,300,000
4	Ozone Pretreatment (3 MGD)		$7,400,000
5	BAC Filter Pretreatment (3 MGD)		$4,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$24,500,000**
	Construction Contingency	10%	$2,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$8,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$35,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Alternatives for 3.0 MGD FAT Facilities Pretreatment: Full-Scale Nitrification/Denitrification**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1-1	MF Membrane System with Nitrified/Denitrified Pretreatment (3 MGD)		$1,800,000
2	RO Membrane System (3 MGD)		$8,800,000
3	UV/AOP System (3 MGD)		$2,300,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$37,900,000**
	Construction Contingency	10%	$3,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$13,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$55,000,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Alternatives for 3.0 MGD FAT Facilities Pretreatment: Parallel Stream MBR**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1-1	MF Membrane System with Nitrified/Denitrified Pretreatment (3 MGD)		$1,800,000
2	RO Membrane System (3 MGD)		$8,800,000
3	UV/AOP System (3 MGD)		$2,300,000
	MBR Treatment System:		
App. H-4 #3	MBR Membrane Tanks		$25,100,000
App. H-4 #4	MBR Aeration Basin		$4,400,000
App. H-4 #5	MBR Air Supply		$2,900,000
App. H-4 #6	Screens for MBR		$2,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$47,900,000**
	Construction Contingency	10%	$4,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$16,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$69,500,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	MF Membrane System with Nitrified/Denitrified Pretreatment (3 MGD)
ELEMENT #:	1-1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	MF/UF Pump Station	20	CuYd	$250	$5,000	$125	$2,500	$10,000
2	MF/UF System Water Supply Pumps (4 @33-1/3 % each)	1	EA	$15,000	$15,000	$3,000	$3,000	$20,000
3	MF/UF System Water Supply Pumps' Accessories (4 @33-1/3 % each)	1	EA	$13,500	$13,500	$2,700	$2,700	$20,000
4	MEMCOR PP M10C modules	450	LS	$1,000	$450,000	$200	$90,000	$540,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$590,000**
	Plant Paving, Grading, and Yard Piping			10%				$60,000
	Mechanical and Piping			5%				$30,000
	Electrical			15%				$90,000
	Instrumentation and Controls			15%				$90,000
	SUBTOTAL							**$860,000**
	Project Phase-Level OPCC Contingency			50%				$430,000
	SUBTOTAL							**$1,290,000**
	Tax on Materials			9.5%				$60,000
	Contractor's Markup on Sub-Contractors' Work			10%				$20,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$320,000
	Contractor's General Conditions			10%				$130,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,820,000**
	Construction Contingency			10%				$180,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$640,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,640,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (3 MGD)
ELEMENT #: 1-2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	MF/UF Pump Station	20	CuYd	$250	$5,000	$125	$2,500	$10,000
2	MF/UF System Water Supply Pumps (4 @33-1/3 % each)	1	EA	$15,000	$15,000	$3,000	$3,000	$20,000
3	MF/UF System Water Supply Pumps' Accessories (4 @33-1/3 % each)	1	EA	$13,500	$13,500	$2,700	$2,700	$20,000
4	MEMCOR PP M10C modules	390	LS	$1,000	$390,000	$200	$78,000	$470,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$520,000**
	Plant Paving, Grading, and Yard Piping			10%				$50,000
	Mechanical and Piping			5%				$30,000
	Electrical			15%				$80,000
	Instrumentation and Controls			15%				$80,000
	SUBTOTAL							**$760,000**
	Project Phase-Level OPCC Contingency			50%				$380,000
	SUBTOTAL							**$1,140,000**
	Tax on Materials			9.5%				$50,000
	Contractor's Markup on Sub-Contractors' Work			10%				$20,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$290,000
	Contractor's General Conditions			10%				$110,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,610,000**
	Construction Contingency			10%				$160,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$560,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,330,000**

PROJECT:	DSRSD WWTP Master Plan	
OWNER:	Dublin San Ramon Services District	
LOCATION:	Pleasanton, California	
WYA Project #:	406-19-15-39	OPPC PROVIDED BY: BJG
PROJECT ELEMENT:	RO Membrane System (3 MGD)	OPPC PREPARATION DATE: 3-Mar-16
ELEMENT #:	2	REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	RO System Equipment	1	LS	$2,600,000	$2,600,000	$260,000	$260,000	$2,860,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$2,860,000**
	Plant Paving, Grading, and Yard Piping			10%				$290,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$430,000
	Instrumentation and Controls			15%				$430,000
	SUBTOTAL							**$4,150,000**
	Project Phase-Level OPCC Contingency			50%				$2,080,000
	SUBTOTAL							**$6,230,000**
	Tax on Materials			9.5%				$300,000
	Contractor's Markup on Sub-Contractors' Work			10%				$90,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,560,000
	Contractor's General Conditions			10%				$620,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$8,800,000**
	Construction Contingency			10%				$880,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$3,080,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$12,760,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	UV/AOP System (3 MGD)
ELEMENT #:	3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	UV/AOP System Equipment	1	LS	$390,000	$390,000	$97,500	$97,500	$490,000
2	UV/AOP System Building (Construct for nominal 12 MGD future capacity	2,000	SF	$60	$120,000	$60	$120,000	$240,000
3	Outlet Pipe Manifold (14 " dia.)	150	LF	$168	$25,200	$168	$25,200	$50,000
4	Inlet & Outlet Elbows (30" dia.)	2	EA	$2,500	$5,000	$2,500	$5,000	$10,000
5	Tees (30" dia.)	2	EA	$5,000	$10,000	$5,000	$10,000	$20,000
6	30" X 10" Reducing Tees	4	EA	$2,500	$10,000	$2,500	$10,000	$20,000
7	8" dia. Isolation Valves (& Open-Closed, Motor-activated),	4	EA	$5,000	$20,000	$5,000	$20,000	$40,000
8								
9								
10								
	SUBTOTAL							**$870,000**
	Plant Paving, Grading, and Yard Piping			10%				$90,000
	Mechanical and Piping			5%				$40,000
	Electrical			15%				$130,000
	Instrumentation and Controls			15%				$130,000
	SUBTOTAL							**$1,260,000**
	Project Phase-Level OPCC Contingency			30%				$380,000
	SUBTOTAL							**$1,640,000**
	Tax on Materials			9.5%				$80,000
	Contractor's Markup on Sub-Contractors' Work			10%				$30,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$410,000
	Contractor's General Conditions			10%				$160,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,320,000**
	Construction Contingency			10%				$230,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$810,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,360,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Ozone Pretreatment (3 MGD)
ELEMENT #: 4

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	26	CuYd	$250	$6,500	$125	$3,300	$10,000
2	Ozone Contactor Walls	109	CuYd	$250	$27,300	$250	$27,300	$50,000
3	Ozone Contactor Suspended Slab	11	CuYd	$250	$2,800	$500	$5,500	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	44	CuYd	$250	$11,000	$125	$5,500	$20,000
5	Ozone Building	1,200	SF	$100	$120,000	$100	$120,000	$240,000
6	Ozone Generation, Transfer, & Off-Gas Handling Systems	1	LS	$2,022,000	$2,022,000	$404,400	$404,400	$2,430,000
7								
8								
9								
10								
	SUBTOTAL							**$2,760,000**
	Plant Paving, Grading, and Yard Piping			10%				$280,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$410,000
	Instrumentation and Controls			15%				$410,000
	SUBTOTAL							**$4,000,000**
	Project Phase-Level OPCC Contingency			30%				$1,200,000
	SUBTOTAL							**$5,200,000**
	Tax on Materials			9.5%				$250,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,300,000
	Contractor's General Conditions			10%				$520,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,350,000**
	Construction Contingency			10%				$740,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,570,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,660,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: BAC Filter Pretreatment (3 MGD)
ELEMENT #: 5

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	14" Diameter Pipeline to/from BAC Filter	100	LF	$168	$16,800	$168	$16,800	$33,600
2	BAC Filter Equipment (3 MGD)	1	EA	$1,607,861	$1,607,861	$0	$0	$1,607,861
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,641,461**
	Plant Paving, Grading, and Yard Piping			10%				$164,000
	Mechanical and Piping			5%				$82,000
	Electrical			15%				$246,000
	Instrumentation and Controls			15%				$246,000
	SUBTOTAL							**$2,379,461**
	Project Phase-Level OPCC Contingency			30%				$710,000
	SUBTOTAL							**$3,090,000**
	Tax on Materials			9.5%				$150,000
	Contractor's Markup on Sub-Contractors' Work			10%				$50,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$770,000
	Contractor's General Conditions			10%				$310,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,370,000**
	Construction Contingency			10%				$440,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,530,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,340,000**

APPENDIX H-8-i

3.0 MGD Raw Water Augmentation

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**No Pretreatment → Raw Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$36,800,000**
	Construction Contingency	10%	$3,700,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$12,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$53,400,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Ozonation Pretreatment → Raw Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$29,400,000**
	Construction Contingency	10%	$2,900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$10,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$42,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Ozonation plus BAC Pretreatment → Raw Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$25,000,000**
	Construction Contingency	10%	$2,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$8,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$36,300,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Full-Scale Nitrification/Denitrification Pretreatment → Raw Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$11,800,000**
	Construction Contingency	10%	$1,200,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$4,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$17,100,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: Parallel Stream MBR Pretreatment → Raw Water Augmentation
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/3/2016

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$11,800,000**
	Construction Contingency	10%	$1,200,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$4,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$17,100,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Ozone Pretreatment (3 MGD)**
ELEMENT #:	**1**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	26	CuYd	$250	$6,500	$125	$3,300	$10,000
2	Ozone Contactor Walls	109	CuYd	$250	$27,300	$250	$27,300	$50,000
3	Ozone Contactor Suspended Slab	11	CuYd	$250	$2,800	$500	$5,500	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	44	CuYd	$250	$11,000	$125	$5,500	$20,000
5	Ozone Building	1,200	SF	$100	$120,000	$100	$120,000	$240,000
6	Ozone Generation, Transfer, & Off-Gas Handling Systems	1	LS	$2,022,000	$2,022,000	$404,400	$404,400	$2,430,000
7								
8								
9								
10								
	SUBTOTAL							**$2,760,000**
	Plant Paving, Grading, and Yard Piping			10%				$280,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$410,000
	Instrumentation and Controls			15%				$410,000
	SUBTOTAL							**$4,000,000**
	Project Phase-Level OPCC Contingency			30%				$1,200,000
	SUBTOTAL							**$5,200,000**
	Tax on Materials			9.5%				$250,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,300,000
	Contractor's General Conditions			10%				$520,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,350,000**
	Construction Contingency			10%				$740,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,570,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,660,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: BAC Filter Pretreatment (3 MGD)
ELEMENT #: 2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	14" Diameter Pipeline to/from BAC Filter	100	LF	$168	$16,800	$168	$16,800	$33,600
2	BAC Filter Equipment (3 MGD)	1	EA	$1,607,861	$1,607,861	$0	$0	$1,607,861
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,641,461**
	Plant Paving, Grading, and Yard Piping			10%				$164,000
	Mechanical and Piping			5%				$82,000
	Electrical			15%				$246,000
	Instrumentation and Controls			15%				$246,000
	SUBTOTAL							**$2,379,461**
	Project Phase-Level OPCC Contingency			30%				$710,000
	SUBTOTAL							**$3,090,000**
	Tax on Materials			9.5%				$150,000
	Contractor's Markup on Sub-Contractors' Work			10%				$50,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$770,000
	Contractor's General Conditions			10%				$310,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,370,000**
	Construction Contingency			10%				$440,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,530,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,340,000**

APPENDIX H-8-ii

3.0 MGD Treated Water Augmentation

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: No Pretreatment → Treated Water Augmentation

TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/3/2016

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
3	Pumping and Conveyance to DLD Site		$1,300,000
4	Final Effluent Chlorination (3 MGD)		$700,000
5	Treated Water Storage (3 MG)		$28,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$67,600,000**
	Construction Contingency	10%	$6,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$23,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$98,100,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Ozonation Pretreatment → Treated Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
3	Pumping and Conveyance to DLD Site		$1,300,000
4	Final Effluent Chlorination (3 MGD)		$700,000
5	Treated Water Storage (3 MG)		$28,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$130,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$60,200,000**
	Construction Contingency	10%	$6,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$21,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$87,300,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: Ozonation plus BAC Pretreatment → Treated Water Augmentation
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/3/2016

ELEMENT #	DESCRIPTION		COST
3	Pumping and Conveyance to DLD Site		$1,300,000
4	Final Effluent Chlorination (3 MGD)		$700,000
5	Treated Water Storage (3 MG)		$28,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$55,800,000**
	Construction Contingency	10%	$5,600,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$19,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$80,900,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**Full-Scale Nitrification/Denitrification Pretreatment → Treated Water Augmentation**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/3/2016**

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
3	Pumping and Conveyance to DLD Site		$1,300,000
4	Final Effluent Chlorination (3 MGD)		$700,000
5	Treated Water Storage (3 MG)		$28,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$42,600,000**
	Construction Contingency	10%	$4,300,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$14,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$61,800,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: Parallel Stream MBR Pretreatment → Treated Water Augmentation
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/3/2016

ELEMENT #	DESCRIPTION		COST
1	Ozone Pretreatment (3 MGD)		$7,400,000
2	BAC Filter Pretreatment (3 MGD)		$4,400,000
3	Pumping and Conveyance to DLD Site		$1,300,000
4	Final Effluent Chlorination (3 MGD)		$700,000
5	Treated Water Storage (3 MG)		$28,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$42,600,000**
	Construction Contingency	10%	$4,300,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$14,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$61,800,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Ozone Pretreatment (3 MGD)
ELEMENT #: 1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	26	CuYd	$250	$6,500	$125	$3,300	$10,000
2	Ozone Contactor Walls	109	CuYd	$250	$27,300	$250	$27,300	$50,000
3	Ozone Contactor Suspended Slab	11	CuYd	$250	$2,800	$500	$5,500	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	44	CuYd	$250	$11,000	$125	$5,500	$20,000
5	Ozone Building	1,200	SF	$100	$120,000	$100	$120,000	$240,000
6	Ozone Generation, Transfer, & Off-Gas Handling Systems	1	LS	$2,022,000	$2,022,000	$404,400	$404,400	$2,430,000
7								
8								
9								
10								
	SUBTOTAL							**$2,760,000**
	Plant Paving, Grading, and Yard Piping			10%				$280,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$410,000
	Instrumentation and Controls			15%				$410,000
	SUBTOTAL							**$4,000,000**
	Project Phase-Level OPCC Contingency			30%				$1,200,000
	SUBTOTAL							**$5,200,000**
	Tax on Materials			9.5%				$250,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,300,000
	Contractor's General Conditions			10%				$520,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,350,000**
	Construction Contingency			10%				$740,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,570,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,660,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: BAC Filter Pretreatment (3 MGD)
ELEMENT #: 2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	14" Diameter Pipeline to/from BAC Filter	100	LF	$168	$16,800	$168	$16,800	$33,600
2	BAC Filter Equipment (3 MGD)	1	EA	$1,607,861	$1,607,861	$0	$0	$1,607,861
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,641,461**
	Plant Paving, Grading, and Yard Piping			10%				$164,000
	Mechanical and Piping			5%				$82,000
	Electrical			15%				$246,000
	Instrumentation and Controls			15%				$246,000
	SUBTOTAL							**$2,379,461**
	Project Phase-Level OPCC Contingency			30%				$710,000
	SUBTOTAL							**$3,090,000**
	Tax on Materials			9.5%				$150,000
	Contractor's Markup on Sub-Contractors' Work			10%				$50,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$770,000
	Contractor's General Conditions			10%				$310,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,370,000**
	Construction Contingency			10%				$440,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,530,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,340,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumping and Conveyance to DLD Site
ELEMENT #: 3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	650 LF 12" dia btwn (E) IPR Building & new PR Facility	650	LF	$108	$70,000	$108	$70,200	$140,000
2	Bore & Jack Crossing under Stoneridge Blvd	100	LF	$1,000	$100,000	$0	$0	$100,000
3	Pump Station Modifications	1	LS	$250,000	$250,000	$0	$0	$250,000
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$490,000**
	Plant Paving, Grading, and Yard Piping			10%				$50,000
	Mechanical and Piping			5%				$20,000
	Electrical			15%				$70,000
	Instrumentation and Controls			15%				$70,000
	SUBTOTAL							**$700,000**
	Project Phase-Level OPCC Contingency			30%				$210,000
	SUBTOTAL							**$910,000**
	Tax on Materials			9.5%				$40,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$230,000
	Contractor's General Conditions			10%				$90,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,280,000**
	Construction Contingency			10%				$130,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$450,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,860,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Final Effluent Chlorination (3 MGD)
ELEMENT #: 4

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Chlorine Contactor Slab-on-Grade	10	CuYd	$250	$2,500	$125	$1,300	$4,000
2	Chlorine Contactor Walls	42	CuYd	$250	$10,500	$250	$10,500	$20,000
3	Chlorine Contactor Suspended Slab	3	CuYd	$250	$800	$375	$1,100	$2,000
4	Chlorine Storage & Feed System	1	LS	$150,000	$150,000	$75,000	$75,000	$230,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$260,000**
	Plant Paving, Grading, and Yard Piping			10%				$30,000
	Mechanical and Piping			5%				$10,000
	Electrical			15%				$40,000
	Instrumentation and Controls			15%				$40,000
	SUBTOTAL							**$380,000**
	Project Phase-Level OPCC Contingency			30%				$110,000
	SUBTOTAL							**$490,000**
	Tax on Materials			9.5%				$20,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$120,000
	Contractor's General Conditions			10%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$690,000**
	Construction Contingency			10%				$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$240,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,000,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Treated Water Storage (3 MG)
ELEMENT #: 5

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Treated Water Transfer Pump Station	20	CuYd	$250	$5,000	$125	$2,500	$10,000
2	3.0 MG Treated Water Storage Tanks	2	EA	$3,440,934	$6,881,867	$1,720,467	$0	$10,322,801
3	Treated Water Transfer Pump Station (Vertical Turbine Pumps)	3	EA	$7,015	$21,000	$2,806	$8,400	$30,000
4	Treated Water Delivery Pump Station (Vertical Turbine Pumps)	3	EA	$12,500	$37,500	$5,000	$15,000	$50,000
5	TW Tank Isolation Valves (24" motor - actuated)	6	EA	$12,750	$76,500	$0	$0	$80,000
6	TW Transfer PS Isolation Valves (18" - 20" manual-actuated)	6	EA	$3,315	$19,890	$0	$0	$20,000
7	TW Transfer PS Check Valves (18" - 20" dia.)	6	EA	$23,771	$142,626	$0	$0	$140,000
8	TW Delivery PS Isolation Valves (18" - 20" manual-actuated)	6	EA	$3,315	$19,890	$0	$0	$20,000
9	TW Delivery PS Check Valves (18" - 20" dia.)	6	EA	$23,771	$142,626	$0	$0	$140,000
10								
	SUBTOTAL							**$10,810,000**
	Plant Paving, Grading, and Yard Piping			10%				$1,080,000
	Mechanical and Piping			5%				$540,000
	Electrical			15%				$1,620,000
	Instrumentation and Controls			15%				$1,620,000
	SUBTOTAL							**$15,670,000**
	Project Phase-Level OPCC Contingency			30%				$4,700,000
	SUBTOTAL							**$20,370,000**
	Tax on Materials			9.5%				$970,000
	Contractor's Markup on Sub-Contractors' Work			10%				$320,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$5,090,000
	Contractor's General Conditions			10%				$2,040,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$28,790,000**
	Construction Contingency			10%				$2,880,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$10,080,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$41,750,000**

APPENDIX H-9-i

Potential 9.0 MGD Raw Water Augmentation Facilities

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ No Pretreatment → 9.0 MGD Raw Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$95,700,000**
	Construction Contingency	10%	$9,600,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$33,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$138,800,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: 3.0 MGD w/ Ozonation Pretreatment → 9.0 MGD Raw Water Augmentation Facilities
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 7/29/2016

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$88,300,000**
	Construction Contingency	10%	$8,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$30,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$128,000,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Ozonation and BAC Pretreatment → 9.0 MGD Raw Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$83,900,000**
	Construction Contingency	10%	$8,400,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$29,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$121,700,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Full-Scale Nitrification/Denitrification → 9.0 MGD Raw Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$70,700,000**
	Construction Contingency	10%	$7,100,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$24,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$102,500,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Parallel Stream MBR → 9.0 MGD Raw Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	Full-Scale Nitrification/Denitrification (with MBR):		
App. H-5-i #1-2	Aeration Basin (1)		$8,500,000
App. H-5-i #3	Chlorination System Improvements		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$79,300,000**
	Construction Contingency	10%	$7,900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$27,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$115,000,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: CMT
DESCRIPTION OF WORK: 3.0 MGD w/ Raw Water Augmentation → 9.0 MGD DPR Raw Water Augmentation Facilities
TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 7/29/2016

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6.0 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6.0 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$58,900,000**
	Construction Contingency	10%	$5,900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$20,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$85,400,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Treated Water Augmentation → 9.0 MGD Raw Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$57,600,000**
	Construction Contingency	10%	$5,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$20,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$83,600,000**

PROJECT:	DSRSD WWTP Master Plan		
OWNER:	Dublin San Ramon Services District		
LOCATION:	Pleasanton, California		
WYA Project #:	406-19-15-39	OPPC PROVIDED BY:	BJG
PROJECT ELEMENT:	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)	OPPC PREPARATION DATE:	29-Jul-16
		REVIEWED BY:	CMT
ELEMENT #:	1		

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	MF/UF Pump Station Slab	90	EA	$250	$22,500	$125	$11,300	$30,000
2	MF/UF System Water Supply Pumps (4 @33-1/3 % each)	3	EA	$62,500	$187,500	$25,000	$75,000	$260,000
3	MF/UF System Equipment	3	EA	$48,475	$145,400	$22,500	$67,500	$210,000
4	MF/UF System Equipment(2)	416	LS	$5,160	$2,146,600	$1,032	$598,600	$2,750,000
5	MF/UF Membrane Building	10,000	SF	$60	$600,000	$60	$600,000	$1,200,000
6								
7								
8								
9								
10								
	SUBTOTAL							**$4,450,000**
	Plant Paving, Grading, and Yard Piping			10%				$450,000
	Mechanical and Piping			5%				$220,000
	Electrical			15%				$670,000
	Instrumentation and Controls			15%				$670,000
	SUBTOTAL							**$6,460,000**
	Project Phase-Level OPCC Contingency			30%				$1,940,000
	SUBTOTAL							**$8,400,000**
	Tax on Materials			9.5%				$400,000
	Contractor's Markup on Sub-Contractors' Work			10%				$134,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$2,100,000
	Contractor's General Conditions			10%				$840,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$11,874,000**
	Construction Contingency			10%				$1,190,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$4,160,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$17,224,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	RO Membrane System (6 MGD)
ELEMENT #:	2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	RO System Water Supply Pumps	4	EA	$70,000	$280,000	$10,500	$42,000	$320,000
2	RO System Water Supply Pumps' Ancillary System Components	4	EA	$90,000	$360,000	$22,500	$90,000	$450,000
3	RO System Equipment	1	LS	$4,007,583	$4,007,600	$477,039	$477,000	$4,480,000
4	RO Membrane Building	10,000	SF	$60	$600,000	$60	$600,000	$1,200,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$6,450,000**
	Plant Paving, Grading, and Yard Piping			10%				$650,000
	Mechanical and Piping			5%				$320,000
	Electrical			15%				$970,000
	Instrumentation and Controls			15%				$970,000
	SUBTOTAL							**$9,360,000**
	Project Phase-Level OPCC Contingency			30%				$2,810,000
	SUBTOTAL							**$12,170,000**
	Tax on Materials			9.5%				$580,000
	Contractor's Markup on Sub-Contractors' Work			10%				$190,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$3,040,000
	Contractor's General Conditions			10%				$1,220,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$17,200,000**
	Construction Contingency			10%				$1,720,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$6,020,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$24,940,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: UV/AOP System (6 MGD)
ELEMENT #: 3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	UV/AOP System Equipment	1	LS	$1,810,000	$1,810,000	$420,064	$420,064	$2,230,064
2	UV/AOP System Building	2,000	SF	$60	$120,000	$60	$120,000	$240,000
3	Inlet Pipe Manifold (30" dia.)	50	LF	$300	$15,000	$300	$15,000	$30,000
4	Outlet Pipe Manifold (30 " dia.)	50	LF	$300	$15,000	$300	$15,000	$30,000
5	Inlet & Outlet Elbows (30" dia.)	6	EA	$2,500	$15,000	$2,500	$15,000	$30,000
6	Tees (30" dia.)	2	EA	$5,000	$10,000	$5,000	$10,000	$20,000
7	30" dia. Isolation Valves (& Open-Closed, Motor-activated),	3	EA	$20,000	$60,000	$10,000	$30,000	$90,000
8								
9								
10								
	SUBTOTAL							**$2,670,064**
	Plant Paving, Grading, and Yard Piping			10%				$270,000
	Mechanical and Piping			5%				$130,000
	Electrical			15%				$400,000
	Instrumentation and Controls			15%				$400,000
	SUBTOTAL							**$3,870,064**
	Project Phase-Level OPCC Contingency			30%				$1,160,000
	SUBTOTAL							**$5,030,064**
	Tax on Materials			9.5%				$240,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$1,260,000
	Contractor's General Conditions			10%				$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,110,064**
	Construction Contingency			10%				$711,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,490,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,311,064**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Ozone Pretreatment (3 MGD)**
ELEMENT #:	**4-1**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	26	CuYd	$250	$6,500	$125	$3,300	$10,000
2	Ozone Contactor Walls	109	CuYd	$250	$27,300	$250	$27,300	$50,000
3	Ozone Contactor Suspended Slab	11	CuYd	$250	$2,800	$500	$5,500	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	44	CuYd	$250	$11,000	$125	$5,500	$20,000
5	Ozone Building	1,200	SF	$100	$120,000	$100	$120,000	$240,000
6	Ozone Generation, Transfer, & Off-Gas Handling Systems	1	LS	$2,022,000	$2,022,000	$404,400	$404,400	$2,430,000
7								
8								
9								
10								
	SUBTOTAL							**$2,760,000**
	Plant Paving, Grading, and Yard Piping			10%				$280,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$410,000
	Instrumentation and Controls			15%				$410,000
	SUBTOTAL							**$4,000,000**
	Project Phase-Level OPCC Contingency			30%				$1,200,000
	SUBTOTAL							**$5,200,000**
	Tax on Materials			9.5%				$250,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,300,000
	Contractor's General Conditions			10%				$520,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,350,000**
	Construction Contingency			10%				$740,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,570,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,660,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Ozone System (6 MGD)
ELEMENT #:	4-2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	21	CuYd	$250	$5,200	$125	$2,600	$10,000
2	Ozone Contactor Walls	103	CuYd	$250	$25,800	$250	$25,800	$50,000
3	Ozone Contactor Suspended Slab	14	CuYd	$250	$3,400	$275	$3,800	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	41	CuYd	$250	$10,300	$125	$5,200	$20,000
5	Stainless Steel Contactor Water-Tight Access Doors	1	LS	$30,000	$30,000	$7,500	$7,500	$40,000
6	Ozone Generation, Transfer, Monitoring, & Off-Gas Handling Systems	1	LS	$3,210,000	$3,210,000	$744,975	$745,000	$3,950,000
7	Ozone Generator Building	2,000	SF	$60	$120,000	$60	$120,000	$240,000
8	Oxygen & Ozone Gas Systems Pipelines, Valves, & Accessories	1	LS	$100,000	$100,000	$20,000	$20,000	$120,000
9	Ozone Generators Cooling Water System	1	LS	$20,000	$20,000	$20,000	$20,000	$40,000
10	30 In Diameter Pipe	300	LF	$360	$108,000	$360	$108,000	$220,000
	SUBTOTAL							**$4,700,000**
	Plant Paving, Grading, and Yard Piping			10%				$470,000
	Mechanical and Piping			5%				$240,000
	Electrical			15%				$710,000
	Instrumentation and Controls			15%				$710,000
	SUBTOTAL							**$6,830,000**
	Project Phase-Level OPCC Contingency			30%				$2,050,000
	SUBTOTAL							**$8,880,000**
	Tax on Materials			9.5%				$420,000
	Contractor's Markup on Sub-Contractors' Work			10%				$140,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$2,220,000
	Contractor's General Conditions			10%				$890,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$12,550,000**
	Construction Contingency			10%				$1,260,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$4,390,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$18,200,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	BAC Filter Pretreatment (3 MGD)
ELEMENT #:	5-1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	14" Diameter Pipeline to/from BAC Filter	100	LF	$168	$16,800	$168	$16,800	$33,600
2	BAC Filter Equipment (3 MGD)	1	EA	$1,607,861	$1,607,861	$0	$0	$1,607,861
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,641,461**
	Plant Paving, Grading, and Yard Piping			10%				$164,000
	Mechanical and Piping			5%				$82,000
	Electrical			15%				$246,000
	Instrumentation and Controls			15%				$246,000
	SUBTOTAL							**$2,379,461**
	Project Phase-Level OPCC Contingency			30%				$710,000
	SUBTOTAL							**$3,090,000**
	Tax on Materials			9.5%				$150,000
	Contractor's Markup on Sub-Contractors' Work			10%				$50,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$770,000
	Contractor's General Conditions			10%				$310,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,370,000**
	Construction Contingency			10%				$440,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,530,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,340,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**BAC Filter Pretreatment (6 MGD)**
ELEMENT #:	**5-2**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Biologically Activated Carbon Filter (6.0 MGD only)	1	EA	$2,923,000	$2,923,000	$365,319	$365,300	$3,290,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$3,290,000**
	Plant Paving, Grading, and Yard Piping			10%				$330,000
	Mechanical and Piping			5%				$160,000
	Electrical			15%				$490,000
	Instrumentation and Controls			15%				$490,000
	SUBTOTAL							**$4,760,000**
	Project Phase-Level OPCC Contingency			30%				$1,430,000
	SUBTOTAL							**$6,190,000**
	Tax on Materials			9.5%				$290,000
	Contractor's Markup on Sub-Contractors' Work			10%				$100,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$1,550,000
	Contractor's General Conditions			10%				$620,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$8,750,000**
	Construction Contingency			10%				$880,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$3,060,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$12,690,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumping and Conveyance to DLD Site
ELEMENT #: 6

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	650 LF 12" dia btwn (E) IPR Building & new PR Facility	650	LF	$108	$70,000	$108	$70,200	$140,000
2	Bore & Jack Crossing under Stoneridge Blvd	100	LF	$1,000	$100,000	$0	$0	$100,000
3	Pump Station Modifications	1	LS	$250,000	$250,000	$0	$0	$250,000
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$490,000**
	Plant Paving, Grading, and Yard Piping			10%				$50,000
	Mechanical and Piping			5%				$20,000
	Electrical			15%				$70,000
	Instrumentation and Controls			15%				$70,000
	SUBTOTAL							**$700,000**
	Project Phase-Level OPCC Contingency			30%				$210,000
	SUBTOTAL							**$910,000**
	Tax on Materials			9.5%				$40,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$230,000
	Contractor's General Conditions			10%				$90,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,280,000**
	Construction Contingency			10%				$130,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$450,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,860,000**

APPENDIX H-9-ii

Potential 9.0 MGD Treated Water Augmentation Facilities

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ No Pretreatment → 9.0 MGD Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$135,000,000**
	Construction Contingency	10%	$13,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$47,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$195,800,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Ozonation Pretreatment → 9.0 MGD Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$127,600,000**
	Construction Contingency	10%	$12,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$44,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$185,100,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Ozonation plus BAC Pretreatment → 9.0 MGD Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
	Full-Scale Nitrification/Denitrification:		
App. H-5-i #1-1	Aeration Basins (2)		$13,100,000
App. H-5-i #2	MLE/IFAS Air Supply		$2,700,000
App. H-5-i #3	Chlorination System Improvements		$100,000
App. H-5-i #4	Secondary Clarifier		$9,100,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$123,200,000**
	Construction Contingency	10%	$12,300,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$43,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$178,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Full-Scale Nitrification/Denitrification → 9.0 MGD Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$110,000,000**
	Construction Contingency	10%	$11,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$38,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$159,500,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD w/ Parallel Stream MBR → 9.0 MGD DPR Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-1	Ozone Pretreatment (3 MGD)		$7,400,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-1	BAC Filter Pretreatment (3 MGD)		$4,400,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
	Full-Scale Nitrification/Denitrification (with MBR):		
App. H-5-i #1-2	Aeration Basin (1)		$8,500,000
App. H-5-i #3	Chlorination System Improvements		$100,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$118,600,000**
	Construction Contingency	10%	$11,900,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$41,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$172,000,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD Raw Water Augmentation → 9.0 MGD DPR Treated Water AugmentationFacilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
6	Pumping and Conveyance to DLD Site		$1,300,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$98,200,000**
	Construction Contingency	10%	$9,800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$34,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$142,400,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**CMT**
DESCRIPTION OF WORK:	**3.0 MGD Treated Water Augmentation → 9.0 MGD Treated Water Augmentation Facilities**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**7/29/2016**

ELEMENT #	DESCRIPTION		COST
1	MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)		$11,900,000
2	RO Membrane System (6 MGD)		$17,200,000
3	UV/AOP System (6 MGD)		$7,100,000
4-2	Ozone Pretreatment (6 MGD)		$12,600,000
5-2	BAC Filter Pretreatment (6 MGD)		$8,800,000
7	Final Effluent Chlorination (9 MGD)		$2,560,000
8	Treated Water Storage (9 MG)		$36,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$96,900,000**
	Construction Contingency	10%	$9,700,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$33,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$140,500,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**MF Membrane System with Nitrified/Denitrified and Ozone/BAC Filter Pretreatment (6 MGD)**
ELEMENT #:	**1**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	MF/UF Pump Station Slab	90	EA	$250	$22,500	$125	$11,300	$30,000
2	MF/UF System Water Supply Pumps (4 @33-1/3 % each)	3	EA	$62,500	$187,500	$25,000	$75,000	$260,000
3	MF/UF System Equipment	3	EA	$48,475	$145,400	$22,500	$67,500	$210,000
4	MF/UF System Equipment(2)	416	LS	$5,160	$2,146,600	$1,032	$598,600	$2,750,000
5	MF/UF Membrane Building	10,000	SF	$60	$600,000	$60	$600,000	$1,200,000
6								
7								
8								
9								
10								
	SUBTOTAL							**$4,450,000**
	Plant Paving, Grading, and Yard Piping			10%				$450,000
	Mechanical and Piping			5%				$220,000
	Electrical			15%				$670,000
	Instrumentation and Controls			15%				$670,000
	SUBTOTAL							**$6,460,000**
	Project Phase-Level OPCC Contingency			30%				$1,940,000
	SUBTOTAL							**$8,400,000**
	Tax on Materials			9.5%				$400,000
	Contractor's Markup on Sub-Contractors' Work			10%				$134,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$2,100,000
	Contractor's General Conditions			10%				$840,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$11,874,000**
	Construction Contingency			10%				$1,190,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$4,160,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$17,224,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: RO Membrane System (6 MGD)
ELEMENT #: 2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	RO System Water Supply Pumps	4	EA	$70,000	$280,000	$10,500	$42,000	$320,000
2	RO System Water Supply Pumps' Ancillary System Components	4	EA	$90,000	$360,000	$22,500	$90,000	$450,000
3	RO System Equipment	1	LS	$4,007,583	$4,007,600	$477,039	$477,000	$4,480,000
4	RO Membrane Building	10,000	SF	$60	$600,000	$60	$600,000	$1,200,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$6,450,000**
	Plant Paving, Grading, and Yard Piping			10%				$650,000
	Mechanical and Piping			5%				$320,000
	Electrical			15%				$970,000
	Instrumentation and Controls			15%				$970,000
	SUBTOTAL							**$9,360,000**
	Project Phase-Level OPCC Contingency			30%				$2,810,000
	SUBTOTAL							**$12,170,000**
	Tax on Materials			9.5%				$580,000
	Contractor's Markup on Sub-Contractors' Work			10%				$190,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$3,040,000
	Contractor's General Conditions			10%				$1,220,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$17,200,000**
	Construction Contingency			10%				$1,720,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$6,020,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$24,940,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	UV/AOP System (6 MGD)
ELEMENT #:	3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	UV/AOP System Equipment	1	LS	$1,810,000	$1,810,000	$420,064	$420,064	$2,230,064
2	UV/AOP System Building	2,000	SF	$60	$120,000	$60	$120,000	$240,000
3	Inlet Pipe Manifold (30" dia.)	50	LF	$300	$15,000	$300	$15,000	$30,000
4	Outlet Pipe Manifold (30 " dia.)	50	LF	$300	$15,000	$300	$15,000	$30,000
5	Inlet & Outlet Elbows (30" dia.)	6	EA	$2,500	$15,000	$2,500	$15,000	$30,000
6	Tees (30" dia.)	2	EA	$5,000	$10,000	$5,000	$10,000	$20,000
7	30" dia. Isolation Valves (& Open-Closed, Motor-activated),	3	EA	$20,000	$60,000	$10,000	$30,000	$90,000
8								
9								
10								
	SUBTOTAL							**$2,670,064**
	Plant Paving, Grading, and Yard Piping			10%				$270,000
	Mechanical and Piping			5%				$130,000
	Electrical			15%				$400,000
	Instrumentation and Controls			15%				$400,000
	SUBTOTAL							**$3,870,064**
	Project Phase-Level OPCC Contingency			30%				$1,160,000
	SUBTOTAL							**$5,030,064**
	Tax on Materials			9.5%				$240,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$1,260,000
	Contractor's General Conditions			10%				$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,110,064**
	Construction Contingency			10%				$711,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,490,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,311,064**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Ozone Pretreatment (3 MGD)
ELEMENT #: 4-1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	26	CuYd	$250	$6,500	$125	$3,300	$10,000
2	Ozone Contactor Walls	109	CuYd	$250	$27,300	$250	$27,300	$50,000
3	Ozone Contactor Suspended Slab	11	CuYd	$250	$2,800	$500	$5,500	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	44	CuYd	$250	$11,000	$125	$5,500	$20,000
5	Ozone Building	1,200	SF	$100	$120,000	$100	$120,000	$240,000
6	Ozone Generation, Transfer, & Off-Gas Handling Systems	1	LS	$2,022,000	$2,022,000	$404,400	$404,400	$2,430,000
7								
8								
9								
10								
	SUBTOTAL							**$2,760,000**
	Plant Paving, Grading, and Yard Piping			10%				$280,000
	Mechanical and Piping			5%				$140,000
	Electrical			15%				$410,000
	Instrumentation and Controls			15%				$410,000
	SUBTOTAL							**$4,000,000**
	Project Phase-Level OPCC Contingency			30%				$1,200,000
	SUBTOTAL							**$5,200,000**
	Tax on Materials			9.5%				$250,000
	Contractor's Markup on Sub-Contractors' Work			10%				$80,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$1,300,000
	Contractor's General Conditions			10%				$520,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$7,350,000**
	Construction Contingency			10%				$740,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$2,570,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,660,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Ozone System (6 MGD)**
ELEMENT #:	**4-2**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Ozone Contactor Slab-on-Grade	21	CuYd	$250	$5,200	$125	$2,600	$10,000
2	Ozone Contactor Walls	103	CuYd	$250	$25,800	$250	$25,800	$50,000
3	Ozone Contactor Suspended Slab	14	CuYd	$250	$3,400	$275	$3,800	$10,000
4	LOX Tank & Vaporizer Slab-on-Grade	41	CuYd	$250	$10,300	$125	$5,200	$20,000
5	Stainless Steel Contactor Water-Tight Access Doors	1	LS	$30,000	$30,000	$7,500	$7,500	$40,000
6	Ozone Generation, Transfer, Monitoring, & Off-Gas Handling Systems	1	LS	$3,210,000	$3,210,000	$744,975	$745,000	$3,950,000
7	Ozone Generator Building	2,000	SF	$60	$120,000	$60	$120,000	$240,000
8	Oxygen & Ozone Gas Systems Pipelines, Valves, & Accessories	1	LS	$100,000	$100,000	$20,000	$20,000	$120,000
9	Ozone Generators Cooling Water System	1	LS	$20,000	$20,000	$20,000	$20,000	$40,000
10	30 In Diameter Pipe	300	LF	$360	$108,000	$360	$108,000	$220,000
	SUBTOTAL							**$4,700,000**
	Plant Paving, Grading, and Yard Piping			10%				$470,000
	Mechanical and Piping			5%				$240,000
	Electrical			15%				$710,000
	Instrumentation and Controls			15%				$710,000
	SUBTOTAL							**$6,830,000**
	Project Phase-Level OPCC Contingency			30%				$2,050,000
	SUBTOTAL							**$8,880,000**
	Tax on Materials			9.5%				$420,000
	Contractor's Markup on Sub-Contractors' Work			10%				$140,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$2,220,000
	Contractor's General Conditions			10%				$890,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$12,550,000**
	Construction Contingency			10%				$1,260,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$4,390,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$18,200,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: BAC Filter Pretreatment (3 MGD)
ELEMENT #: 5-1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	14" Diameter Pipeline to/from BAC Filter	100	LF	$168	$16,800	$168	$16,800	$33,600
2	BAC Filter Equipment (3 MGD)	1	EA	$1,607,861	$1,607,861	$0	$0	$1,607,861
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$1,641,461**
	Plant Paving, Grading, and Yard Piping			10%				$164,000
	Mechanical and Piping			5%				$82,000
	Electrical			15%				$246,000
	Instrumentation and Controls			15%				$246,000
	SUBTOTAL							**$2,379,461**
	Project Phase-Level OPCC Contingency			30%				$710,000
	SUBTOTAL							**$3,090,000**
	Tax on Materials			9.5%				$150,000
	Contractor's Markup on Sub-Contractors' Work			10%				$50,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$770,000
	Contractor's General Conditions			10%				$310,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,370,000**
	Construction Contingency			10%				$440,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$1,530,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,340,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: BAC Filter Pretreatment (6 MGD)
ELEMENT #: 5-2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Biologically Activated Carbon Filter (6.0 MGD only)	1	EA	$2,923,000	$2,923,000	$365,319	$365,300	$3,290,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$3,290,000**
	Plant Paving, Grading, and Yard Piping			10%				$330,000
	Mechanical and Piping			5%				$160,000
	Electrical			15%				$490,000
	Instrumentation and Controls			15%				$490,000
	SUBTOTAL							**$4,760,000**
	Project Phase-Level OPCC Contingency			30%				$1,430,000
	SUBTOTAL							**$6,190,000**
	Tax on Materials			9.5%				$290,000
	Contractor's Markup on Sub-Contractors' Work			10%				$100,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$1,550,000
	Contractor's General Conditions			10%				$620,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$8,750,000**
	Construction Contingency			10%				$880,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$3,060,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$12,690,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pumping and Conveyance to DLD Site**
ELEMENT #:	**6**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3-Mar-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	650 LF 12" dia btwn (E) IPR Building & new PR Facility	650	LF	$108	$70,000	$108	$70,200	$140,000
2	Bore & Jack Crossing under Stoneridge Blvd	100	LF	$1,000	$100,000	$0	$0	$100,000
3	Pump Station Modifications	1	LS	$250,000	$250,000	$0	$0	$250,000
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$490,000**
	Plant Paving, Grading, and Yard Piping			10%				$50,000
	Mechanical and Piping			5%				$20,000
	Electrical			15%				$70,000
	Instrumentation and Controls			15%				$70,000
	SUBTOTAL							**$700,000**
	Project Phase-Level OPCC Contingency			30%				$210,000
	SUBTOTAL							**$910,000**
	Tax on Materials			9.5%				$40,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$230,000
	Contractor's General Conditions			10%				$90,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,280,000**
	Construction Contingency			10%				$130,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$450,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,860,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Final Effluent Chlorination (9 MG)**
ELEMENT #:	**7**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Chlorine Contactor Slab-on-Grade	715	CuYd	$250	$178,800	$125	$89,400	$270,000
2	Chlorine Contactor Walls	844	CuYd	$250	$211,000	$250	$211,000	$420,000
3	Chlorine Contactor Suspended Slab	62	CuYd	$250	$15,500	$375	$23,300	$40,000
4	Chlorine Storage & Feed System	1	LS	$150,000	$150,000	$75,000	$75,000	$230,000
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$960,000**
	Plant Paving, Grading, and Yard Piping			10%				$100,000
	Mechanical and Piping			5%				$50,000
	Electrical			15%				$140,000
	Instrumentation and Controls			15%				$140,000
	SUBTOTAL							**$1,390,000**
	Project Phase-Level OPCC Contingency			30%				$420,000
	SUBTOTAL							**$1,810,000**
	Tax on Materials			9.5%				$90,000
	Contractor's Markup on Sub-Contractors' Work			10%				$30,000
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$450,000
	Contractor's General Conditions			10%				$180,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,560,000**
	Construction Contingency			10%				$260,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,720,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Treated Water Storage (9 MG)
ELEMENT #: 8

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 29-Jul-16
REVIEWED BY: CMT

	DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Treated Water Transfer Pump Station	90	CuYd	$250	$22,500	$125	$11,250	$33,750
2	3.0 MG Treated Water Storage Tanks	3	EA	$2,890,000	$8,670,000	$1,445,000	$4,335,000	$13,005,000
3	Treated Water Transfer Pump Station (Vertical Turbine Pumps)	3	EA	$21,044	$63,131	$8,418	$25,253	$88,384
4	Treated Water Delivery Pump Station (Vertical Turbine Pumps)	3	EA	$60,000	$180,000	$24,000	$72,000	$252,000
5	TW Tank Isolation Valves (24" motor - actuated)	6	EA	$12,750	$76,500	$0	$0	$76,500
6	TW Transfer PS Isolation Valves (18" - 20" manual-actuated)	6	EA	$3,315	$19,890	$0	$0	$19,890
7	TW Transfer PS Check Valves (18" - 20" dia.)	6	EA	$23,771	$142,626	$0	$0	$142,626
8	TW Delivery PS Isolation Valves (18" - 20" manual-actuated)	6	EA	$3,315	$19,890	$0	$0	$19,890
9	TW Delivery PS Check Valves (18" - 20" dia.)	6	EA	$23,771	$142,626	$0	$0	$142,626
10								
	SUBTOTAL							**$13,780,666**
	Plant Paving, Grading, and Yard Piping			10%				$1,378,000
	Mechanical and Piping			5%				$689,000
	Electrical			15%				$2,067,000
	Instrumentation and Controls			15%				$2,067,000
	SUBTOTAL							**$19,981,666**
	Project Phase-Level OPCC Contingency			30%				$5,994,000
	SUBTOTAL							**$25,975,666**
	Tax on Materials			9.5%				$1,234,000
	Contractor's Markup on Sub-Contractors' Work			10%				$413,400
	Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$6,494,000
	Contractor's General Conditions			10%				$2,598,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$36,715,066**
	Construction Contingency			10%				$3,670,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$12,850,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$53,235,066**

APPENDIX H-10

Alternatives for Increasing Anaerobic Digestion Capacity

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Fourth Digester**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/20/2017**

ELEMENT #	DESCRIPTION		COST
1	Fourth Digester		$5,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$5,300,000**
	Construction Contingency	10%	$500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$1,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$7,700,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**High Solids Digestion**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/20/2017**

ELEMENT #	DESCRIPTION		COST
2	High Solids Digestion System		$5,800,000
3	High Solids Digestion System Digested Sludge Pumps		$100,000
4	High Solids Digestion System Recupertive Thickener EQ and Pumps		$700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$6,600,000**
	Construction Contingency	10%	$700,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$2,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$9,600,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Fourth Digester

ELEMENT #: 1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Reinforced Concrete Slab	165	CuYd	$250	$41,000	$250	$41,000	$80,000
Reinforced Concrete Walls	470	CuYd	$300	$141,000	$700	$329,000	$470,000
Digester Coating	1	LS	$50,000	$50,000	$150,000	$150,000	$200,000
Digester Mixing System	1	LS	$50,000	$50,000	$20,000	$20,000	$70,000
Digester Steel Dome	1	LS	$200,000	$200,000	$180,000	$180,000	$380,000
Digester Gas Piping	1	LS	$50,000	$50,000	$30,000	$30,000	$80,000
Digester Mix Piping	1	LS	$50,000	$50,000	$30,000	$30,000	$80,000
Digester Heating System	1	LS	$400,000	$400,000	$250,000	$250,000	$650,000
SUBTOTAL							**$2,010,000**
Plant Paving, Grading, and Yard Piping			15%				$300,000
Mechanical and Piping			10%				$200,000
Electrical			10%				$200,000
Instrumentation and Controls			10%				$200,000
SUBTOTAL							**$2,910,000**
Project Phase-Level OPCC Contingency			30%				$870,000
SUBTOTAL							**$3,780,000**
Tax on Materials			9.5%				$180,000
Contractor's Markup on Sub-Contractors' Work			10%				$40,000
Contractor's Overhead and Profit, Mob/Demob			25%				$950,000
Contractor's General Conditions			10%				$380,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$5,330,000**
Construction Contingency			10%				**$530,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$1,870,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$7,730,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: High Solids Digestion System Equipment

ELEMENT #: 2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
High Solids Digestion Thickeners and Mixers	2	EA	$1,250,000	$2,500,000	INCL.		$2,500,000
Digester Heating System	2	EA	$250,000	$500,000	$100,000	$200,000	$700,000
SUBTOTAL							**$3,200,000**
Plant Paving, Grading, and Yard Piping			0%				$0
Mechanical and Piping			0%				$0
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$3,200,000**
Project Phase-Level OPCC Contingency			30%				$960,000
SUBTOTAL							**$4,160,000**
Tax on Materials			9.5%				$200,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$1,040,000
Contractor's General Conditions			10%				$420,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$5,820,000**
Construction Contingency			10%				**$580,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$2,040,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$8,440,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: High Solids Digestion System Pumps

ELEMENT #: 3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
High Solids Digestion Sludge Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$45,000
SUBTOTAL							**$45,000**
Plant Paving, Grading, and Yard Piping			10%				$5,000
Mechanical and Piping			5%				$2,000
Electrical			15%				$7,000
Instrumentation and Controls			15%				$7,000
SUBTOTAL							**$70,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$90,000**
Tax on Materials			9.5%				$4,000
Contractor's Markup on Sub-Contractors' Work			10%				$1,000
Contractor's Overhead and Profit, Mob/Demob			25%				$23,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$130,000**
Construction Contingency			10%				**$10,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$50,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$190,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: High Solids Digestion System EQ

ELEMENT #: 4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Recuperative Thickener Return Flow EQ Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Recuperative Thickener Return Stream EQ Tank	4	10,000 gal	$51,000	$204,000.00	INCL.	INCL.	$200,000
SUBTOTAL							**$250,000**
Plant Paving, Grading, and Yard Piping			10%				$30,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$40,000
Instrumentation and Controls			15%				$40,000
SUBTOTAL							**$370,000**
Project Phase-Level OPCC Contingency			30%				$110,000
SUBTOTAL							**$480,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$120,000
Contractor's General Conditions			10%				$50,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$680,000**
Construction Contingency			10%				**$70,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$240,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$990,000**

APPENDIX H-11

Alternatives for Reducing DLD Site Hydraulic Loadings

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Thicken All FSL solids for DLD Site Application in Summer**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/20/2017**

ELEMENT #	DESCRIPTION		COST
1-1	Pipeline		$300,000
2-1	Pumps		$1,500,000
3	Thickening Facilities		$4,600,000
4-1	Thickener Building		$5,000,000
5-1	Flow EQ		$3,800,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$15,200,000**
	Construction Contingency	10%	$1,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$5,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$22,000,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER WLS
REVIEWED BY: GKC

DESCRIPTION OF WORK: Dewater Portion of Digested Solids for Offsite Disposal Year-Round
TYPE OF ESTIMATE: Conceptual Design Level
DATE: Conceptual Design Level

ELEMENT #	DESCRIPTION		COST
1-2	Pipeline		$400,000
2-2	Pumps		$400,000
6-1	Dewatering Facilities		$2,710,000
4-2	Dewatering Building		$6,600,000
5-2	Flow EQ		$1,900,000
7	Odor Control		$1,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$13,100,000**
	Construction Contingency	10%	$1,300,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$4,600,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$19,000,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER WLS
REVIEWED BY: GKC

DESCRIPTION OF WORK: Dewater a Portion of FSL Solids for Offsite Disposal in Winter
TYPE OF ESTIMATE: Conceptual Design Level
DATE: 1/20/2017

ELEMENT #	DESCRIPTION		COST
1-3	Pipeline		$500,000
2-3	Pumps		$400,000
6-2	Dewatering Facilities		$2,700,000
4-1	Dewatering Building		$5,000,000
5-3	Flow EQ		$1,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$10,100,000**
	Construction Contingency	10%	$1,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$3,500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$14,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Dewater All FSLs Solids for DLD Site Application in Summer**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/20/2017**

ELEMENT #	DESCRIPTION		COST
1-4	Pipeline		$500,000
2-2	Pumps		$400,000
6-3	Dewatering Facilities		$6,100,000
4-1	Dewatering Building		$5,000,000
5-4	Flow EQ		$2,300,000
8	Biosolids Spreader		$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$14,800,000**
	Construction Contingency	10%	$1,500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$5,200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$21,500,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Thicken All FSL solids for DLD Site Application in Summer)**
ELEMENT #:	**1-1**

OPPC PROVIDED BY: **WLS**
OPPC PREPARATION DATE: **1/3/2017**
REVIEWED BY: **GKC**

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Feed Pipeline	410	LF	$75	$30,750	$75	$30,750	$60,000
Thickening Return Stream Pipeline	865	LF	$75	$64,875	$75	$64,875	$130,000
Thickened Sludge Pipeline	376	LF	$75	$28,200	$75	$28,200	$60,000
FSL Return Stream Treatment Pipeline	245	LF	$75	$18,375	$75	$18,375	$40,000
SUBTOTAL							**$140,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$10,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$160,000**
Project Phase-Level OPCC Contingency			30%				$50,000
SUBTOTAL							**$210,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$50,000
Contractor's General Conditions			10%				$20,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$290,000**
Construction Contingency			10%				**$30,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$100,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$420,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Dewater Portion of Digested Solids for Offsite Disposal Year-Round)**
ELEMENT #:	**1-2**

OPPC PROVIDED BY: **WLS**
OPPC PREPARATION DATE: **1/3/2017**
REVIEWED BY: **GKC**

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pipeline	70	LF	$75	$5,000	$75	$5,000	$10,000
Dewatering Return Stream Pipeline	865	LF	$75	$65,000	$75	$65,000	$130,000
FSL Return Stream Treatment Pipeline	245	LF	$75	$18,000	$75	$18,000	$40,000
SUBTOTAL							**$180,000**
Plant Paving, Grading, and Yard Piping			10%				$20,000
Mechanical and Piping			5%				$9,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$210,000**
Project Phase-Level OPCC Contingency			30%				$60,000
SUBTOTAL							**$270,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$70,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$380,000**
Construction Contingency			10%				**$40,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$130,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$550,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Dewater a Portion of FSL Solids for Offsite Disposal in Winter)**
ELEMENT #:	**1-3**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pipeline	410	LF	$75	$30,750	$75	$30,750	$60,000
Dewatering Return Stream Pipeline	865	LF	$75	$64,875	$75	$64,875	$130,000
FSL Return Stream Treatment Pipeline	245	LF	$75	$18,375	$75	$18,375	$40,000
SUBTOTAL							**$230,000**
Plant Paving, Grading, and Yard Piping			10%				$20,000
Mechanical and Piping			5%				$10,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$260,000**
Project Phase-Level OPCC Contingency			30%				$80,000
SUBTOTAL							**$340,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$90,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$480,000**
Construction Contingency			10%				**$50,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$170,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$700,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Pipeline (Dewater All FSLs Solids for DLD Site Application in Summer)
ELEMENT #:	1-4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pipeline	410	LF	$75	$30,800	$75	$30,800	$60,000
Dewatering Return Stream Pipeline	865	LF	$75	$64,900	$75	$64,900	$130,000
FSL Return Stream Treatment Pipeline	245	LF	$75	$18,400	$75	$18,400	$40,000
SUBTOTAL							**$230,000**
Plant Paving, Grading, and Yard Piping			10%				$20,000
Mechanical and Piping			5%				$10,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$260,000**
Project Phase-Level OPCC Contingency			30%				$80,000
SUBTOTAL							**$340,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$90,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$480,000**
Construction Contingency			10%				**$50,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$170,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$700,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pumps (Thicken All FSL solids for DLD Site Application in Summer)**
ELEMENT #:	**2-1**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Return Stream Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Solids Storage Feed Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Sludge Injection Tractor Feed Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Thickening Return Flow EQ Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Dredge	1	EA	$350,000	$350,000	INCL	INCL	$350,000
Thickening Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$575,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$90,000
Instrumentation and Controls			15%				$90,000
SUBTOTAL							**$845,000**
Project Phase-Level OPCC Contingency			30%				$250,000
SUBTOTAL							**$1,095,000**
Tax on Materials			9.5%				$50,000
Contractor's Markup on Sub-Contractors' Work			10%				$18,000
Contractor's Overhead and Profit, Mob/Demob			25%				$270,000
Contractor's General Conditions			10%				$110,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,540,000**
Construction Contingency			10%				**$150,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$540,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,230,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pumps (Dewater Portion of Digested Solids for Offsite Disposal Year-Round)**
ELEMENT #:	**2-2**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Dewatering Return Flow EQ Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Dewatering Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$135,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$7,000
Electrical			15%				$20,000
Instrumentation and Controls			15%				$20,000
SUBTOTAL							**$190,000**
Project Phase-Level OPCC Contingency			30%				$60,000
SUBTOTAL							**$250,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$4,000
Contractor's Overhead and Profit, Mob/Demob			25%				$60,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$350,000**
Construction Contingency			10%				**$40,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$120,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$510,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumps (Dewater a Portion of FSL Solids for Offsite Disposal in Winter)

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 2-3

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$45,000
Return Flow EQ Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$45,000
Dewatering Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$135,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$7,000
Electrical			15%				$20,000
Instrumentation and Controls			15%				$20,000
SUBTOTAL							**$190,000**
Project Phase-Level OPCC Contingency			30%				$60,000
SUBTOTAL							**$250,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$4,000
Contractor's Overhead and Profit, Mob/Demob			25%				$60,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$350,000**
Construction Contingency			10%				**$40,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$120,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$510,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumps (Dewater All FSLs Solids for DLD Site Application in Summer)
ELEMENT #: 2-4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Return Flow EQ Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
Dewatering Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$135,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$7,000
Electrical			15%				$20,000
Instrumentation and Controls			15%				$20,000
SUBTOTAL							**$190,000**
Project Phase-Level OPCC Contingency			30%				$60,000
SUBTOTAL							**$250,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$4,000
Contractor's Overhead and Profit, Mob/Demob			25%				$60,000
Contractor's General Conditions			10%				$30,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$350,000**
Construction Contingency			10%				**$40,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$120,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$510,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Thickening Facilities

ELEMENT #: 3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Equipment Pads	54	CuYd	$250	$14,000	$125	$6,800	$20,000
Rotary Screen Thickener	3	EA	$341,500	$1,024,500	$100,000	$300,000	$1,320,000
Polymer Dosing Equipment Pads	1	CuYd	$250	$250	$125	$130	$400
Polymer Dosing System	1	EA	$41,000	$41,000	$7,500	$8,000	$50,000
Thickened Sludge Storage	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$306,000
SUBTOTAL							**$1,700,000**
Plant Paving, Grading, and Yard Piping			10%				$170,000
Mechanical and Piping			5%				$90,000
Electrical			15%				$260,000
Instrumentation and Controls			15%				$260,000
SUBTOTAL							**$2,480,000**
Project Phase-Level OPCC Contingency			30%				$740,000
SUBTOTAL							**$3,220,000**
Tax on Materials			9.5%				$150,000
Contractor's Markup on Sub-Contractors' Work			10%				$50,000
Contractor's Overhead and Profit, Mob/Demob			25%				$810,000
Contractor's General Conditions			10%				$320,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,550,000**
Construction Contingency			10%				**$460,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$1,590,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$6,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Thickening Building**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 4-1

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Building	4,425	SF	$420	$1,859,000	INCL.	INCL.	$1,860,000
SUBTOTAL							**$1,860,000**
Plant Paving, Grading, and Yard Piping			10%				$190,000
Mechanical and Piping			5%				$90,000
Electrical			15%				$280,000
Instrumentation and Controls			15%				$280,000
SUBTOTAL							**$2,700,000**
Project Phase-Level OPCC Contingency			30%				$810,000
SUBTOTAL							**$3,510,000**
Tax on Materials			9.5%				$170,000
Contractor's Markup on Sub-Contractors' Work			10%				$60,000
Contractor's Overhead and Profit, Mob/Demob			25%				$880,000
Contractor's General Conditions			10%				$350,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,970,000**
Construction Contingency			10%				**$500,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$1,740,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$7,210,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Dewatering Building**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 4-2

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Building	5,900	SF	$420	$2,478,000	INCL.	INCL.	$2,480,000
SUBTOTAL							**$2,480,000**
Plant Paving, Grading, and Yard Piping			10%				$250,000
Mechanical and Piping			5%				$120,000
Electrical			15%				$370,000
Instrumentation and Controls			15%				$370,000
SUBTOTAL							**$3,590,000**
Project Phase-Level OPCC Contingency			30%				$1,080,000
SUBTOTAL							**$4,670,000**
Tax on Materials			9.5%				$220,000
Contractor's Markup on Sub-Contractors' Work			10%				$70,000
Contractor's Overhead and Profit, Mob/Demob			25%				$1,170,000
Contractor's General Conditions			10%				$470,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$6,600,000**
Construction Contingency			10%				**$660,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$2,310,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$9,570,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**EQ Tank (Thicken All FSL solids for DLD Site Application in Summer)**
ELEMENT #:	**5-1**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickening Return Stream EQ Tank	12	10,000 gal	$51,000	$612,000	INCL.	INCL.	$610,000
Thickened Sludge Storage Tank	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
FSL Solids Storage	10	10,000 gal	$51,000	$510,000	INCL.	INCL.	$510,000
SUBTOTAL							**$1,430,000**
Plant Paving, Grading, and Yard Piping			10%				$140,000
Mechanical and Piping			5%				$70,000
Electrical			15%				$210,000
Instrumentation and Controls			15%				$210,000
SUBTOTAL							**$2,060,000**
Project Phase-Level OPCC Contingency			30%				$620,000
SUBTOTAL							**$2,680,000**
Tax on Materials			9.5%				$130,000
Contractor's Markup on Sub-Contractors' Work			10%				$40,000
Contractor's Overhead and Profit, Mob/Demob			25%				$670,000
Contractor's General Conditions			10%				$270,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$3,790,000**
Construction Contingency			10%				**$380,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$1,330,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$5,500,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: EQ Tank (Dewater Portion of Digested Solids for Offsite Disposal Year-Round)

ELEMENT #: 5-2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream EQ Tank	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
Digested Solids Storage	8	10,000 gal	$51,000	$408,000	INCL.	INCL.	$410,000
SUBTOTAL							**$710,000**
Plant Paving, Grading, and Yard Piping			10%				$70,000
Mechanical and Piping			5%				$40,000
Electrical			15%				$110,000
Instrumentation and Controls			15%				$110,000
SUBTOTAL							**$1,040,000**
Project Phase-Level OPCC Contingency			30%				$310,000
SUBTOTAL							**$1,350,000**
Tax on Materials			9.5%				$60,000
Contractor's Markup on Sub-Contractors' Work			10%				$22,000
Contractor's Overhead and Profit, Mob/Demob			25%				$338,000
Contractor's General Conditions			10%				$135,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,905,000**
Construction Contingency			10%				**$190,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$670,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,765,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**EQ Tank (Dewater a Portion of FSL Solids for Offsite Disposal in Winter)**
ELEMENT #:	**5-3**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream EQ Tank	5	10,000 gal	$51,000	$255,000	INCL.	INCL.	$260,000
FSL Solids Storage	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
SUBTOTAL							**$560,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$80,000
Instrumentation and Controls			15%				$80,000
SUBTOTAL							**$810,000**
Project Phase-Level OPCC Contingency			30%				$240,000
SUBTOTAL							**$1,050,000**
Tax on Materials			9.5%				$50,000
Contractor's Markup on Sub-Contractors' Work			10%				$16,000
Contractor's Overhead and Profit, Mob/Demob			25%				$260,000
Contractor's General Conditions			10%				$110,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,490,000**
Construction Contingency			10%				**$150,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$520,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,160,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**EQ Tank (Dewater All FSLs Solids for DLD Site Application in Summer)**
ELEMENT #:	**5-4**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Return Stream EQ Tank	11	10,000 gal	$51,000	$561,000	INCL.	INCL.	$561,000
FSL Solids Storage	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
SUBTOTAL							**$870,000**
Plant Paving, Grading, and Yard Piping			10%				$90,000
Mechanical and Piping			5%				$40,000
Electrical			15%				$130,000
Instrumentation and Controls			15%				$130,000
SUBTOTAL							**$1,260,000**
Project Phase-Level OPCC Contingency			30%				$380,000
SUBTOTAL							**$1,640,000**
Tax on Materials			9.5%				$80,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$410,000
Contractor's General Conditions			10%				$160,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,320,000**
Construction Contingency			10%				**$230,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$810,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,360,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering Facilities (Dewater Portion of Digested Solids for Offsite Disposal Year-Round)
ELEMENT #: 6-1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Screw Press Equipment Pads	70	CuYd	$250	$18,000	$125	$8,800	$30,000
Polymer Dosing Equipment Pads	2	CuYd	$250	$500	$125	$300	$1,000
Screw Press	2	EA	$341,500	$683,000	$75,000	$150,000	$830,000
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
Polymer Dosing System	1	LS	$40,500	$40,500	$7,500	$7,500	$50,000
SUBTOTAL							**$1,030,000**
Plant Paving, Grading, and Yard Piping			10%				$100,000
Mechanical and Piping			5%				$50,000
Electrical			15%				$150,000
Instrumentation and Controls			15%				$150,000
SUBTOTAL							**$1,480,000**
Project Phase-Level OPCC Contingency			30%				$440,000
SUBTOTAL							**$1,920,000**
Tax on Materials			9.5%				$90,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$480,000
Contractor's General Conditions			10%				$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,710,000**
Construction Contingency			10%				**$270,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$950,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,930,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering Facilities (Dewater a Portion of FSL Solids for Offsite Disposal in Winter)

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 6-2

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Screw Press Equipment Pads	36	CuYd	$250	$9,000	$125	$4,500	$10,000
Polymer Dosing Equipment Pads	1	CuYd	$250	$250	$125	$130	$400
Screw Press	2	EA	$341,500	$683,000	$75,000	$150,000	$830,000
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
Polymer Dosing System	1	LS	$40,500	$40,500	$7,500	$7,500	$50,000
SUBTOTAL							**$1,010,000**
Plant Paving, Grading, and Yard Piping			10%				$100,000
Mechanical and Piping			5%				$50,000
Electrical			15%				$150,000
Instrumentation and Controls			15%				$150,000
SUBTOTAL							**$1,460,000**
Project Phase-Level OPCC Contingency			30%				$440,000
SUBTOTAL							**$1,900,000**
Tax on Materials			9.5%				$90,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$480,000
Contractor's General Conditions			10%				$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,690,000**
Construction Contingency			10%				**$270,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$940,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,900,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering Facilities (Dewater All FSLs Solids for DLD Site Application in Summer)
ELEMENT #: 6-3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Screw Press Equipment Pads	90	CuYd	$250	$23,000	$125	$11,300	$34,300
Polymer Dosing Equipment Pads	1	CuYd	$250	$250	$125	$100	$400
Screw Press	5	EA	$341,500	$1,707,500	$75,000	$375,000	$2,080,000
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
Polymer Dosing System	1	LS	$40,500	$40,500	$7,500	$7,500	$50,000
SUBTOTAL							**$2,290,000**
Plant Paving, Grading, and Yard Piping			10%				$230,000
Mechanical and Piping			5%				$110,000
Electrical			15%				$340,000
Instrumentation and Controls			15%				$340,000
SUBTOTAL							**$3,310,000**
Project Phase-Level OPCC Contingency			30%				$990,000
SUBTOTAL							**$4,300,000**
Tax on Materials			9.5%				$200,000
Contractor's Markup on Sub-Contractors' Work			10%				$70,000
Contractor's Overhead and Profit, Mob/Demob			25%				$1,080,000
Contractor's General Conditions			10%				$430,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$6,080,000**
Construction Contingency			10%				**$610,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$2,130,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$8,820,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**ODOR CONTROL**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 7

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Odor Control Fans, Duct Work, and Biofilter	1	LS	$400,000	$400,000	INCL.	INCL.	$400,000
SUBTOTAL							**$400,000**
Plant Paving, Grading, and Yard Piping			10%				$40,000
Mechanical and Piping			5%				$20,000
Electrical			15%				$60,000
Instrumentation and Controls			15%				$60,000
SUBTOTAL							**$580,000**
Project Phase-Level OPCC Contingency			30%				$170,000
SUBTOTAL							**$750,000**
Tax on Materials			9.5%				$40,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$190,000
Contractor's General Conditions			10%				$80,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,070,000**
Construction Contingency			10%				**$110,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$370,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,550,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Spreader Truck (Dewater All FSLs Solids for DLD Site Application in Summer)**
ELEMENT #:	**8**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Truck	2	EA	$155,000	$310,000	INCL.	INCL.	$310,000
Spreader	2	EA	$65,000	$130,000	INCL.	INCL.	$130,000
SUBTOTAL							**$440,000**
Plant Paving, Grading, and Yard Piping			0%				$0
Mechanical and Piping			0%				$0
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$440,000**
Project Phase-Level OPCC Contingency			0%				$0
SUBTOTAL							**$440,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			0%				$0
Contractor's Overhead and Profit, Mob/Demob			0%				$0
Contractor's General Conditions			0%				$0
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$460,000**
Construction Contingency			0%				**$0**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			0%				**$0**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$460,000**

APPENDIX H-12-i

Potential Future Expansion to Full Dewatering:
All Dewatering from FSLs

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
PROJECT #:	406-19-15-39
OPPC MANAGER	WLS
REVIEWED BY:	GKC
DESCRIPTION OF WORK:	Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from FSLs
TYPE OF ESTIMATE:	Conceptual Design Level
DATE:	1/3/2017

ELEMENT #	DESCRIPTION		COST
1	Thickening System Modifications		$200,000
2	Sludge Conveyor		$300,000
4-1	Flow EQ		$300,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$900,000**
	Construction Contingency	10%	$100,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,300,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Dewater Portion of Digested Solids for Offsite Disposal Year-Round→Dewater All Solids From FSLs**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/3/2017**

ELEMENT #	DESCRIPTION		COST
3	Pipeline		$20,000
4-2	Flow EQ		$600,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$700,000**
	Construction Contingency	10%	$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$200,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,000,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from FSLs**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/3/2017**

ELEMENT #	DESCRIPTION		COST
4-3	Flow EQ		$900,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$1,000,000**
	Construction Contingency	10%	$100,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,500,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Dewater Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from FSLs**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/3/2017**

ELEMENT #	DESCRIPTION		COST
4-4	Flow EQ		$900,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$1,000,000**
	Construction Contingency	10%	$100,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,500,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Thickener Modifications (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from FSLs)
ELEMENT #: 1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Modify Thickener (install Dewatering Screen)	2	EA	$22,800	$45,600	$10,000	$20,000	$70,000
SUBTOTAL							**$70,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$4,000
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$100,000**
Project Phase-Level OPCC Contingency			30%				$30,000
SUBTOTAL							**$130,000**
Tax on Materials			9.5%				$6,000
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob			25%				$30,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$180,000**
Construction Contingency			10%				**$20,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$60,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$260,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Sludge Conveyor (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from FSLs)**
ELEMENT #:	**2**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
SUBTOTAL							**$120,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$20,000
Instrumentation and Controls			15%				$20,000
SUBTOTAL							**$180,000**
Project Phase-Level OPCC Contingency			30%				$50,000
SUBTOTAL							**$230,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$4,000
Contractor's Overhead and Profit, Mob/Demob			25%				$60,000
Contractor's General Conditions			10%				$20,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$320,000**
Construction Contingency			10%				**$30,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$110,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$460,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Dewater Portion of Digested Solids for Offsite Disposal Year-Round→Dewater All Solids From FSLs)**
ELEMENT #:	**3**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
SUBTOTAL							**$10,000**
Plant Paving, Grading, and Yard Piping			10%				$1,000
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$12,000**
Project Phase-Level OPCC Contingency			30%				$4,000
SUBTOTAL							**$16,000**
Tax on Materials			9.5%				$1,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$0
Contractor's General Conditions			10%				$2,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$20,000**
Construction Contingency			10%				**$2,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$10,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$30,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: EQ Tanks (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from FSLs)

ELEMENT #: 4-1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dredge FSL Solids Storage	2	10,000 gal	$51,000	$102,000	INCL.	INCL.	$100,000
SUBTOTAL							**$100,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$20,000
Instrumentation and Controls			15%				$20,000
SUBTOTAL							**$160,000**
Project Phase-Level OPCC Contingency			30%				$50,000
SUBTOTAL							**$210,000**
Tax on Materials			9.5%				$10,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$50,000
Contractor's General Conditions			10%				$20,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$290,000**
Construction Contingency			10%				**$29,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$100,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$419,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**EQ Tanks (Dewater Portion of Digested Solids for Offsite Disposal Year-Round→Dewater All Solids From FSLs)**
ELEMENT #:	**4-2**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dredge FSL Solids Storage	4	10,000 gal	$51,000	$204,000	INCL.	INCL.	$200,000
SUBTOTAL							**$200,000**
Plant Paving, Grading, and Yard Piping			10%				$20,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$30,000
Instrumentation and Controls			15%				$30,000
SUBTOTAL							**$290,000**
Project Phase-Level OPCC Contingency			30%				$90,000
SUBTOTAL							**$380,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$100,000
Contractor's General Conditions			10%				$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$550,000**
Construction Contingency			10%				**$55,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$190,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$795,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	EQ Tanks (Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from FSLs)
ELEMENT #:	4-3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dredge FSL Solids Storage	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
SUBTOTAL							**$310,000**
Plant Paving, Grading, and Yard Piping			10%				$30,000
Mechanical and Piping			5%				$20,000
Electrical			15%				$50,000
Instrumentation and Controls			15%				$50,000
SUBTOTAL							**$460,000**
Project Phase-Level OPCC Contingency			30%				$140,000
SUBTOTAL							**$600,000**
Tax on Materials			9.5%				$30,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$150,000
Contractor's General Conditions			10%				$60,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$850,000**
Construction Contingency			10%				**$85,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$300,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,235,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: EQ Tanks (Dewater Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from FSLs)

ELEMENT #: 4-4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dredge FSL Solids Storage	6	10,000 gal	$51,000	$306,000	INCL.	INCL.	$310,000
SUBTOTAL							**$310,000**
Plant Paving, Grading, and Yard Piping			10%				$30,000
Mechanical and Piping			5%				$20,000
Electrical			15%				$50,000
Instrumentation and Controls			15%				$50,000
SUBTOTAL							**$460,000**
Project Phase-Level OPCC Contingency			30%				$140,000
SUBTOTAL							**$600,000**
Tax on Materials			9.5%				$30,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$150,000
Contractor's General Conditions			10%				$60,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$850,000**
Construction Contingency			10%				**$85,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$300,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,235,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Sludge Storage Pumps

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 8

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$50,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$3,000
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$80,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$100,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob			25%				$30,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$140,000**
Construction Contingency			10%				**$10,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$50,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$200,000**

APPENDIX H-12-ii

Potential Future Expansion to Full Dewatering:
All Dewatering from Digesters

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Thicken All FSL solids for DLD Site Application in Summer → Dewater All Solids from Digester**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/3/2017**

ELEMENT #	DESCRIPTION		COST
1-1	Pipeline		$40,000
2	Thickening System Modifications		$1,400,000
4	Sludge Conveyor		$500,000
5-1	Dewatering Building Modifications		$1,700,000
7	Odor Control		$1,100,000
6-1	Flow EQ		$1,100,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$5,900,000**
	Construction Contingency	10%	$600,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$2,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$8,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Dewater Portion of Digested Solids for Offsite Disposal Year-Round → Dewater All Solids from Digester**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**1/3/2017**

ELEMENT #	DESCRIPTION		COST
3-1	Dewatering System Modifications		$1,500,000
6-2	Flow EQ		$2,300,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$3,900,000**
	Construction Contingency	10%	$400,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$1,400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$5,700,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
PROJECT #:	406-19-15-39
OPPC MANAGER	WLS
REVIEWED BY:	GKC
DESCRIPTION OF WORK:	Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from Digester
TYPE OF ESTIMATE:	Conceptual Design Level
DATE:	1/3/2017

ELEMENT #	DESCRIPTION		COST
1-2	Pipeline		$10,000
3-2	Dewatering System		$2,600,000
6-3	Flow EQ		$2,700,000
5-2	Dewatering Building Modifications		$1,700,000
7	Odor Control		$1,100,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$8,200,000**
	Construction Contingency	10%	$800,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$2,900,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$11,900,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER WLS
REVIEWED BY: GKC

DESCRIPTION OF WORK: Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from Digesters
TYPE OF ESTIMATE: Conceptual Design Level
DATE: 1/3/2017

ELEMENT #	DESCRIPTION		COST
1-3	Pipeline		$10,000
6-4	Flow EQ		$1,900,000
5-3	Dewatering Building Modifications		$1,700,000
7	Odor Control		$1,100,000
8	Sludge Storage Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$4,800,000**
	Construction Contingency	10%	$500,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$1,700,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$7,000,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Thicken All FSL solids for DLD Site Application in Summer → Dewater All Solids from Digester)**
ELEMENT #:	**1-1**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Feed Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
Convert Thickened Sludge Storage to Filtrate Storage By Adding New Piping	50	LF	$75	$3,750	$75	$3,750	$10,000
SUBTOTAL							**$20,000**
Plant Paving, Grading, and Yard Piping			10%				$2,000
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$20,000**
Project Phase-Level OPCC Contingency			30%				$10,000
SUBTOTAL							**$30,000**
Tax on Materials			9.5%				$1,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$10,000
Contractor's General Conditions			10%				$3,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$40,000**
Construction Contingency			10%				**$4,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$10,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$50,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pipeline (Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from Digester)

ELEMENT #: 1-2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
SUBTOTAL							**$10,000**
Plant Paving, Grading, and Yard Piping			10%				$1,000
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$10,000**
Project Phase-Level OPCC Contingency			30%				$0
SUBTOTAL							**$10,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$0
Contractor's General Conditions			10%				$1,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$10,000**
Construction Contingency			10%				**$1,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$0**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Pipeline (Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from Digesters)
ELEMENT #:	1-3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
SUBTOTAL							**$10,000**
Plant Paving, Grading, and Yard Piping			10%				$1,000
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$10,000**
Project Phase-Level OPCC Contingency			30%				$3,000
SUBTOTAL							**$10,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob			25%				$0
Contractor's General Conditions			10%				$1,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$10,000**
Construction Contingency			10%				**$1,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$0**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Thickener Modifications (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from Digester)

ELEMENT #: 2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Modify Thickener (install Dewatering Screen)	3	EA	$22,800	$68,400	$10,000	$30,000	$100,000
Screw Press	1	EA	$341,500	$341,500	$75,000	$75,000	$420,000
SUBTOTAL							**$520,000**
Plant Paving, Grading, and Yard Piping			10%				$50,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$80,000
Instrumentation and Controls			15%				$80,000
SUBTOTAL							**$760,000**
Project Phase-Level OPCC Contingency			30%				$230,000
SUBTOTAL							**$990,000**
Tax on Materials			9.5%				$50,000
Contractor's Markup on Sub-Contractors' Work			10%				$16,000
Contractor's Overhead and Profit, Mob/Demob			25%				$248,000
Contractor's General Conditions			10%				$100,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,400,000**
Construction Contingency			10%				**$140,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$490,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,030,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering System Modifications (Dewater Portion of Digested Solids for Offsite Disposal Year-Round → Dewater All Solids from Digester)
ELEMENT #: 3-1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Screw Press	1	EA	$341,500	$341,500	$75,000	$75,000	$420,000
Screw Press Equipment Pads	35	CuYd	$250	$9,000	$125	$4,380	$10,000
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
SUBTOTAL							**$550,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$80,000
Instrumentation and Controls			15%				$80,000
SUBTOTAL							**$800,000**
Project Phase-Level OPCC Contingency			30%				$240,000
SUBTOTAL							**$1,040,000**
Tax on Materials			9.5%				$50,000
Contractor's Markup on Sub-Contractors' Work			10%				$20,000
Contractor's Overhead and Profit, Mob/Demob			25%				$260,000
Contractor's General Conditions			10%				$100,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,470,000**
Construction Contingency			10%				**$150,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$510,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,130,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering System Modifications (Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from Digester)

ELEMENT #: 3-2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Screw Press	2	EA	$341,500	$683,000	$75,000	$150,000	$830,000
Screw Press Equipment Pads	70	CuYd	$250	$18,000	$125	$8,750	$30,000
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
SUBTOTAL							**$980,000**
Plant Paving, Grading, and Yard Piping			10%				$100,000
Mechanical and Piping			5%				$50,000
Electrical			15%				$150,000
Instrumentation and Controls			15%				$150,000
SUBTOTAL							**$1,430,000**
Project Phase-Level OPCC Contingency			30%				$430,000
SUBTOTAL							**$1,860,000**
Tax on Materials			9.5%				$90,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$470,000
Contractor's General Conditions			10%				$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,640,000**
Construction Contingency			10%				**$260,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$920,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,820,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Sludge Conveyor (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from Digester)

ELEMENT #: 4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Sludge Conveyor	1	LS	$103,000	$103,000	$17,000	$17,000	$120,000
Dewatered Sludge Hopper	1	LS	$50,000	$50,000	$10,000	$10,000	$60,000
SUBTOTAL							**$180,000**
Plant Paving, Grading, and Yard Piping			10%				$20,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$30,000
Instrumentation and Controls			15%				$30,000
SUBTOTAL							**$270,000**
Project Phase-Level OPCC Contingency			30%				$80,000
SUBTOTAL							**$350,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$6,000
Contractor's Overhead and Profit, Mob/Demob			25%				$90,000
Contractor's General Conditions			10%				$40,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$510,000**
Construction Contingency			10%				**$50,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$180,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$740,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering Building (Thicken All FSL Solids for DLD Site Application in Summer → Dewater All Solids from Digester)

ELEMENT #: 5-1

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Building Modifications	1,475	SF	$420	$620,000	INCL.	INCL.	$620,000
SUBTOTAL							**$620,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$90,000
Instrumentation and Controls			15%				$90,000
SUBTOTAL							**$890,000**
Project Phase-Level OPCC Contingency			30%				$270,000
SUBTOTAL							**$1,160,000**
Tax on Materials			9.5%				$60,000
Contractor's Markup on Sub-Contractors' Work			10%				$20,000
Contractor's Overhead and Profit, Mob/Demob			25%				$290,000
Contractor's General Conditions			10%				$120,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,650,000**
Construction Contingency			10%				**$170,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$580,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,400,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Dewatering Building (Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from Digester)

ELEMENT #: 5-2

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Building Modifications	1,475	SF	$420	$620,000	INCL.	INCL.	$620,000
SUBTOTAL							**$620,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$90,000
Instrumentation and Controls			15%				$90,000
SUBTOTAL							**$890,000**
Project Phase-Level OPCC Contingency			30%				$270,000
SUBTOTAL							**$1,160,000**
Tax on Materials			9.5%				$100,000
Contractor's Markup on Sub-Contractors' Work			10%				$20,000
Contractor's Overhead and Profit, Mob/Demob			25%				$290,000
Contractor's General Conditions			10%				$120,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,690,000**
Construction Contingency			10%				**$170,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$590,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,450,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Dewatering Building (Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from Digesters)
ELEMENT #:	5-3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Building Modifications	1,475	SF	$420	$620,000	INCL.	INCL.	$620,000
SUBTOTAL							**$620,000**
Plant Paving, Grading, and Yard Piping			10%				$60,000
Mechanical and Piping			5%				$30,000
Electrical			15%				$90,000
Instrumentation and Controls			15%				$90,000
SUBTOTAL							**$890,000**
Project Phase-Level OPCC Contingency			30%				$270,000
SUBTOTAL							**$1,160,000**
Tax on Materials			9.5%				$60,000
Contractor's Markup on Sub-Contractors' Work			10%				$20,000
Contractor's Overhead and Profit, Mob/Demob			25%				$290,000
Contractor's General Conditions			10%				$120,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,650,000**
Construction Contingency			10%				**$170,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$580,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,400,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Return Flow EQ (Thicken All FSL solids for DLD Site Application in Summer → Dewater All Solids from Digester)
ELEMENT #:	6-1

OPPC PROVIDED BY:	WLS
OPPC PREPARATION DATE:	1/3/2017
REVIEWED BY:	GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Digested Solids Storage	8	10,000 gal	$51,000	$408,000	INCL.	INCL.	$410,000
SUBTOTAL							**$410,000**
Plant Paving, Grading, and Yard Piping			10%				$41,000
Mechanical and Piping			5%				$21,000
Electrical			15%				$62,000
Instrumentation and Controls			15%				$62,000
SUBTOTAL							**$600,000**
Project Phase-Level OPCC Contingency			30%				$180,000
SUBTOTAL							**$780,000**
Tax on Materials			9.5%				$37,000
Contractor's Markup on Sub-Contractors' Work			10%				$12,400
Contractor's Overhead and Profit, Mob/Demob			25%				$195,000
Contractor's General Conditions			10%				$78,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,100,000**
Construction Contingency			10%				**$110,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$390,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,600,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Return Flow EQ (Dewater Portion of Digested Solids for Offsite Disposal Year-Round → Dewater All Solids from Digester)**
ELEMENT #:	**6-2**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Additional Dewatering Return Stream EQ	7	10,000 gal	$51,000	$357,000	INCL.	INCL.	$360,000
Digested Solids Storage	10	10,000 gal	$51,000	$510,000	INCL.	INCL.	$510,000
SUBTOTAL							**$870,000**
Plant Paving, Grading, and Yard Piping			10%				$90,000
Mechanical and Piping			5%				$40,000
Electrical			15%				$130,000
Instrumentation and Controls			15%				$130,000
SUBTOTAL							**$1,260,000**
Project Phase-Level OPCC Contingency			30%				$380,000
SUBTOTAL							**$1,640,000**
Tax on Materials			9.5%				$80,000
Contractor's Markup on Sub-Contractors' Work			10%				$26,000
Contractor's Overhead and Profit, Mob/Demob			25%				$410,000
Contractor's General Conditions			10%				$160,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,320,000**
Construction Contingency			10%				**$230,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$810,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,360,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Return Flow EQ (Dewater a Portion of FSL Solids for Offsite Disposal in Winter → Dewater All Solids from Digester)

ELEMENT #: 6-3

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Additional Dewatering Return Stream EQ	8	10,000 gal	$51,000	$408,000	INCL.	INCL.	$410,000
Digested Solids Storage	12	10,000 gal	$51,000	$612,000	INCL.	INCL.	$610,000
SUBTOTAL							**$1,020,000**
Plant Paving, Grading, and Yard Piping			10%				$100,000
Mechanical and Piping			5%				$50,000
Electrical			15%				$150,000
Instrumentation and Controls			15%				$150,000
SUBTOTAL							**$1,470,000**
Project Phase-Level OPCC Contingency			30%				$440,000
SUBTOTAL							**$1,910,000**
Tax on Materials			9.5%				$90,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$478,000
Contractor's General Conditions			10%				$190,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,698,000**
Construction Contingency			10%				**$270,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$940,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,908,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Return Flow EQ (Dewater All FSLs Solids for DLD Site Application in Summer → Dewater All Solids from Digesters)
ELEMENT #:	6-4

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Additional Dewatering Return Stream EQ	2	10,000 gal	$51,000	$102,000	INCL.	INCL.	$100,000
Digested Solids Storage	12	10,000 gal	$51,000	$612,000	INCL.	INCL.	$610,000
SUBTOTAL							**$710,000**
Plant Paving, Grading, and Yard Piping			10%				$71,000
Mechanical and Piping			5%				$36,000
Electrical			15%				$110,000
Instrumentation and Controls			15%				$110,000
SUBTOTAL							**$1,040,000**
Project Phase-Level OPCC Contingency			30%				$310,000
SUBTOTAL							**$1,350,000**
Tax on Materials			9.5%				$64,000
Contractor's Markup on Sub-Contractors' Work			10%				$22,000
Contractor's Overhead and Profit, Mob/Demob			25%				$340,000
Contractor's General Conditions			10%				$140,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,920,000**
Construction Contingency			10%				**$190,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$670,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,780,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Odor Control**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 7

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Odor Control Fans, Duct Work, and Biofilter	1	LS	$400,000	$400,000	INCL.	INCL.	$400,000
SUBTOTAL							**$400,000**
Plant Paving, Grading, and Yard Piping			10%				$40,000
Mechanical and Piping			5%				$20,000
Electrical			15%				$60,000
Instrumentation and Controls			15%				$60,000
SUBTOTAL							**$580,000**
Project Phase-Level OPCC Contingency			30%				$170,000
SUBTOTAL							**$750,000**
Tax on Materials			9.5%				$40,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$190,000
Contractor's General Conditions			10%				$80,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,070,000**
Construction Contingency			10%				**$110,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$370,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,550,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	Sludge Storage Pumps

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 1/3/2017
REVIEWED BY: GKC

ELEMENT #: 8

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Dewatering Feed Pumps from Solids Storage	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$50,000**
Plant Paving, Grading, and Yard Piping			10%				$10,000
Mechanical and Piping			5%				$3,000
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$80,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$100,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob			25%				$30,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$140,000**
Construction Contingency			10%				**$10,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$50,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$200,000**

APPENDIX H-13

Potential Future Addition of a Supercritical Oxidation Process

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
PROJECT #:	406-19-15-39
OPPC MANAGER	WLS
REVIEWED BY:	GKC
DESCRIPTION OF WORK:	Undigested Solids to AquaCritox™
TYPE OF ESTIMATE:	Conceptual Design Level
DATE:	12/15/2016

ELEMENT #	DESCRIPTION		COST
1-1	Pipeline		$1,400,000
2-1	Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$1,500,000**
	Construction Contingency	10%	$200,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$500,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$2,200,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER WLS
REVIEWED BY: GKC

DESCRIPTION OF WORK: Digested Solids to AquaCritox™
TYPE OF ESTIMATE: Conceptual Design Level
DATE: 12/15/2016

ELEMENT #	DESCRIPTION		COST
1-2	Pipeline		$10,000
2-2	Pumps		$100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$100,000**
	Construction Contingency	10%	$10,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$40,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$200,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**WLS**
REVIEWED BY:	**GKC**
DESCRIPTION OF WORK:	**Digested and Thickened Solids to AquaCritox™**
TYPE OF ESTIMATE:	**Conceptual Design Level**
DATE:	**12/15/2016**

ELEMENT #	DESCRIPTION		COST
1-3	Pipeline		$10,000
2-3	Pumps		$200,000
3	Thickening Equipment		$2,500,000
4	Thickening Building		$5,000,000
5	Return Stream EQ		$700,000
6	Odor Control		$1,100,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$9,500,000**
	Construction Contingency	10%	$1,000,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$3,300,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$13,800,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pipeline (Undigested Solids To AquaCritox™)

ELEMENT #: 1-1

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox™ Feed Pipeline	4500	LF	$75	$337,500	$75	$337,500	$680,000
SUBTOTAL							**$680,000**
Plant Paving, Grading, and Yard Piping			10%				$68,000
Mechanical and Piping			5%				$30,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$778,000**
Project Phase-Level OPCC Contingency			30%				$230,000
SUBTOTAL							**$1,008,000**
Tax on Materials			9.5%				$50,000
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$252,000
Contractor's General Conditions			10%				$100,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,410,000**
Construction Contingency			10%				**$140,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$494,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$2,044,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Digested Solids To AquaCritox^{TM})**

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

ELEMENT #: 1-2

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox^{TM} Feed Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
SUBTOTAL							**$10,000**
Plant Paving, Grading, and Yard Piping			10%				$0
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$10,000**
Project Phase-Level OPCC Contingency			30%				$0
SUBTOTAL							**$10,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$0
Contractor's General Conditions			10%				$0
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$10,000**
Construction Contingency			10%				**$0**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$0**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pipeline (Digested and Thickened Solids to AquaCritox^{TM})**
ELEMENT #:	**1-3**

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox^{TM} Feed Pipeline	70	LF	$75	$5,250	$75	$5,250	$10,000
SUBTOTAL							**$10,000**
Plant Paving, Grading, and Yard Piping			10%				$0
Mechanical and Piping			5%				$1,000
Electrical			0%				$0
Instrumentation and Controls			0%				$0
SUBTOTAL							**$10,000**
Project Phase-Level OPCC Contingency			30%				$0
SUBTOTAL							**$10,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$0
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$0
Contractor's General Conditions			10%				$0
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$10,000**
Construction Contingency			10%				**$0**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$0**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$10,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Pumps (Undigested Solids To AquaCritox™)**
ELEMENT #:	**2-1**

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox™ Feed Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$45,000**
Plant Paving, Grading, and Yard Piping			10%				$0
Mechanical and Piping			5%				$2,000
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$70,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$90,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$20,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$120,000**
Construction Contingency			10%				**$10,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$40,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$170,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumps (Digested Solids to AquaCritox™)

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

ELEMENT #: 2-2

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox™ Feed Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$45,000**
Plant Paving, Grading, and Yard Piping			10%				$0
Mechanical and Piping			5%				$0
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$65,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$85,000**
Tax on Materials			9.5%				$0
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$20,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$120,000**
Construction Contingency			10%				**$10,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$40,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$170,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Pumps (Digested and Thickened Solids to AquaCritox™)

ELEMENT #: 2-3

OPCC PROVIDED BY: WLS
OPCC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
AquaCritox™ Return Stream Pumps	2	EA	$15,000	$30,000	$7,500	$15,000	$50,000
SUBTOTAL							**$50,000**
Plant Paving, Grading, and Yard Piping			10%				$5,000
Mechanical and Piping			5%				$3,000
Electrical			15%				$10,000
Instrumentation and Controls			15%				$10,000
SUBTOTAL							**$80,000**
Project Phase-Level OPCC Contingency			30%				$20,000
SUBTOTAL							**$100,000**
Tax on Materials			9.5%				$5,000
Contractor's Markup on Sub-Contractors' Work			10%				$2,000
Contractor's Overhead and Profit, Mob/Demob, Insurance, Bonds, etc.			25%				$30,000
Contractor's General Conditions			10%				$10,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$150,000**
Construction Contingency			10%				**$20,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$50,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$220,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Thickening Equipment (Digested and Thickened Solids to AquaCritox^{TM})**
ELEMENT #:	**3**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Equipment Pads	36	CuYd	$250	$9,000	$125	$4,500	$10,000
Rotary Screen Thickener	2	EA	$341,500	$683,000	$100,000	$200,000	$880,000
Polymer Dosing Equipment Pads	1	CuYd	$250	$250	$125	$130	$400
Polymer Dosing System	1	EA	$41,000	$41,000	$7,500	$8,000	$50,000
SUBTOTAL							**$940,000**
Plant Paving, Grading, and Yard Piping			10%				$90,000
Mechanical and Piping			5%				$50,000
Electrical			15%				$140,000
Instrumentation and Controls			15%				$140,000
SUBTOTAL							**$1,360,000**
Project Phase-Level OPCC Contingency			30%				$410,000
SUBTOTAL							**$1,770,000**
Tax on Materials			9.5%				$80,000
Contractor's Markup on Sub-Contractors' Work			10%				$30,000
Contractor's Overhead and Profit, Mob/Demob			25%				$440,000
Contractor's General Conditions			10%				$180,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$2,500,000**
Construction Contingency			10%				**$250,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$880,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$3,630,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Thickener Building (Digested and Thickened Solids to AquaCritox™)**
ELEMENT #:	**4**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickener Building	4425	SF	$420	$1,859,000	INCL.	INCL.	$1,860,000
SUBTOTAL							**$1,860,000**
Plant Paving, Grading, and Yard Piping			10%				$190,000
Mechanical and Piping			5%				$90,000
Electrical			15%				$280,000
Instrumentation and Controls			15%				$280,000
SUBTOTAL							**$2,700,000**
Project Phase-Level OPCC Contingency			30%				$810,000
SUBTOTAL							**$3,510,000**
Tax on Materials			9.5%				$170,000
Contractor's Markup on Sub-Contractors' Work			10%				$60,000
Contractor's Overhead and Profit, Mob/Demob			25%				$880,000
Contractor's General Conditions			10%				$350,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$4,970,000**
Construction Contingency			10%				**$500,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$1,740,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$7,210,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Return Stream EQ Tank (Digested and Thickened Solids to AquaCritox[TM])**
ELEMENT #:	**5**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Thickening Return Stream EQ Tank	2	10,000 gal	$51,000	$102,000	INCL.	INCL.	$100,000
Digested Sludge Storage	3	10,000 gal	$51,000	$153,000	INCL.	INCL.	$150,000
SUBTOTAL							**$260,000**
Plant Paving, Grading, and Yard Piping			10%				$30,000
Mechanical and Piping			5%				$10,000
Electrical			15%				$40,000
Instrumentation and Controls			15%				$40,000
SUBTOTAL							**$380,000**
Project Phase-Level OPCC Contingency			30%				$110,000
SUBTOTAL							**$490,000**
Tax on Materials			9.5%				$20,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$120,000
Contractor's General Conditions			10%				$50,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$690,000**
Construction Contingency			10%				**$70,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$240,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,000,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Odor Control (Digested and Thickened Solids to AquaCritox^{TM})**
ELEMENT #:	**6**

OPPC PROVIDED BY: WLS
OPPC PREPARATION DATE: 12/15/2016
REVIEWED BY: GKC

DESCRIPTION	MATERIAL QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
Odor Control Fans, Duct Work, and Biofilter	1	LS	$400,000	$400,000	INCL.	INCL.	$400,000
SUBTOTAL							**$400,000**
Plant Paving, Grading, and Yard Piping			10%				$40,000
Mechanical and Piping			5%				$20,000
Electrical			15%				$60,000
Instrumentation and Controls			15%				$60,000
SUBTOTAL							**$580,000**
Project Phase-Level OPCC Contingency			30%				$170,000
SUBTOTAL							**$750,000**
Tax on Materials			9.5%				$40,000
Contractor's Markup on Sub-Contractors' Work			10%				$10,000
Contractor's Overhead and Profit, Mob/Demob			25%				$190,000
Contractor's General Conditions			10%				$80,000
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,070,000**
Construction Contingency			10%				**$110,000**
Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				**$370,000**
ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,550,000**

APPENDIX H-14

Gas Treatment System

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
PROJECT #: 406-19-15-39
OPPC MANAGER BJG
REVIEWED BY: TDD
DESCRIPTION OF WORK: Gas Treatment System: Step 1

TYPE OF ESTIMATE: Conceptual Design Level Construction Cost
DATE: 3/31/2017

ELEMENT #	DESCRIPTION		COST
1	Hydrogen Sulfide Removal (430 CFM)		$740,000
2-1	2 Air Compressors and Coalescing Filter		$720,000
3	Refrigerated Dryer System (430 CFM)		$730,000
4	Siloxane Removal System and Filter (430 CFM)		$550,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$2,740,000**
	Construction Contingency	10%	$270,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$960,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$3,970,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**TDD**
DESCRIPTION OF WORK:	**Gas Treatment System: Step 1 → Step 2**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/31/2017**

ELEMENT #	DESCRIPTION		COST
2-2	1 Air Compressor and Coalescing Filter		$420,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$420,000**
	Construction Contingency	10%	$40,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$150,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$610,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**TDD**
DESCRIPTION OF WORK:	**Gas Treatment System: Step 2 → Step 3**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/31/2017**

ELEMENT #	DESCRIPTION		COST
2-3	1 Air Compressor		$420,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$420,000**
	Construction Contingency	10%	$40,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$150,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$610,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**TDD**
DESCRIPTION OF WORK:	**Gas Treatment System: Step 3 → Step 4**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/31/2017**

ELEMENT #	DESCRIPTION		COST
1	Hydrogen Sulfide Removal (430 CFM)		$740,000
2-2	1 Air Compressor and Coalescing Filter		$420,000
3	Refrigerated Dryer System (430 CFM)		$730,000
4	Siloxane Removal System and Filter (430 CFM)		$550,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$2,440,000**
	Construction Contingency	10%	$240,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$850,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$3,530,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
PROJECT #:	**406-19-15-39**
OPPC MANAGER	**BJG**
REVIEWED BY:	**TDD**
DESCRIPTION OF WORK:	**Gas Treatment System: Step 4 → Step 5**
TYPE OF ESTIMATE:	**Conceptual Design Level Construction Cost**
DATE:	**3/31/2017**

ELEMENT #	DESCRIPTION		COST
2-4	3 Air Compressors and 1 Coalescing Filter		$1,130,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST		**$1,130,000**
	Construction Contingency	10%	$110,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs	35%	$400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE PROJECT COST		**$1,640,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Hydrogen Sulfide Removal (430 CFM)
ELEMENT #: 1

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	8ft x 8 ft x 20ft Box	2	EA	$55,000	$110,000	$22,000	$44,000	$150,000
2	Separator	1	EA	$12,000	$12,000	$5,000	$5,000	$20,000
3	410 CHP Media	100,000	LB	$0.66	$66,000	$0.06	$6,000	$72,000
4	H2S Monitoring Sensor	1	EA	$6,615	$6,615	$3,000	$3,000	$10,000
5	Platform for Media Replacement	2	EA	$30,000	$60,000	$12,000	$24,000	$80,000
6								
7								
8								
9								
10								
	SUBTOTAL							**$330,000**
	Plant Paving, Grading, and Yard Piping			10%				$30,000
	Mechanical and Piping			5%				$20,000
	Electrical			3%				$10,000
	Instrumentation and Controls			5%				$20,000
	SUBTOTAL							**$410,000**
	Project Phase-Level OPCC Contingency			30%				$120,000
	SUBTOTAL							**$530,000**
	Tax on Materials			9.5%				$30,000
	Contractor's Markup on Sub-Contractors' Work			10%				$3,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$130,000
	Contractor's General Conditions			10%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$740,000**
	Construction Contingency			10%				$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$260,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,070,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**2 Air Compressors and Coalescing Filter**
ELEMENT #:	**2-1**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Skid Mounted Package (2 x 110 CFM Air Compressors)	1	EA	$252,305	$252,305	$101,000	$101,000	$350,000
2	220 CFM Coalescing Filter	1	EA	$1,716	$1,716	$1,000	$1,000	$3,000
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$350,000**
	Plant Paving, Grading, and Yard Piping			5%				$20,000
	Mechanical and Piping			5%				$20,000
	Electrical			15%				$50,000
	Instrumentation and Controls			5%				$20,000
	SUBTOTAL							**$460,000**
	Project Phase-Level OPCC Contingency			10%				$50,000
	SUBTOTAL							**$510,000**
	Tax on Materials			9.5%				$20,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$130,000
	Contractor's General Conditions			10%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$720,000**
	Construction Contingency			10%				$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$250,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,040,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39
PROJECT ELEMENT:	1 Air Compressor and Coalescing Filter
ELEMENT #:	2-2

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Skid Mounted Package (1 x 110 CFM Air Compressor)	1	EA	$151,383	$151,383	$61,000	$61,000	$210,000
2	220 CFM Coalescing Filter	1	EA	$1,716	$1,716	$1,000	$1,000	$3,000
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$210,000**
	Plant Paving, Grading, and Yard Piping			5%				$10,000
	Mechanical and Piping			5%				$10,000
	Electrical			15%				$30,000
	Instrumentation and Controls			5%				$10,000
	SUBTOTAL							**$270,000**
	Project Phase-Level OPCC Contingency			10%				$30,000
	SUBTOTAL							**$300,000**
	Tax on Materials			9.5%				$10,000
	Contractor's Markup on Sub-Contractors' Work			10%				$4,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$80,000
	Contractor's General Conditions			10%				$30,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$420,000**
	Construction Contingency			10%				$40,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$150,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$610,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: 1 Air Compressor
ELEMENT #: 2-3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Skid Mounted Package (1 x 110 CFM Air Compressor)	1	EA	$151,383	$151,383	$61,000	$61,000	$210,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$210,000**
	Plant Paving, Grading, and Yard Piping			5%				$10,000
	Mechanical and Piping			5%				$10,000
	Electrical			15%				$30,000
	Instrumentation and Controls			5%				$10,000
	SUBTOTAL							**$270,000**
	Project Phase-Level OPCC Contingency			10%				$30,000
	SUBTOTAL							**$300,000**
	Tax on Materials			9.5%				$10,000
	Contractor's Markup on Sub-Contractors' Work			10%				$4,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$80,000
	Contractor's General Conditions			10%				$30,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$420,000**
	Construction Contingency			10%				$40,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$150,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$610,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: 3 Air Compressors and 1 Coalescing Filter
ELEMENT #: 2-4

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Skid Mounted Package (3 x 110 CFM Air Compressors)	1	EA	$403,688	$403,688	$161,000	$161,000	$560,000
2	220 CFM Coalescing Filter	1	EA	$1,716	$1,716	$1,000	$1,000	$3,000
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$560,000**
	Plant Paving, Grading, and Yard Piping			5%				$30,000
	Mechanical and Piping			5%				$30,000
	Electrical			15%				$80,000
	Instrumentation and Controls			5%				$30,000
	SUBTOTAL							**$730,000**
	Project Phase-Level OPCC Contingency			10%				$70,000
	SUBTOTAL							**$800,000**
	Tax on Materials			9.5%				$40,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$200,000
	Contractor's General Conditions			10%				$80,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$1,130,000**
	Construction Contingency			10%				$110,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$400,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,640,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39
PROJECT ELEMENT: Refrigerated Dryer System (430 CFM)
ELEMENT #: 3

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Refridgerated Dryer System	1	LS	$217,175	$217,175	$87,000	$87,000	$300,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$300,000**
	Plant Paving, Grading, and Yard Piping			10%				$30,000
	Mechanical and Piping			5%				$15,000
	Electrical			15%				$50,000
	Instrumentation and Controls			15%				$50,000
	SUBTOTAL							**$450,000**
	Project Phase-Level OPCC Contingency			15%				$70,000
	SUBTOTAL							**$520,000**
	Tax on Materials			9.5%				$20,000
	Contractor's Markup on Sub-Contractors' Work			10%				$10,000
	Contractor's Overhead and Profit, Mob/Demob			25%				$130,000
	Contractor's General Conditions			10%				$50,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$730,000**
	Construction Contingency			10%				$70,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$260,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$1,060,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**
PROJECT ELEMENT:	**Siloxane Removal System and Filter (430 CFM)**
ELEMENT #:	**4**

OPPC PROVIDED BY: BJG
OPPC PREPARATION DATE: 3/31/2017
REVIEWED BY: TDD

	DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL COST	INSTALL UNIT COST	INSTALL COST	TOTAL COST
1	Siloxane Removal System	1	LS	$184,850	$184,850	$74,000	$74,000	$260,000
2								
3								
4								
5								
6								
7								
8								
9								
10								
	SUBTOTAL							**$260,000**
	Plant Paving, Grading, and Yard Piping			10%				$30,000
	Mechanical and Piping			5%				$10,000
	Electrical			0%				$0
	Instrumentation and Controls			0%				$0
	SUBTOTAL							**$300,000**
	Project Phase-Level OPCC Contingency			30%				$90,000
	SUBTOTAL							**$390,000**
	Tax on Materials			9.5%				$19,000
	Contractor's Markup on Sub-Contractors' Work			10%				$0
	Contractor's Overhead and Profit, Mob/Demob			25%				$100,000
	Contractor's General Conditions			10%				$39,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST							**$550,000**
	Construction Contingency			10%				$60,000
	Engineering Design, Environmental Planning and Studies, Construction Management, ESDC, and Legal and Admin Costs			35%				$190,000
	ENGINEER'S PRELIMINARY OPINION OF PROBABLE TOTAL CAPITAL COST							**$800,000**

APPENDIX I

Operating Cost Details

APPENDIX I-1

Primary Sedimentation Basins

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Additional Primary Sedimentation Basins
Primary Sedimentation Basins	
Mixers	
Primary Solids Pumping, mgd	0.39
Primary Solids Pumping Head, ft	20
Pumping Efficiency, %	0.70
Primary Solids Pump Power Demand, hp	1.96
Energy Consumption, kWhr/year	12,811
Energy Cost, $/yr	**2,000**
Longitudinal Collectors	
Number of Future Primary Sedimentation Basins	7.0
Unit Longitudinal Collector Power, hp/primary	1.0
Longitudinal Collector Power, hp	7.0
Energy Consumption, kWhr/year	45,726
Energy Cost, $/yr	**7,000**
Scum Skimmers	
Number of Future Primary Sedimentation Basins	7.0
Unit Power Demand	0.5
Scum Skimmer Power Demand, hp	3.5
Energy Consumption, kWhr/year	22,863
Energy Cost, $/yr	**3,000**
Total Energy Consumption, kWhr/yr	81,400
Total Cost, $/yr	**12,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Element	Additional Primary Sedimentation Basins
FTE's for Operations and Maintenance	0.33
Labor Hours, hours per Year	660
Unit Labor Cost, $/hour	150
Total Cost, $/yr	**99,000**

APPENDIX I-2

Alternatives for Addressing Secondary Clarifier Capacity Limitations

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Additional Secondary Clarifier	Alum Addition for Year-Round Anaerobic Selector Operation	Parallel Stream MBR
Parallel Stream MBR System			
MBR Cleaning Cost			
Unit MBR Clean In Place (CIP), $/mgd/yr	12,750	12,750	12,750
Ave Annual MBR Flow, mgd	-	-	4
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 50,000**
Sidestream Treatment System			
Sidestream Alum			
Sidestream Alum Demand, lb/d	-	1,800	-
Unit Alum Cost, $/ton	220	220	220
Chemical Cost, $/yr	**$ -**	**$ 70,000**	**$ -**
Total Cost, $/yr	**$ -**	**$ 70,000**	**$ 50,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs - Energy

Element	Additional Secondary Clarifier	Alum Addition for Year-Round Anaerobic Selector Operation	Parallel Stream MBR
Aeration Tanks			
Mixers			
Biol. Total Volume, Mgal	3.6	3.6	3.6
Anaerobic Volume, Mgal	-	0.7	0.7
Anoxic Volume, Mgal	-	-	-
Unit Mixer Power Demand, hp/MG	30	30	30
Anaerobic Mixing, hp	7.0	21	21
Anoxic Mixing, hp	-	-	-
Energy Consumption, kWhr/year	45,726	137,179	137,179
Energy Cost, $/yr	**$ 10,000**	**$ 20,000**	**$ 20,000**
Blowers			
Oxygen Demand, lb/d	16,780	16,780	11,786
Alpha, none	0	0	0
Oxygen Transfer Efficiency (OTE), %	8	8	8
Blower Airflow, scfm	13,400	13,400	9,400
Unit Blower Power Demand, SCFM/hp	19	19	19
Blower Power, hp	710	710	490
Energy Consumption, kWhr/year	4,637,956	4,637,956	3,200,843
Energy Cost, $/yr	**$ 696,000**	**$ 696,000**	**$ 480,000**
RAS Pumping			
RAS Flow, mgd	9	9	7
RAS Pumping Head, ft	30	30	30
Pumping Efficiency, %	1	1	1
RAS Pumps - Energy, hp	70	70	50
Energy Consumption, kWhr/year	457,263	457,263	326,617
Energy Cost, $/yr	**$ 69,000**	**$ 69,000**	**$ 50,000**
Secondary Clarifiers			
No. of Secondaries, Number	5	4	4
Unit Secondaries Mechanism Power, hp/secondary	1	1	1
Longitudinal Collector Power, hp	5	4	4
Energy Consumption, kWhr/year	32,662	26,129	26,129
Energy Cost, $/yr	**$ 5,000**	**$ 4,000**	**$ 4,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Additional Secondary Clarifier	Alum Addition for Year-Round Anaerobic Selector Operation	Parallel Stream MBR
Parallel Stream MBR System			
MBR Blowers			
Average Flow, mgd	-	-	4
Flux, gfd	12	12	12
Membrane Area, sf	-	-	333,000
Unit Scour, scfm/sf	0	0	0
Scour Airflow, scfm	-	-	4,995
Total Oxygen Demand, lb/d	-	-	8,300
Alpha, none	1	1	1
Oxygen Transfer Efficiency (OTE), %	9	9	9
Blower Airflow, scfm	-	-	3,700
Total Airflow, scfm	-	-	8,695
Unit Blower Power Demand, SCFM/hp	19	19	19
Blower Power, hp	-	-	460
Energy Consumption, kWhr/year	-	-	3,004,873
Energy Cost, $/yr	**$ -**	**$ -**	**$ 450,000**
MBR Permeate Pump			
Flow, mgd	-	-	4
Pumping Head, ft	30	30	30
Pumping Efficiency, %	1	1	1
Pumping Power, hp	-	-	30
Energy Consumption, kWhr/year	-	-	197,090
Energy Cost, $/yr	**$ -**	**$ -**	**$ 30,000**
Total Energy Consumption, kWhr/yr	**5,170,000**	**5,260,000**	**6,890,000**
Total Cost, $/yr	**$ 780,000**	**$ 790,000**	**$ 1,040,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Labor

Element	Additional Secondary Clarifier	Alum Addition for Year-Round Anaerobic Selector Operation	Parallel Stream MBR
Aeration Tanks			
FTE's for Operations and Maintenance	3	3	4
Labor Hours, hours per Year	5,920	5,340	7,520
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**888,000**	**801,000**	**1,128,000**
Filter System			
FTE's for Operations and Maintenance	-	-	-
Labor Hours, hours per Year	-	-	-
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**-**	**-**
Sidestream Treatment System			
FTE's for Operations and Maintenance	-	0	-
Labor Hours, hours per Year	-	200	-
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**30,000**	**-**
Total Cost, $/yr	**$ 890,000**	**$ 830,000**	**$ 1,130,000**

APPENDIX I-3

Potential Future Nutrient Removal Improvements

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
Methanol			
Methanol Vol. (Liquid), gpd	-	-	2,900
Unit Methanol Cost, $/gal	1.75	1.75	1.75
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 1,850,000**
Filter System			
Filter Alum			
Filter Alum Demand, lb/d	-	-	9,500
Unit Alum Cost, $/ton	220	220	220
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 380,000**
Filter Polymer			
Polymer Demand, lb/d	-	-	70
Unit Polymer cost, $/lb	2.25	2.25	2.25
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 60,000**
Sidestream Treatment System			
Sidestream Alum			
Sidestream Alum Demand, lb/d	-	1,800	1,800
Unit Alum Cost, $/ton	220	220	220
Chemical Cost, $/yr	**$ -**	**$ 70,000**	**$ 70,000**
Total Cost, $/yr	**$ -**	**$ 70,000**	**$ 2,360,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
Mixers			
Biol. Total Volume, Mgal	5.0	5.8	7.2
Anaerobic Volume, Mgal	-	1.2	1.4
Anoxic Volume, Mgal	1.0	1.4	2.4
Unit Mixer Power Demand, hp/MG	30	30	30
Anaerobic Mixing, hp	-	36	42
Anoxic Mixing, hp	30.0	42.0	72.0
Energy Consumption, kWhr/year	195,970	509,522	744,686
Energy Cost, $/yr	**$ 29,000**	**$ 76,000**	**$ 112,000**
Blowers			
Oxygen Demand, lb/d	31,180	32,890	30,130
Alpha, none	1	1	1
Oxygen Transfer Efficiency (OTE), %	8	8	8
Blower Airflow, scfm	14,900	15,700	14,400
Unit Blower Power Demand, SCFM/hp	19	19	16
Blower Power, hp	780	830	900
Energy Consumption, kWhr/year	5,095,219	5,421,836	5,879,099
Energy Cost, $/yr	**$ 764,000**	**$ 813,000**	**$ 882,000**
Mixed Liquor Return Pumping			
Biol. MLR Pumping, mgd	27	34	54
Mixed Liquor Pumping Head, ft	10	10	10
Pumping Efficiency, %	1	1	1
MLR Pumps - Energy, hp	70	80	140
Energy Consumption, kWhr/year	457,263	522,587	914,526
Energy Cost, $/yr	**$ 69,000**	**$ 78,000**	**$ 137,000**
RAS Pumping			
RAS Flow, mgd	9	9	9
RAS Pumping Head, ft	30	30	30
Pumping Efficiency, %	1	1	1
RAS Pumps - Energy, hp	70	70	70
Energy Consumption, kWhr/year	457,263	457,263	457,263
Energy Cost, $/yr	**$ 69,000**	**$ 69,000**	**$ 69,000**

WEST YOST ASSOCIATES

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Secondary Clarifiers			
No. of Secondaries, Number	5	5	5
Unit Secondaries Mechanism Power, hp/secondary	1	1	1
Longitudinal Collector Power, hp	5	5	5
Energy Consumption, kWhr/year	32,662	32,662	32,662
Energy Cost, $/yr	**$ 5,000**	**$ 5,000**	**$ 5,000**
Total Energy Consumption, kWhr/yr	**6,240,000**	**6,940,000**	**8,030,000**
Total Cost, $/yr	**$ 940,000**	**$ 1,040,000**	**$ 1,200,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
FTE's for Operations and Maintenance	4	4	4
Labor Hours, hours per Year	7,260	7,300	7,500
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**1,089,000**	**1,095,000**	**1,125,000**
Filter System			
FTE's for Operations and Maintenance	-	-	0
Labor Hours, hours per Year	-	-	420
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**-**	**63,000**
Sidestream Treatment System			
FTE's for Operations and Maintenance	-	0	0
Labor Hours, hours per Year	-	200	200
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**30,000**	**30,000**
Total Cost, $/yr	**$ 1,090,000**	**$ 1,130,000**	**$ 1,220,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs (with Parrallel Stream MBR Pretreatment) - Chemical

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
Methanol			
Methanol Vol. (Liquid), gpd	-	-	2,900
Unit Methanol Cost, $/gal	1.75	1.75	1.75
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 1,850,000**
Parallel Stream MBR System			
MBR Cleaning Cost			
Unit MBR Clean In Place (CIP), $/mgd/yr	12,750	12,750	12,750
Ave Annual MBR Flow, mgd	4	4	4
Chemical Cost, $/yr	**$ 51,000**	**$ 51,000**	**$ 51,000**
Filter System			
Filter Alum			
Filter Alum Demand, lb/d	-	-	6,700
Unit Alum Cost, $/ton	220	220	220
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 270,000**
Filter Polymer			
Polymer Demand, lb/d	-	-	50
Unit Polymer cost, $/lb	2.25	2.25	2.25
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 40,000**
Sidestream Treatment System			
Sidestream Alum			
Sidestream Alum Demand, lb/d	-	1,800	1,800
Unit Alum Cost, $/ton	220	220	220
Chemical Cost, $/yr	**$ -**	**$ 70,000**	**$ 70,000**
Total Cost, $/yr	**$ 50,000**	**$ 120,000**	**$ 2,280,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs (with Parrallel Stream MBR Pretreatment) - Energy

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
Mixers			
Biol. Total Volume, Mgal	4.3	5.0	7.2
Anaerobic Volume, Mgal	-	1.0	1.4
Anoxic Volume, Mgal	1.0	1.2	2.4
Unit Mixer Power Demand, hp/MG	30	30	30
Anaerobic Mixing, hp	-	31	42
Anoxic Mixing, hp	30.0	36.3	72.0
Energy Consumption, kWhr/year	195,970	440,328	744,686
Energy Cost, $/yr	**$ 29,000**	**$ 66,000**	**$ 112,000**
Blowers			
Oxygen Demand, lb/d	21,900	23,100	21,200
Alpha, none	1	1	1
Oxygen Transfer Efficiency (OTE), %	8	8	8
Blower Airflow, scfm	10,500	11,000	10,100
Unit Blower Power Demand, SCFM/hp	19	19	19
Blower Power, hp	550	580	530
Energy Consumption, kWhr/year	3,592,783	3,788,753	3,462,136
Energy Cost, $/yr	**$ 539,000**	**$ 568,000**	**$ 519,000**
Mixed Liquor Return Pumping			
Biol. MLR Pumping, mgd	19	24	38
Mixed Liquor Pumping Head, ft	10	10	10
Pumping Efficiency, %	1	1	1
MLR Pumps - Energy, hp	50	60	90
Energy Consumption, kWhr/year	326,617	391,940	587,910
Energy Cost, $/yr	**$ 49,000**	**$ 59,000**	**$ 88,000**
RAS Pumping			
RAS Flow, mgd	7	7	7
RAS Pumping Head, ft	30	30	30
Pumping Efficiency, %	1	1	1
RAS Pumps - Energy, hp	50	50	50
Energy Consumption, kWhr/year	326,617	326,617	326,617
Energy Cost, $/yr	**$ 49,000**	**$ 49,000**	**$ 49,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs (with Parrallel Stream MBR Pretreatment) - Energy

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Secondary Clarifiers			
No. of Secondaries, Number	5	5	5
Unit Secondaries Mechanism Power, hp/secondary	1	1	1
Longitudinal Collector Power, hp	5	5	5
Energy Consumption, kWhr/year	32,662	32,662	32,662
Energy Cost, $/yr	**$ 5,000**	**$ 5,000**	**$ 5,000**
Parallel Stream MBR System			
MBR Blowers			
Average Flow, mgd	4	4	4
Flux, gfd	12	12	12
Membrane Area, sf	333,000	333,000	333,000
Unit Scour, scfm/sf	0	0	0
Scour Airflow, scfm	5,000	5,000	5,000
Total Oxygen Demand, lb/d	8,300	8,300	8,300
Alpha, none	1	1	1
Oxygen Transfer Efficiency (OTE), %	9	9	9
Blower Airflow, scfm	3,700	3,700	3,700
Total Airflow, scfm	8,700	8,700	8,700
Unit Blower Power Demand, SCFM/hp	19	19	19
Blower Power, hp	460	460	460
Energy Consumption, kWhr/year	3,004,873	3,004,873	3,004,873
Energy Cost, $/yr	**$ 451,000**	**$ 451,000**	**$ 451,000**
MBR Permeate Pump			
Flow, mgd	4	4	4
Pumping Head, ft	30	30	30
Pumping Efficiency, %	1	1	1
Pumping Power, hp	30	30	30
Energy Consumption, kWhr/year	197,090	197,090	197,090
Energy Cost, $/yr	**$ 30,000**	**$ 30,000**	**$ 30,000**
Total Energy Consumption, kWhr/yr	**7,680,000**	**8,180,000**	**8,360,000**
Total Cost, $/yr	**$ 1,150,000**	**$ 1,230,000**	**$ 1,250,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs (with Parrallel Stream MBR Pretreatment) - Labor

Element	Potable Reuse Conditioning	BACWA Level 2	BACWA Level 3
Aeration Tanks			
FTE's for Operations and Maintenance	4	4	4
Labor Hours, hours per Year	8,860	8,900	8,900
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**1,329,000**	**1,335,000**	**1,335,000**
Filter System			
FTE's for Operations and Maintenance	-	-	0
Labor Hours, hours per Year	-	-	420
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**-**	**63,000**
Sidestream Treatment System			
FTE's for Operations and Maintenance	-	0	0
Labor Hours, hours per Year	-	200	200
Unit Labor Cost, $/hour	150	150	150
Labor Cost, $/year	**-**	**30,000**	**30,000**
Total Cost, $/yr	**$ 1,330,000**	**$ 1,370,000**	**$ 1,430,000**

APPENDIX I-4

Alternatives for 3.0 MGD FAT Facilities Pretreatment

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Replacements

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System					
Estimated Service Life, years	10	10	10	10	10
Cost per Module, $/module[a]	1,200	1,200	1,200	1,200	1,200
Average yearly cost, $/Module/year	120	120	120	120	120
Months in Operation	6	6	6	6	6
Modules per train	100	100	100	100	100
Trains	2	2	2	2	2
Multiplier for Water Quality	2.0	1.5	1	1.5	1.5
Total Replacement Cost	**$ 20,000**	**$ 15,000**	**$ 10,000**	**$ 15,000**	**$ 15,000**
RO System					
Estimated Service Life, years	4	4	4	4	4
Cost per Module, $/module[a]	1,400	1,400	1,400	1,400	1,400
Average yearly cost, $/Module/year	350	350	350	350	350
Months in Operation	6	6	6	6	6
Modules per train	100	100	100	100	100
Trains	3	3	3	3	3
Replacement Cost	**$ 60,000**	**$ 60,000**	**$ 60,000**	**$ 60,000**	**$ 60,000**
UV/AOP System (lamps)					
Estimated Service Life, years	2	2	2	2	2
Cost per lamp, $/lamp[b]	320	320	320	320	320
Number of Lamps	**$ 24**	**$ 24**	**$ 24**	**$ 24**	**$ 24**
Months in Operation	6	6	6	6	6
Replacement Cost	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
Ozone System					
Average Annual Costs, $/year[c]	**$ -**	**$ 20,000**	**$ 20,000**	**$ -**	**$ -**
BAC Filter					
Estimated Service Life, years	-	-	10	-	-
Cost of Media, $/lb[d]	**-**	**-**	$ 2.37	**-**	**-**
Media Required, lb	-	-	80,000	-	-
Replacement Cost, $/year[d]	-	-	$ 19,000	-	-
Cleaning Before Replacement	-	-	2,600	-	-
Cost, $/year			**$ 260**		
Total Replacement Cost	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ 100,000**

[a] Replacement Cost provided by GE Water

[b] Replacement Cost provided by WEDECO.

[c] Replacement Cost provided by MEPPI.

[d] Replacement and cleaning Cost provided by Calgon Carbon.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System					
NaOCL					
Trains	2	2	2	2	2
Gallons/Train (Annual)[(a)]	1,250	1,250	1,250	1,250	1,250
Operating Time, yrs	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	0.40	0.40	0.40	0.40	0.40
Chemical Cost, $/yr	**$ 1,000**	**$ 1,000**	**$ 1,000**	**$ 1,000**	**$ 1,000**
Sodium Bisulfite					
Trains	2	2	2	2	2
Gallons/Train (Annual)[(a)]	280	280	280	280	280
Operating Time, yrs	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	0.90	0.90	0.90	0.90	0.90
Chemical Cost, $/yr	**$ 300**	**$ 300**	**$ 300**	**$ 300**	**$ 300**
Sulfuric Acid					
Trains	2	2	2	2	2
Gallons/Train (Annual)[(a)]	130	130	130	130	130
Operating Time, yrs	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	5.79	5.79	5.79	5.79	5.79
Chemical Cost, $/yr	**300**	**300**	**300**	**300**	**300**
NaOH					
Trains	2	2	2	2	2
Gallons/Train (Annual)[(a)]	70	70	70	70	70
Operating Time, yrs	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	1.00	1.00	1.00	1.00	1.00
Chemical Cost, $/yr	100	100	100	100	100
Cost Subtotal, $/yr	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Multiplier for Water Quality	2.0	1.5	1.0	1.5	1.5
Total Cost	**$ 4,000**	**$ 3,000**	**$ 2,000**	**$ 3,000**	**$ 3,000**
RO System					
Sodium EDTA					
Trains	3	3	3	3	3
Chemical Use, lbs/cleaning/train[(a)]	360	360	360	360	360
Cleanings Needed, /yr/train	4	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/lb	61	61	61	61	61
Chemical Cost, $/yr	**$ 142,000**	**$ 142,000**	**$ 142,000**	**$ 142,000**	**$ 142,000**
NaOH					
Trains	3	3	3	3	3
Chemical Use, lbs/cleaning/train[(a)]	72	72	72	72	72
Cleanings Needed, /yr/train	4	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54	0.54
Unit Cost, $/lb	0.20	0.20	0.20	0.20	0.20
Chemical Cost, $/yr	**$ 100**	**$ 100**	**$ 100**	**$ 100**	**$ 100**
Sodium DDS					
Trains	3	3	3	3	3
Chemical Use, lbs/cleaning/train[(a)]	90	90	90	90	90
Cleanings Needed, /yr/train	4	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54	0.54
Chemical Cost, $/lb	233	233	233	233	233
Chemical Cost, $/yr	**$ 135,500**	**$ 135,500**	**$ 135,500**	**$ 135,500**	**$ 135,500**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Chemical

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Sodium Triphosphate					
Trains	3	3	3	3	3
Chemical Use, lbs/cleaning/train[(a)]	288	288	288	288	288
Cleanings Needed, /yr/train	4	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54	0.54
Chemical Cost, $/lb	41.95	41.95	41.95	41.95	41.95
Chemical Cost, $/yr	**$ 78,100**	**$ 78,100**	**$ 78,100**	**$ 78,100**	**$ 78,100**
Citric Acid					
Trains	3	3	3	3	3
Chemical Use, lbs/cleaning/train[(a)]	720	720	720	720	720
Cleanings Needed, /yr/train	4	4	4	4	4
Operating Time, yr	0.5	0.5	0.5	0.5	0.5
Unit Cost, $/lb	0.56	0.56	0.56	0.56	0.56
Chemical Cost, $/yr	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
UV/AOP System					
H_2O_2					
Chemical dose, lb/MG	33	33	33	33	33
Total Flow, MG/year	591	591	591	591	591
Unit Cost, $/lb	1.0	1.0	1.0	1.0	1.0
Chemical Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Sodium Bisulfite					
Chemical dose, lb/MG	38	38	38	38	38
Total Flow, MG/year	591	591	591	591	591
Density, lb/gal	0.24	0.24	0.24	0.24	0.24
Unit Cost, $/gal	0.90	0.90	0.90	0.90	0.90
Chemical Cost, $/yr	**$ 5,000**	**$ 5,000**	**$ 5,000**	**$ 5,000**	**$ 5,000**
Ozone System					
Ozone Generation, lb/day	-	251	251	-	-
Ozone Gas Concentration, %wt	-	12	12	-	-
Lox Operation, ppd	-	2,091	2,091	-	-
Lox Use, SCF	-	25,250	25,250	-	-
Unit Cost, $/CCF	-	0.30	0.30	-	-
Chemical Cost, $/MG AWT Produced	-	25.25	25.25	-	-
Total Flow, MG/year	-	591.0	591.0	-	-
Chemical Cost, $/yr	**$ -**	**$ 10,000**	**$ 10,000**	**$ -**	**$ -**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)					
Chemical Cost $/yr	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)					
Chemical Cost $/yr	**$ -**	**$ -**	**$ -**	**$ -**	**$ 50,000**
Total Chemical Cost	**$ 390,000**	**$ 400,000**	**$ 400,000**	**$ 390,000**	**$ 440,000**

[(a)] Value Provided by GE Water.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System Pumps					
Flow Rate, gpm	2,785	2,785	2,785	2,785	2,785
Head, ft	92	92	92	92	92
Pump Load Conversion, HP	3,960	3,960	3,960	3,960	3,960
Energy Consumption, kWhr/year	310,000	310,000	310,000	310,000	310,000
Cost Subtotal, $/yr	**$ 47,000**	**$ 47,000**	**$ 47,000**	**$ 47,000**	**$ 47,000**
Multiplier for Water Quality	2.0	1.5	1.5	1.0	1.5
Energy Cost, $/yr	**$ 90,000**	**$ 70,500**	**$ 70,500**	**$ 47,000**	**$ 70,500**
RO System					
Trains	2	2	2	2	2
Power Consumption, kWhr/train/year[(a)]	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000
Power Consumption, kWhr/year	4,200,000	4,200,000	4,200,000	4,200,000	4,200,000
Operating Time, days/year	197	197	197	197	197
Energy Consumption, kWhr	2,265,298	2,265,298	2,265,298	2,265,298	2,265,298
Energy Cost, $/yr	**$ 340,000**	**$ 340,000**	**$ 340,000**	**$ 340,000**	**$ 340,000**
UV/AOP System					
Energy Consumption, kWhr/ MG Treated[(b)]	260	260	260	260	260
Flow, MGD	3	3	3	3	3
Operating Time, Days	197	197	197	197	197
Energy, kWh	153,660	153,660	153,660	153,660	153,660
Energy Cost, $/yr	**$ 20,000**	**$ 23,000**	**$ 23,000**	**$ 23,000**	**$ 23,000**
Ozone System					
Electrical Power Use, kWhr/MG Treated[(c)]	-	250	250	-	-
Power, hp	-	2	2	-	-
AWT Produced, MG/Year	-	591	591	-	-
Energy, kWh	-	147,868	147,868	-	-
Energy Cost, $/yr	**$ -**	**$ 22,000**	**$ 22,000**	**$ -**	**$ -**
BAC Filter					
Pumps					
Flow Rate, gpm	-	-	2,932	-	-
Head, ft	-	-	10	-	-
Pump Load Conversion, HP	-	-	10	-	-
Days in Operation[(d)]	-	-	211	-	-
Energy Consumption, kWhr/year	-	-	37,276	-	-
Energy Cost, $/yr	**$ -**	**$ -**	**$ 6,000**	**$ -**	**$ -**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Energy

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Backwash					
Flow Rate, gpm	-	-	600	-	-
Head, ft	-	-	10	-	-
Pump Load Conversion, HP	-	-	2.0	-	-
Time in Operation, hr/week/filter	-	-	0.50	-	-
Filters	-	-	4	-	-
Weeks in Operation, weeks/year[e]	-	-	52	-	-
Energy, kWh	-	-	157	-	-
Energy Cost, $/yr	**$ -**	**$ -**	**$ 20**	**$ -**	**$ -**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)					
Energy Cost $/year	**$ -**	**$ -**	**$ -**	**$ 940,000**	**$ -**
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)					
Energy Cost $/year	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,040,000**
Total Energy Cost	**$ 450,000**	**$ 460,000**	**$ 470,000**	**$ 1,350,000**	**$ 1,470,000**

[a] Power Use Provided by GE Water.

[b] Power Use Provided by WEDECO.

[c] Power Use Provided by MEPPI.

[d] BAC filter will run for 182 days when recycled water is being produced and for two hours per day on all other days. Days in operation includes this total time in operation.

[e] BAC filter will backwash at a normal frequency throughout the year.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System					
Normal Operating Hours					
Time Applying, hr/week	13	13	13	13	13
Time Applying, week/yr	28	28	28	28	28
Time Applying, hr	350	350	350	350	350
Labor Cost, $/yr	**$ 53,000**	**$ 53,000**	**$ 53,000**	**$ 53,000**	**$ 53,000**
Start-Up and Shut Down					
Start-Up Time, hrs	16	24	24	20	0
Shut Down Time, hrs	40	24	24	20	0
Total, hrs	56	48	48	40	0
Labor Cost, $/yr	**$ 7,000**	**$ 7,000**	**$ 7,000**	**$ 7,000**	**$ 7,000**
RO Membrane System					
Normal Operating Hours					
Time Applying, hr/week	13	13	13	13	13
Time Applying, week/yr	28	28	28	28	28
Time Applying, hr	350	350	350	350	350
Labor Cost, $/yr	**$ 53,000**	**$ 53,000**	**$ 53,000**	**$ 53,000**	**$ 53,000**
Start-Up and Shut Down					
Start-Up Time, hrs	24	24	24	24	24
Shut Down Time, hrs	24	24	24	24	24
Total, hrs	48	48	48	48	48
Labor Cost, $/yr	**$ 7,000**	**$ 7,000**	**$ 7,000**	**$ 7,000**	**$ 7,000**
UV/AOP System					
Normal Operating Hours					
Time Applying, hr/week	$ 4	$ 4	$ 4	$ 4	$ 4
Time Applying, week/yr	28	28	28	28	28
Time Applying, hr	112	112	112	112	112
Labor Cost, $/yr	**$ 17,000**	**$ 17,000**	**$ 17,000**	**$ 17,000**	**$ 17,000**
Start-Up and Shut Down					
Start-Up Time, hrs	$ 20	$ 20	$ 20	$ 20	$ 20
Shut Down Time, hrs	20	20	20	20	20
Total, hrs	**$ 40**	**$ 40**	**$ 40**	**$ 40**	**$ 40**
Labor Cost, $/yr	**$ 6,000**	**$ 6,000**	**$ 6,000**	**$ 6,000**	**$ 6,000**
Ozone System					
Normal Operating Hours					
Time Applying, hr/week	-	4	4	-	-
Time Applying, week/yr	-	28	28	-	-
Time Applying, hr	-	112	112	-	-
Labor Cost, $/yr	**$ -**	**$ 17,000**	**$ 17,000**	**$ -**	**$ -**
Start-Up and Shut Down					
Start-Up Time, hrs	-	16	16	-	
Shut Down Time, hrs	-	40	40	-	
Total, hrs	-	56	56	-	
Labor Cost, $/yr	**$ -**	**$ 8,000**	**$ 8,000**	**$ -**	

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
BAC Filter[a]					
Normal Operating Hours					
Time Applying, hr/week	-	-	4	-	-
Time Applying, week/yr	-	-	52	-	-
Time Applying, hr	-	-	208	-	-
Labor Cost, $/yr	**$ -**	**$ -**	**$ 31,000**	**$ -**	**$ -**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)					
Labor Cost $/year	**$ -**	**$ -**	**$ -**	**$ 1,090,000**	**$ -**
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)					
Labor Cost $/year	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,130,000**
Total Labor Cost, $/yr	**$ 143,000**	**$ 168,000**	**$ 199,000**	**$ 1,233,000**	**$ 1,273,000**

[a]BAC Filter operates intermittently during weeks when recycled water system is not in use. Labor costs are mainly incurred during backwash of the system, which will occur year-round.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Sampling and Analytical

Element	No Pretreatment	Ozone Pretreatment	Ozone plus BAC Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Total Sampling and Analytical Cost, $/yr	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ 100,000**

APPENDIX I-5

3.0 MGD Raw Water Augmentation and Treated Water Augmentation

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Replacements

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
Estimated Service Life, years	10	10	10	10
Cost per Module, $/module[a]	1,200	1,200	1,200	1,200
Average yearly cost, $/Module/year	120	120	120	120
Months in Operation	6	6	6	6
Modules per train	100	100	100	100
Trains	2	2	2	2
Multiplier for Water Quality	1	1	1	1
Total Replacement Cost	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
RO System				
Estimated Service Life, years	4	4	4	4
Cost per Module, $/module[a]	1,400	1,400	1,400	1,400
Average yearly cost, $/Module/year	350	350	350	350
Months in Operation	6	6	6	6
Modules per train	100	100	100	100
Trains	3	3	3	3
Replacement Cost	**$ 60,000**	**$ 60,000**	**$ 60,000**	**$ 60,000**
UV/AOP System (lamps)				
Estimated Service Life, years	2	2	2	2
Cost per lamp, $/lamp[b]	320	320	320	320
Number of Lamps	**$ 24**	**$ 24**	**$ 24**	**$ 24**
Months in Operation	6	6	6	6
Replacement Cost	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
Ozone System				
Average Annual Costs, $/year[c]	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
BAC Filter				
Estimated Service Life, years	10	10	10	10
Cost of Media, $/lb[d]	**$ 2.37**	**$ 2.37**	**$ 2.37**	**$ 2.37**
Media Required, lb	80,000	80,000	80,000	80,000
Replacement Cost, $/year[d]	$ 19,000	$ 19,000	$ 19,000	$ 19,000
Cleaning Before Replacement, $[d]	2,600	2,600	2,600	2,600
Cost, $/year	**$ 260**	**$ 260**	**$ 260**	**$ 260**
Total Replacement Cost	**$ 93,000**	**$ 93,000**	**$ 93,000**	**$ 93,000**

[a] Replacement Cost provided by GE Water
[b] Replacement Cost provided by WEDECO.
[c] Replacement Cost provided by MEPPI.
[d] Replacement and Cleaning Cost provided by Calgon Carbon.

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
NaOCL				
Trains	2	2	2	2
Gallons/Train (Annual)[a]	1,250	1,250	1,250	1,250
Operating Time, yrs	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	0.40	0.40	0.40	0.40
Chemical Cost, $/yr	**$ 1,000**	**$ 1,000**	**$ 1,000**	**$ 1,000**
Sodium Bisulfite				
Trains	2	2	2	2
Gallons/Train (Annual)[a]	280	280	280	280
Operating Time, yrs	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	0.90	0.90	0.90	0.90
Chemical Cost, $/yr	**$ 300**	**$ 300**	**$ 300**	**$ 300**
Sulfuric Acid				
Trains	2	2	2	2
Gallons/Train (Annual)[a]	130	130	130	130
Operating Time, yrs	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	5.79	5.79	5.79	5.79
Chemical Cost, $/yr	**300.0**	**300.0**	**300.0**	**300.0**
NaOH				
Trains	2	2	2	2
Gallons/Train (Annual)[a]	70	70	70	70
Operating Time, yrs	0.54	0.54	0.54	0.54
Unit Cost, $/gallon	1.00	1.00	1.00	1.00
Chemical Cost, $/yr	**100.0**	**100.0**	**100.0**	**100.0**
RO System				
Sodium EDTA				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	360.0	360.0	360.0	360.0
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54
Unit Cost, $/lb	61	61	61	61
Chemical Cost, $/yr	**$ 142,000**	**$ 142,000**	**$ 142,000**	**$ 142,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
NaOH				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	72	72	72	72
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54
Unit Cost, $/lb	0.20	0.20	0.20	0.20
Chemical Cost, $/yr	**$ 100**	**$ 100**	**$ 100**	**$ 100**
Sodium DDS				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	90	90	90	90
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54
Chemical Cost, $/lb	233	233	233	233
Chemical Cost, $/yr	**$ 135,500**	**$ 135,500**	**$ 135,500**	**$ 135,500**
Sodium Triphosphate				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	288	288	288	288
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54
Chemical Cost, $/lb	41.95	41.95	41.95	41.95
Chemical Cost, $/yr	**$ 78,100**	**$ 78,100**	**$ 78,100**	**$ 78,100**
Citric Acid				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	720	720	720	720
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr	0.54	0.54	0.54	0.54
Unit Cost, $/lb	0.56	0.56	0.56	0.56
Chemical Cost, $/yr	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
UV/AOP System				
H_2O_2				
Chemical dose, lb/MG	33	33	33	33
Total Flow, MG/year	591	591	591	591
Unit Cost, $/lb	1.0	1.0	1.0	1.0
Chemical Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Sodium Bisulfite				
Chemical dose, lb/MG	38	38	38	38
Total Flow, MG/year	591	591	591	591
Density, lb/gal	0.24	0.24	0.24	0.24
Unit Cost, $/gal	0.90	0.90	0.90	0.90
Chemical Cost, $/yr	**$ 5,000**	**$ 5,000**	**$ 5,000**	**$ 5,000**
Ozone System				
Ozone Generation, lb/day	251	251	251	251
Ozone Gas Concentration, %wt	12	12	12	12
Lox Operation, ppd	2,091	2,091	2,091	2,091
Lox Use, SCF	25,250	25,250	25,250	25,250
Unit Cost, $/CCF	0.30	0.30	0.30	0.30
Chemical Cost, $/MG AWT Produced	25.25	25.25	25.25	25.25
Total Flow, MG/year	591	591	591	591
Chemical Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Chemical Cost $/yr	**$ -**	**$ -**	**$ -**	**$ -**
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Chemical Cost $/yr	**$ -**	**$ 50,000**	**$ -**	**$ 50,000**
Disinfection System				
Dose Needed, lb/day	75	75	75	75
Days in Operation	197	197	197	197
Unit Cost, $/lb	1	1	1	1
Chemical Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Total Chemical Cost	**$ 412,000**	**$ 462,000**	**$ 412,000**	**$ 462,000**

[a] Value Provided by GE Water.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System Pumps				
Flow Rate, gpm	2,785	2,785	2,785	2,785
Head, ft	92	92	92	92
Pump Load Conversion, HP	3,960	3,960	3,960	3,960
Energy Consumption, kWhr/year	310,000	310,000	310,000	310,000
Cost Subtotal, $/yr	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Multiplier for Water Quality	1.0	1.0	1.0	1.0
Energy Cost, $/yr	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**
RO System				
Trains	2	2	2	2
Power Consumption, kWhr/train/year[(a)]	2,100,000	2,100,000	2,100,000	2,100,000
Power Consumption, kWhr/year	4,200,000	4,200,000	4,200,000	4,200,000
Operating Time, days/year	197	197	197	197
Energy Consumption, kWhr	2,265,298	2,265,298	2,265,298	2,265,298
Energy Cost, $/yr	**$ 340,000**	**$ 340,000**	**$ 340,000**	**$ 340,000**
UV/AOP System				
Energy Consumption, kWhr/ MG Treated[(b)]	260	260	260	260
Flow, MGD	3	3	3	3
Operating Time, Days	197	197	197	197
Energy, kWh	153,660	153,660	153,660	153,660
Energy Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Ozone System				
Electrical Power Use, kWhr/MG Treated[(c)]	250	250	250	250
Power, hp	2	2	2	2
AWT Produced, MG/Year	591	591	591	591
Energy, kWh	147,868	147,868	147,868	147,868
Energy Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
BAC Filter				
Pumps				
Flow Rate, gpm	2,932	2,932	2,932	2,932
Head, ft	10	10	10	10
Pump Load Conversion, HP	10	10	10	10
Days in Operation[(d)]	211	211	211	211
Energy Consumption, kWhr/year	37,276	37,276	37,276	37,276
Energy Cost, $/yr	**$ 6,000**	**$ 6,000**	**$ 6,000**	**$ 6,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Backwash				
Flow Rate, gpm	600	600	600	600
Head, ft	10	10	10	10
Pump Load Conversion, HP	2.0	2.0	2.0	2.0
Time in Operation, hr/week/filter	0.50	0.50	0.50	0.50
Filters	4	4	4	4
Weeks in Operation, weeks/year[(e)]	52	52	52	52
Energy, kWh	157	157	157	157
Energy Cost, $/yr	**$ 20**	**$ 20**	**$ 20**	**$ 20**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Energy Cost $/year	**$ 940,000**	**$ -**	**$ 940,000**	
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Energy Cost $/year	**$ -**	**$ 1,040,000**	**$ -**	**$ 1,040,000**
Treated Water Storage Pumps				
Flow Rate,gpm	2,083	2,083	2,083	2,083
Head, ft	25	25	25	25
Pump Load Conversion, HP	18	18	18	18
Days in Operation	197	197	197	197
Energy Consumption, kWhr/year	61,828	61,828	61,828	61,828
Energy Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Total Energy Cost	**$ 1,392,000**	**$ 1,492,000**	**$ 1,392,000**	**$ 1,492,000**

(a) Power Use Provided by GE Water.

(b) Power Use Provided by WEDECO.

(c) Power Use Provided by MEPPI.

(d) BAC filter will run for 182 days when recycled water is being produced and for two hours per day on all other days. Days in operation includes this total time in operation.

(e) BAC filter will backwash at a normal frequency throughout the year.

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Labor

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
Normal Operating Hours				
Time Applying, hr/week	13	13	13	13
Time Applying, week/yr	28	28	28	28
Time Applying, hr	350	350	350	350
Labor Cost, $/yr	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**
Start-Up and Shut Down				
Start-Up Time, hrs	16	24	24	20
Shut Down Time, hrs	40	24	24	20
Total, hrs	56	48	48	40
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
RO Membrane System				
Normal Operating Hours				
Time Applying, hr/week	13	13	13	13
Time Applying, week/yr	28	28	28	28
Time Applying, hr	350	350	350	350
Labor Cost, $/yr	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**
Start-Up and Shut Down				
Start-Up Time, hrs	24	24	24	24
Shut Down Time, hrs	24	24	24	24
Total, hrs	48	48	48	48
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
UV/AOP System				
Normal Operating Hours				
Time Applying, hr/week	$ 4	$ 4	$ 4	$ 4
Time Applying, week/yr	28	28	28	28
Time Applying, hr	112	112	112	112
Labor Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Start-Up and Shut Down				
Start-Up Time, hrs	$ 20	$ 20	$ 20	$ 20
Shut Down Time, hrs	20	20	20	20
Total, hrs	**$ 40**	**$ 40**	**$ 40**	**$ 40**
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs - Labor

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Ozone System				
Normal Operating Hours				
Time Applying, hr/week	4	4	4	4
Time Applying, week/yr	28	28	28	28
Time Applying, hr	112	112	112	112
Labor Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Start-Up and Shut Down				
Start-Up Time, hrs	16	16	16	16
Shut Down Time, hrs	40	40	40	40
Total, hrs	56	56	56	56
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
BAC Filter[(a)]				
Normal Operating Hours				
Time Applying, hr/week	4	4	4	4
Time Applying, week/yr	52	52	52	52
Time Applying, hr	208	208	208	208
Labor Cost, $/yr	**$ 31,000**	**$ 31,000**	**$ 31,000**	**$ 31,000**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Labor Cost $/year	**$ 1,090,000**	**$ -**	**$ 1,090,000**	
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Labor Cost $/year	**$ -**	**$ 1,130,000**	**$ -**	**$ 1,130,000**
Total Labor Cost, $/yr	**$ 1,301,000**	**$ 1,341,000**	**$ 1,301,000**	**$ 1,341,000**

[(a)]BAC Filter operates intermittently during weeks when recycled water system is not in use. Labor costs are mainly incurred during backwash of the system, which will occur year-round.

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Sampling and Analytical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Total Cost, $/yr	**$ 100,000**	**$ 100,000**	**$ 200,000**	**$ 200,000**

APPENDIX I-6

Potential 9.0 MGD Raw Water Augmentation and Treated Water Augmentation

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Replacements

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
Estimated Service Life, years	10	10	10	10
Cost per Module, \$/module[(a)]	1200	1200	1200	1200
Average yearly cost, \$/Module/year	120	120	120	120
Months in Operation	6	6	6	6
Modules per train	100	100	100	100
Trains	7	7	7	7
Replacement Cost	**\$ 30,000**	**\$ 30,000**	**\$ 30,000**	**\$ 30,000**
RO System				
Estimated Service Life, years	4	4	4	4
Cost per Module, \$/module[(a)]	1400	1400	1400	1400
Average yearly cost, \$/Module/year	350	350	350	350
Months in Operation	6.5	6.5	6.5	6.5
Modules per train	100	100	100	100
Trains	7	7	7	7
Replacement Cost	**\$ 110,000**	**\$ 110,000**	**\$ 110,000**	**\$ 110,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Replacements

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
UV/AOP System (lamps)				
Estimated Service Life, years	1.60	1.60	1.60	1.60
Cost per lamp, $/lamp[b]	320	320	320	320
Number of Lamps	48	48	48	48
Months in Operation	6.5	6.5	6.5	6.5
Replacement Cost	**$ 5,000**	**$ 5,000**	**$ 5,000**	**$ 5,000**
BAC Filter				
Estimated Service Life, years	10	10	10	10
Cost of Media, $/lb[c]	2.37	2.37	2.37	2.37
Media Required, lb	240,000	240,000	240,000	240,000
Replacement Cost, $/year[c]	**$ 57,000**	**$ 57,000**	**$ 57,000**	**$ 57,000**
Cleaning Before Replacement, $[c]				
Cost, $/year	**$ 6,000**	**$ 6,000**	**$ 6,000**	**$ 6,000**
Ozone System Replacements				
Average Annual Costs, $/year[d]	**$ 40,000**	**$ 40,000**	**$ 40,000**	**$ 40,000**
Total Replacement Cost	**$ 248,000**	**$ 248,000**	**$ 248,000**	**$ 248,000**

[a] Replacement Cost provided by GE Water

[b] Replacement Cost provided by WEDECO.

[c] Replacement and Cleaning Cost provided by Calgon Carbon.

[d] Replacement Cost provided by MEPPI.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
NaOCL				
Trains	9	9	9	9
Gallons/Train (Annual)[(a)]	1,250	1,250	1,250	1,250
Operating Time, yrs[(b)]	0.4	0.4	0.4	0.4
Unit Cost, $/gallon	0.40	0.40	0.40	0.40
Chemical Cost, $/yr[(b)]	**$ 2,000**	**$ 2,000**	**$ 2,000**	**$ 2,000**
Sodium Bisulfite				
Trains	9	9	9	9
Gallons/Train (Annual)[(a)]	280	280	280	280
Operating Time, yrs[(b)]	0.4	0.4	0.4	0.4
Unit Cost, $/gallon	0.90	0.90	0.90	0.90
Chemical Cost, $/yr[(b)]	**$ 1,300**	**$ 1,300**	**$ 1,300**	**$ 1,300**
Sulfuric Acid				
Trains	9	9	9	9
Gallons/Train (Annual)[(a)]	130	130	130	130
Operating Time, yrs[(b)]	0.4	0.4	0.4	0.4
Unit Cost, $/gallon	5.79	5.79	5.79	5.79
Chemical Cost, $/yr[(b)]	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
NaOH				
Trains	9	9	9	9
Gallons/Train (Annual)[(a)]	70	70	70	70
Operating Time, yrs[(b)]	0.4	0.4	0.4	0.4
Unit Cost, $/gallon	1.00	1.00	1.00	1.00
Chemical Cost, $/yr[(b)]	**$ 300**	**$ 300**	**$ 300**	**$ 300**
RO System				
Sodium EDTA				
Trains	8	8	8	8
Chemical Use, lbs/cleaning/train[(a)]	360	360	360	360
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr[(b)]	0.4	0.4	0.4	0.4
Unit Cost, $/lb	61	61	61	61
Chemical Cost, $/yr[(b)]	**$ 290,000**	**$ 290,000**	**$ 290,000**	**$ 290,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
NaOH				
Trains	8	8	8	8
Chemical Use, lbs/cleaning/train[a]	72	72	72	72
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr[b]	0.4	0.4	0.4	0.4
Unit Cost, $/lb	0.20	0.20	0.20	0.20
Chemical Cost, $/yr[b]	**$ 200**	**$ 200**	**$ 200**	**$ 200**
Sodium DDS				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	90	90	90	90
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr[b]	0.4	0.4	0.4	0.4
Chemical Cost, $/lb	233	233	233	233
Chemical Cost, $/yr[b]	**$ 270,000**	**$ 270,000**	**$ 270,000**	**$ 270,000**
Sodium Triphosphate				
Trains	8	8	8	8
Chemical Use, lbs/cleaning/train[a]	288	288	288	288
Cleanings Needed, /yr/train	4	4	4	4
Operating Time, yr[b]	0.4	0.4	0.4	0.4
Chemical Cost, $/lb	41.95	41.95	41.95	41.95
Chemical Cost, $/yr[b]	**$ 160,000**	**$ 160,000**	**$ 160,000**	**$ 160,000**
Citric Acid				
Trains	3	3	3	3
Chemical Use, lbs/cleaning/train[a]	720	720	720	720
Cleanings Needed, /yr/train	8	4	4	4
Operating Time, yr[b]	0.4	0.4	0.4	0.4
Unit Cost, $/lb	0.56	0.56	0.56	0.56
Chemical Cost, $/yr[b]	**$ 6,000**	**$ 6,000**	**$ 6,000**	**$ 6,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Chemical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
UV/AOP System				
H_2O_2				
Chemical dose, lb/MG	33	33	33	33
Total Flow, MG/year	1,565	1,565	1,565	1,565
Unit Cost, $/lb	1.0	1.0	1.0	1.0
Chemical Cost, $/yr	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**
Sodium Bisulfite				
Chemical dose, lb/MG	38	38	38	38
Total Flow, MG/year	1,565	1,565	1,565	1,565
Density, lb/gal	0.24	0.24	0.24	0.24
Unit Cost, $/gal	0.90	0.90	0.90	0.90
Chemical Cost, $/yr	**$ 13,000**	**$ 13,000**	**$ 13,000**	**$ 13,000**
Ozone System				
Ozone Generation, lb/day	251	251	251	251
Ozone Gas Concentration, %wt	12	12	12	12
Lox Operation, ppd	2,091	2,091	2,091	2,091
Lox Use, SCF	25,250	25,250	25,250	25,250
Unit Cost, $/CCF	0.30	0.30	0.30	0.30
Chemical Cost, $/MG AWT Produced	25.25	25.25	25.25	25.25
Total Flow, MG/year	1,565	1,565	1,565	1,565
Chemical Cost, $/yr	**$ 30,000**	**$ 30,000**	**$ 30,000**	**$ 30,000**
Disinfection System				
Dose Needed, lb/day	-	-	300	300
Days in Operation	-	-	145	145
Unit Cost, $/lb	-	-	1	1
Chemical Cost, $/yr	**$ -**	**$ -**	**$ 20,000**	**$ 20,000**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Chemical Cost $/yr	**$ -**	**$ -**	**$ -**	**$ -**
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Chemical Cost $/yr	**$ -**	**$ 50,000**	**$ -**	**$ 50,000**
Total Chemical Cost, $/yr	**$ 830,000**	**$ 880,000**	**$ 850,000**	**$ 900,000**

[a] Value provided by GE Water.

[b] Operating time shown is the average operating time of the 3MGD and 6MGD systems. The total costs were calculated separately for each system and added together.

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System Pumps				
Flow Rate,gpm	8,356	8,356	8,356	8,356
Head, ft	92	92	92	92
Pump Load Conversion, HP	3,960	3,960	3,960	3,960
Energy Consumption, kWhr/year	680,000	680,000	680,000	680,000
Energy Cost, $/yr	**$ 103,000**	**$ 103,000**	**$ 103,000**	**$ 103,000**
RO System				
Trains	4	4	4	4
Power Consumption, kWhr/train/year[(a)]	2,100,000	2,100,000	2,100,000	2,100,000
Power Consumption, kWhr/year	4,200,000	4,200,000	4,200,000	4,200,000
Operating Time, days/year[(b)]	158	158	158	158
Energy Consumption, kWhr	1,816,838	1,816,838	1,816,838	1,816,838
Energy Cost, $/yr[(b)]	**$ 550,000**	**$ 550,000**	**$ 550,000**	**$ 550,000**
UV/AOP System				
Energy Consumption, kWhr/ MG Treated[(c)]	260	260	260	260
Flow, MGD	9	9	9	9
Operating Time, Days[(b)]	158	158	158	158
Energy, kWh	339,300	339,300	339,300	339,300
Energy Cost, $/yr[(b)]	**$ 51,000**	**$ 51,000**	**$ 51,000**	**$ 51,000**
Ozone System				
Electrical Power Use, kWhr/MG Treated[(d)]	292	292	292	292
Power, hp				
AWT Produced, MG/Year	1,565	1,565	1,565	1,565
Energy, kWh	452,487	452,487	452,487	452,487
Energy Cost, $/yr	**$ 70,000**	**$ 70,000**	**$ 70,000**	**$ 70,000**
BAC Filter				
Pumps				
Flow Rate,gpm	8,795	8,795	8,795	8,795
Head, ft	10	10	10	10
Pump Load Conversion, HP	10	10	10	10
Days in Operation[(e)]	163	163	163	163
Energy Consumption, kWhr/year	86,566	86,566	86,566	86,566
Energy Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Backwash				
Flow Rate,gpm	1,200	1,200	1,200	1,200
Head, ft	20	20	20	20
Pump Load Conversion, HP	4	4	4	4
Time in Operation, hr/week/filter	1	1	1	1
Filters	12	12	12	12
Weeks in Operation, weeks/year[f]	52	52	52	52
Energy, kWh	470	470	470	470
Energy Cost, $/yr	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Energy Cost $/year	**$ 940,000**	**$ -**	**$ 940,000**	
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Energy Cost $/year	**$ -**	**$ 1,040,000**	**$ -**	**$ 1,040,000**
Treated Water Storage Pumps				
Flow Rate,gpm	-	-	5,208	5,208
Head, ft	-	-	25	25
Pump Load Conversion, HP	-	-	18	18
Days in Operation[b]	-	-	158	158
Energy Consumption, kWhr/year	-	-	173,871	173,871
Energy Cost, $/yr[b]	**$ -**	**$ -**	**$ 30,000**	**$ 30,000**
Total Energy Cost, $/year	**$ 1,750,000**	**$ 1,850,000**	**$ 1,780,000**	**$ 1,880,000**

[a] Power Use Provided by GE Water.

[b] Operating time shown is the average operating time of the 3MGD and 6MGD systems. The total costs were calculated separately for each system and added together.

[c] Power Use Provided by WEDECO.

[d] Power Use Provided by MEPPI.

[e] BAC filter will run for 182 days when recycled water is being produced and for two hours per day on all other days. Days

[f] BAC filter will backwash at a normal frequency throughout the year.

PROJECT:	DSRSD WWTP Master Plan
OWNER:	Dublin San Ramon Services District
LOCATION:	Pleasanton, California
WYA Project #:	406-19-15-39

Operating Costs - Labor

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
MF Membrane System				
Normal Operating Hours				
Time Applying, hr/week	31	31	31	31
Time Applying, week/yr	23	23	23	23
Time Applying, hr	100,000	100,000	100,000	100,000
Labor Cost, $/yr	**$ 101,000**	**$ 101,000**	**$ 101,000**	**$ 101,000**
Start-Up and Shut Down				
Start-Up Time, hrs	48	48	48	48
Shut Down Time, hrs	48	48	48	48
Total, hrs	96	96	96	96
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Total Cost, $/yr	**$ 110,000**	**$ 110,000**	**$ 110,000**	**$ 110,000**
RO Membrane System				
Normal Operating Hours				
Time Applying, hr/week	31	31	31	31
Time Applying, week/yr	23	23	23	23
Time Applying, hr	669	669	669	669
Labor Cost, $/yr	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ 100,000**
Start-Up and Shut Down				
Start-Up Time, hrs	48	48	48	48
Shut Down Time, hrs	48	48	48	48
Total, hrs	96	96	96	96
Labor Cost, $/yr	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Total Cost, $/yr	**$ 110,000**	**$ 110,000**	**$ 110,000**	**$ 110,000**
UV/AOP System				
Normal Operating Hours				
Time Applying, hr/week	10	10	10	10
Time Applying, week/yr	15	15	15	15
Time Applying, hr	214	214	214	214
Labor Cost, $/yr	**$ 32,000**	**$ 32,000**	**$ 32,000**	**$ 32,000**
Start-Up and Shut Down				
Start-Up Time, hrs	40	40	40	40
Shut Down Time, hrs	40	40	40	40
Total, hrs	80	80	80	80
Labor Cost, $/yr	**$ 12,000**	**$ 12,000**	**$ 12,000**	**$ 12,000**
Total Cost, $/yr	**$ 40,000**	**$ 40,000**	**$ 40,000**	**$ 40,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
BAC Filter[(a)]				
Normal Operating Hours				
Time Applying, hr/week	10	10	10	10
Time Applying, week/yr	52	52	52	52
Time Applying, hr	520	520	520	520
Labor Cost, $/yr	**$ 78,000**	**$ 78,000**	**$ 78,000**	**$ 78,000**
Ozone System				
Normal Operating Hours				
Time Applying, hr/week	10	10	10	10
Time Applying, week/yr	23	23	23	23
Time Applying, hr	214	214	214	214
Labor Cost, $/yr	**$ 30,000**	**$ 30,000**	**$ 30,000**	**$ 30,000**
Start-Up and Shut Down				
Start-Up Time, hrs	32	32	32	32
Shut Down Time, hrs	80	80	80	80
Total, hrs	112	112	112	112
Labor Cost, $/yr	**$ 16,000**	**$ 16,000**	**$ 16,000**	**$ 16,000**
Total Cost, $/yr	**$ 46,000**	**$ 46,000**	**$ 46,000**	**$ 46,000**
Full Scale Nitrification/Denitification (See Potable Reuse Conditioning in Appendix I-3)				
Labor Cost $/year	**$ 1,090,000**	**$ -**	**$ 1,090,000**	
MBR Pretreatment (See Parallel Stream MBR in Appendix I-2)				
Labor Cost $/year	**$ -**	**$ 1,130,000**	**$ -**	**$ 1,130,000**
Total Labor Cost	**$ 1,506,000**	**$ 1,546,000**	**$ 1,506,000**	**$ 1,546,000**

[(a)]BAC Filter operates intermittently during weeks when recycled water system is not in use. Labor costs are mainly incurred during backwash of the system, which will occur year-round.

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Sampling and Analytical

Element	Raw Water Augmentation		Treated Water Augmentation	
	Full Nitrification Pretreatment	MBR Pretreatment	Full Nitrification Pretreatment	MBR Pretreatment
Total Labor Cost	**$ 500,000**	**$ 500,000**	**$ 500,000**	**$ 500,000**

APPENDIX I-7

Alternatives for Increasing Anaerobic Digestion Capacity

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Labor

Operating Costs	Fourth Digester
Operations Staff	
Digesters, number	4
Quantity, hr/day	1
Quantity, day/wk	7
Quantity, wk/yr	52
Rate, $/hr	150
Cost, $/yr	**$ 109,000.00**
Maintenance Staff	
Digesters, number	4
Quantity, hr/yr	45
Rate, $/hr	150
Cost, $/yr	**$ 27,000.00**
Operating Cost - Labor, $/yr	**$ 140,000.00**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Operating Costs	Fourth Digester
Digester Mixing	
Small Digesters, number	2
Operating Time, hr	8,800
Power, hp	10
Power, kW	7
Cost, $/yr	**$ 20,000.00**
Large Digesters, number	2
Operating Time, hr	8,800
Power, hp	30
Power, kW	22
Cost, $/yr	**$ 60,000.00**
Digester Recirculation	
Small Digesters, number	2
Operating Time, hr	8,800
Power, hp	15
Power, kW	11
Cost, $/yr	**$ 30,000.00**
Large Digesters, number	2
Operating Time, hr	8,800
Power, hp	20
Power, kW	15
Cost, $/yr	**$ 39,000.00**
Operating Costs - Energy, $/yr	**$ 150,000.00**

DSRSD WWTP Master Plan
Dublin San Ramon Services District
Pleasanton, California
406-19-15-39

Operating Costs - Energy

Operating Costs	High Solids Digestion (Omnivore)
Omnivore Digester Mixing	
Digesters	2
Energy, kWh/d	250
Cost, $/yr	**$ 27,594**
Conventional Digester Mixing	
Digesters	1
Operating Time, hr	8,760
Power, hp	30
Power, kW	22
Energy, kWh/d	536
Cost, $/yr	**$ 29,368**
Omnivore Digester Recirculation	
Small Digesters (Omnivore)	2
Operating Time, hr	8,760
Power, hp	20
Power, kW	15
Cost, $/yr	**$ 39,157**
Conventional Digester Recirculation	
Large Digester (Conventional)	1
Operating Time, hr	8,760
Power, hp	20
Power, kW	**15**
Cost, $/yr	**$ 19,579**
Recuperative Thickener	
Energy, kWh/d	133
Energy Cost, $/yr	**$ 7,000**
Pumps/Grinders	
Energy, kWh/d	25
Energy Cost, $/yr	**$ 1,000**
Operating Costs - Energy, $/yr	**$ 120,000**

DSRSD WWTP Master Plan
Dublin San Ramon Services District
Pleasanton, California
406-19-15-39

Operating Costs - Labor

Operating Costs	High Solids Digestion (Omnivore)
Operations Staff	
Digesters	3
Quantity, hr/day	1
Quantity, day/wk	7
Quantity, wk/yr	52
Rate, $/hr	$ 150
Cost, $/yr	**$ 80,000**
Thickener	1
Quantity, hr/day	1
Quantity, day/wk	7
Quantity, wk/yr	52
Rate, $/hr	$ 150
Cost, $/yr	**$ 80,000**
Maintenance Staff	
Digesters	3
Quantity, hr/yr	45
Rate, $/hr	$ 150
Cost, $/yr	**$ 20,000**
Thickener	2
Quantity, hr/yr	100
Rate, $/hr	$ 150.00
Cost, $/yr	**$ 30,000**
Operating Costs - Labor, $/yr	**$ 210,000**

WEST YOST ASSOCIATES

DSRSD WWTP Master Plan
Dublin San Ramon Services District
Pleasanton, California
406-19-15-39

Operating Costs - Chemical

Operating Costs	High Solids Digestion (Omnivore)
Polymer, lb/d	53
Unit Cost, $/pound	$ 7.00
Cost, $/yr	**$ 140,000**
Operating Costs - Chemical, $/y	**$ 140,000**

APPENDIX I-8

Alternatives for Reducing DLD Site Hydraulic Loadings

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Thicken All FSL solids for DLD Site Application in Summer	Dewater Portion of Digested Solids for Offsite Disposal Year-Round	Dewater a Portion of FSL Solids for Offsite Disposal in Winter	Dewater All FSLs Solids for DLD Site Application in Summer
Odor Control Fans				
Quantity	-	2	-	-
Power, kW	11	11	11	11
Operating Time, hr	-	2,912	-	-
Energy, kWh	-	65,000	-	-
Energy Cost, $/yr	**$ -**	**$ 10,000**	**$ -**	**$ -**
Dredge				
Quantity	1	1	1	1
Power, kW	30	30	30	30
Operating Time, hr	840	1,560	600	840
Energy, kWh	25,000	47,000	18,000	25,000
Energy Cost, $/yr	**$ 4,000**	**$ 7,000**	**$ 3,000**	**$ 4,000**
Thickener				
Quantity	3	-	-	-
Power, kW	4	-	-	-
Operating Time, hr	840	-	-	-
Energy, kWh	9,387	-	-	-
Energy Cost, $/yr	**$ 1,000**	**$ -**	**$ -**	**$ -**
Dewatering				
Quantity	-	2	2	5
Power, kW	-	4	4	4
Operating Time, hr	-	2,184	840	840
Energy, kWh	-	16,000	6,000	16,000
Energy Cost, $/yr	**$ -**	**$ 2,000**	**$ 1,000**	**$ 2,000**
Pumps				
Dewatering Return Stream Pump Cost				
Quantity	-	2	2	2
Power, kW	-	0.8	0.7	2.2
Operating Time, hr	-	2,184	840	840
Energy, kWh	-	1,800	600	1,900
Energy Cost, $/yr	**$ -**	**$ 270**	**$ 80**	**$ 280**
Thickening Return Stream Pump				
Quantity	2	-	-	-
Power, hp	3	-	-	-
Power, kW	1.9	-	-	-
Operating Time, hr	840	-	-	-
Energy, kWh	1,600	-	-	-
Energy Cost, $/yr	**$ 240**	**$ -**	**$ -**	**$ -**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Thicken All FSL solids for DLD Site Application in Summer	Dewater Portion of Digested Solids for Offsite Disposal Year-Round	Dewater a Portion of FSL Solids for Offsite Disposal in Winter	Dewater All FSLs Solids for DLD Site Application in Summer
Solids Storage Feed Pump Cost				
Quantity	2	-	-	-
Power, kW	4.2	-	-	-
Operating Time, hr	840	-	-	-
Energy, kWh	3,500	-	-	-
Energy Cost, $/yr	**$ 530**	**$ -**	**$ -**	**$ -**
Solids Storage Mixing Cost				
Mixing Pump Quantity	1	-	-	-
Power, kW	4.5	-	-	-
Operating Time, hr	2,016	-	-	-
Energy, kWh	9,100	-	-	-
Energy Cost, $/yr	**$ 1,370**	**$ -**	**$ -**	**$ -**
New Tractor Feed Pump Cost				
Quantity	2	-	-	-
Power, kW	3.9	-	-	-
Operating Time, hr	840	-	-	-
Energy, kWh	3,000	-	-	-
Energy Cost, $/yr	**$ 490**	**$ -**	**$ -**	**$ -**
Existing Dredge Cost				
Quantity	1	1	1	1
Power, kW	14.2	0.4	11.6	11.6
Operating Time, hr	840	2,184	600	840
Energy, kWh	11,900	900	7,000	9,800
Energy Cost, $/yr	**$ 1,790**	**$ 140**	**$ 1,040**	**$ 1,460**
EQ Pumps (from EQ tanks)				
Quantity	2	2	2	2
Power, kW	2.1	0.8	0.8	1.6
Operating Time, hr	840	2,184	1,456	2,184
Energy, kWh	1,723	1,728	1,122	3,484
Energy Cost, $/yr	**$ 260**	**$ 260**	**$ 170**	**$ 520**
Existing Digested Sludge Feed Pumps				
Quantity	2	2	2	2
Power, kW	1.8	1.8	1.8	1.8
Operating Time, hr	2,912	2,912	2,912	2,912
Energy, kWh	5,300	5,300	5,300	5,300
Energy Cost, $/yr	**$ 800**	**$ 800**	**$ 800**	**$ 800**
Operating Costs - Energy, $/yr	**$ 10,700**	**$ 20,700**	**$ 5,800**	**$ 9,200**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Thicken All FSL solids for DLD Site Application in Summer	Dewater Portion of Digested Solids for Offsite Disposal Year-Round	Dewater a Portion of FSL Solids for Offsite Disposal in Winter	Dewater All FSLs Solids for DLD Site Application in Summer
Polymer				
Solids processed (DT/year)	2,200	1,400	900	2,200
Quantity, lbs/ton dry solids	25	25	25	25
Unit Cost, $/active pound	$ 7.00	$ 7.00	$ 7.00	$ 7.00
Operating Costs - Chemical, $/yr	**$ 380,000**	**$ 250,000**	**$ 160,000**	**$ 380,000**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Hauling and Disposal

Operating Costs	Thicken All FSL solids for DLD Site Application in Summer	Dewater Portion of Digested Solids for Offsite Disposal Year-Round	Dewater a Portion of FSL Solids for Offsite Disposal in Winter	Dewater All FSLs Solids for DLD Site Application in Summer
Hauling and Tipping Fee				
Dry tons/year	-	1,404	941	-
Solids Content, %	0%	18%	18%	18%
Wet tons/year	-	7,802	5,227	-
Tipping Fee, $/wet ton	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Cost, $/yr	**$ -**	**$ 390,000**	**$ 260,000**	**$ -**
Operating Costs - Hauling and Disposal, $/yr	**$ -**	**$ 390,000**	**$ 260,000**	**$ -**

WEST YOST ASSOCIATES

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Labor

Operating Costs	Thicken All FSL solids for DLD Site Application in Summer	Dewater Portion of Digested Solids for Offsite Disposal Year-Round	Dewater a Portion of FSL Solids for Offsite Disposal in Winter	Dewater All FSLs Solids for DLD Site Application in Summer
Dredge				
Operations Staff				
Quantity, wk/yr	20	20	40	20
Quantity, hr/wk	56	40	48	56
Rate, $/hr	$ 150	$ 150	$ 150	$ 150
Cost, $/yr	**$ 168,000**	**$ 120,000**	**$ 288,000**	**$ 168,000**
Maintenance Staff				
Minor Maintenace, annual	**$ 3,600**	**$ 3,600**	**$ 3,600**	**$ 3,600**
Major Maintenance, every five years	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Major Maintenance, annual	**$ 1,300**	**$ 1,300**	**$ 1,300**	**$ 1,300**
Thickener				
Operations Staff				
FTE	1	-	-	-
Quantity, hr/day	8	-	-	-
Quantity, day/wk	7	-	-	-
Quantity, wk/yr	20	-	-	-
Rate, $/hr	$ 150	$ 150	$ 150	$ 150
Cost, $/yr	**$ 168,000**	**$ -**	**$ -**	**$ -**
Dewatering				
Maintenance Staff				
FTE	-	1	1	1
Quantity, hr/day	-	8	8	8
Quantity, day/wk	-	5	7	7
Quantity, wk/yr	-	52	20	20
Rate, $/hr	$ 150	$ 150	$ 150	$ 150
Cost, $/yr	**$ -**	**$ 310,000**	**$ 170,000**	**$ 170,000**
DLD				
Operations Staff				
FTE	2	2	2	2
Time Harvesting, wk	20	20	20	20
Time Applying, day/wk	7	5	5	7
Time Applying, hr/day	8	8	8	8
Time Applying, hr	1,120	800	800	1,120
Cost, $/yr	**$ 340,000**	**$ 240,000**	**$ 240,000**	**$ 340,000**
Operating Costs - Labor, $/yr	**$ 680,000**	**$ 680,000**	**$ 700,000**	**$ 680,000**

APPENDIX I-9

Potential Future Expansion to Full Dewatering

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Energy

Element	Full Dewatering from FSLs	Full Dewatering from Digesters
Odor Control Fans		
Quantity		2
Power, kW	11	11
Operating Time, hr	-	2,912
Energy, kWh	-	65,000
Energy Cost, $/yr	**$ -**	**$ 10,000.00**
Dredge		
Quantity	1	-
Power, kW	30	30
Operating Time, hr	840	-
Energy, kWh	25,000	-
Energy Cost, $/yr	**$ 4,000**	**$ -**
Dewatering		
Quantity	5	3
Power, kW	4	4
Operating Time, hr	840	2,184
Energy, kWh	16,000	24,000
Energy Cost, $/yr	**$ 2,000**	**$ 4,000**
Pumps		
Dewatering Return Stream Pump Cost		
Quantity	2	2
Power, kW	2.2	1.7
Operating Time, hr	840	2,184
Energy, kWh	1,900	3,700
Energy Cost, $/yr	**$ 280**	**$ 560**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Energy

Element	Full Dewatering from FSLs	Full Dewatering from Digesters
Existing Dredge Cost		
Quantity	1	-
Power, kW	11.6	-
Operating Time, hr	840	-
Energy, kWh	9,800	-
Energy Cost, $/yr	**$ 1,460**	**$ -**
EQ Pumps (from EQ tanks)		
Quantity	2	2
Power, kW	1.6	2.7
Operating Time, hr	2,184	2,184
Energy, kWh	3,484	5,808
Energy Cost, $/yr	**$ 520**	**$ 870**
SCFI Return Stream Pump Cost		
Quantity	-	-
Power, kW	-	-
Operating Time, hr	-	-
Energy, kWh	-	-
Energy Cost, $/yr	**$ -**	**$ -**
Existing Digested Sludge Feed Pumps		
Quantity	2	2
Power, kW	1.8	1.8
Operating Time, hr	2,912	2,912
Energy, kWh	5,300	5,300
Energy Cost, $/yr	**$ 800**	**$ 800**
Operating Costs - Energy, $/yr	**$ 9,200**	**$ 15,700**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Chemical

Element	Full Dewatering from FSLs	Full Dewatering from Digesters
Polymer		
Solids processed (DT/year)	2,200	3,200
Quantity, lbs/ton dry solids	25	25
Unit Cost, $/active pound	$ 7.00	$ 7.00
Operating Costs - Chemical, $/yr	**$ 380,000**	**$ 560,000**

PROJECT: DSRSD WWTP Master Plan
OWNER: Dublin San Ramon Services District
LOCATION: Pleasanton, California
WYA Project #: 406-19-15-39

Operating Costs - Hauling and Disposal

Operating Costs	Full Dewatering from FSLs	Full Dewatering from Digesters
Hauling and Tipping Fee		
Dry tons/year	2,200	3,200
Solids Content, %	18%	18%
Wet tons/year	11,954.76	17,844
Tipping Fee, $/wet ton	$ 50.00	$ 50.00
Cost, $/yr	**$ 600,000**	**$ 890,000**
Operating Costs - Hauling and Disposal, $/yr	**$ 600,000**	**$ 890,000**

PROJECT:	**DSRSD WWTP Master Plan**
OWNER:	**Dublin San Ramon Services District**
LOCATION:	**Pleasanton, California**
WYA Project #:	**406-19-15-39**

Operating Costs - Labor

Operating Costs	Dewater All Solids from FSLs and Haul Offsite	Dewater All Solids from Digesters
Dredge		
Operations Staff		
Quantity, wk/yr	20	-
Quantity, hr/wk	56	-
Rate, $/hr	$ 150	$ 150
Cost, $/yr	**$ 168,000**	**$ -**
Maintenance Staff		
Minor Maintenace, annual	**$ 3,600**	**$ -**
Major Maintenance, every five years	$ 6,600	$ -
Major Maintenance, annual	**$ 1,300**	**$ -**
Thickener		
Operations Staff		
FTE	-	-
Quantity, hr/day	-	-
Quantity, day/wk	-	-
Quantity, wk/yr	-	-
Rate, $/hr	$ 150	$ 150
Cost, $/yr	**$ -**	**$ -**
Dewatering		
Maintenance Staff		
FTE	1	1
Quantity, hr/day	8	8
Quantity, day/wk	7	7
Quantity, wk/yr	20	52
Rate, $/hr	$ 150	$ 150
Cost, $/yr	**$ 170,000**	**$ 440,000**
DLD		
Operations Staff		
FTE	-	-
Time Harvesting, wk	-	-
Time Applying, day/wk	-	-
Time Applying, hr/day	-	-
Time Applying, hr	-	-
Cost, $/yr	**$ -**	**$ -**
Operating Costs - Labor, $/yr	**$ 340,000**	**$ 440,000**

APPENDIX J

ENVision Process Model Output

Appendix J. ENVision Output

Process/Loading	Full Parameter Names	Units	Additional Secondary Clarifier		Parallel MBR		Year-Round Anaerobic Selector		Potable Reuse		BACWA Level 2		BACWA Level 3	
			Annual Average	Max Month	Annual Average	Max Month	Annual Average	Max Month	Annual Average	Max Month	Annual Average	Max Month	Annual Average	Max Month
Temperature	Temperature	C	21	16	21	16	21	16	16	16	16	16	16	16
Influent														
Flow	Influent - Flow	mgd	13.4	16.0	13.4	16.0	13.4	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Biochemical oxygen demand concentration (total)	Influent - Biochemical oxygen demand concentration (total)	mg/L	240	240	240	240	240	240	240	240	240	240	240	240
Total suspended solids concentration	Influent - Total suspended solids concentration	mg/L	266	244	266	244	266	244	244	244	244	244	244	244
Ammonia concentration	Influent - Ammonia concentration	mg N/L	32	32	32	32	32	32	32	32	32	32	32	32
Total Kjeldahl Nitrogen	Influent - Total Kjeldahl Nitrogen	mg N/L	45	45	45	45	45	45	45	45	45	45	45	45
Total phosphorus	Influent - Total phosphorus	mg P/L	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Alkalinity concentration	Influent - Alkalinity concentration	mg/L	230	230	230	230	230	230	230	230	230	230	230	230
Primary Sedimentation														
Number of Primary Clarifier	Primary Sedimentation - Number of Primary Clarifier	none	4	4	4	4	4	4	4	4	4	4	4	4
Clarifier area (Total)	Number of Primary Clarifier - Clarifier area (Total)	sq ft	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600
TSS removal efficiency	Primary Sedimentation - TSS removal efficiency	%	65	65	65	65	65	65	65	65	65	65	65	65
Hydraulic surface loading rate	Primary Sedimentation - Hydraulic surface loading rate	gpd/sq ft	2,034	2,412	1,184	1,563	2,036	2,400	2,372	1,517	2,363	1,509	2,367	1,512
Hydraulic retention time	Primary Sedimentation - Hydraulic retention time	hr	0.79	0.67	1.36	1.03	0.79	0.67	0.68	1.07	0.68	1.07	0.68	1.07
Primary sludge TSS concentration	Primary Sedimentation - Primary sludge TSS concentration	%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Activated Sludge														
Number of units	Activated Sludge - Number of units	none	5	5	5	5	5	5	7	6	8	7	10	9
Volume of each unit	Activated Sludge - Volume of each unit	Mgal	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Anaerobic volume fraction	Activated Sludge - Anaerobic volume fraction	none	0.20	0	0.20	0	0.20	0.20	0	0	0.20	0.20	0.20	0.20
Anoxic volume fraction	Activated Sludge - Anoxic volume fraction	none	0	0	0	0	0	0	0.2	0.2	0.25	0.25	0.33	0.33
Total volume	Activated Sludge - Total volume	Mgal	3.6	3.6	3.6	3.6	3.6	3.6	5.0	4.3	5.8	5.0	7.2	6.5
Depth (aerobic)	Activated Sludge - Depth (aerobic)	ft	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Sludge age (aerobic)	Activated Sludge - Sludge age (aerobic)	days	2.3	2.3	2.3	2.3	2.3	2.3	6.5	6.5	8	8	8	8
Detention time (total)	Activated Sludge - Detention time (total)	hr	5.676	4.782	9.752	7.38	5.673	4.807	6.808	9.126	7.813	10.7	9.763	13.75
MLSS	Activated Sludge - MLSS	mg/L	1157	1188	682.4	781.7	1164	1426	2297	1742	3281	2430	3163	2235
F/M	Activated Sludge - F/M	lb BOD/lb VSS/d	0.62	0.71	0.62	0.71	0.62	0.59	0.27	0.27	0.17	0.17	0.14	0.14
Yield total	Activated Sludge - Yield total	lb TSS/lb BOD	0.69	0.75	0.69	0.75	0.70	0.72	0.58	0.58	0.53	0.53	0.54	0.53
Total oxygen required	Activated Sludge - Total oxygen required	lb/d	16,780	17,470	10,010	11,610	16,770	18,310	35,840	21,370	38,220	22,410	35,050	22,710
Aerobic oxygen uptake rate	Activated Sludge - Aerobic oxygen uptake rate	mg/L/h	29.1	24.2	17.3	16.1	29.1	31.7	44.4	30.9	60.2	40.3	51.7	37.2
Secondary Clarifiers														
Number of secondary clarifiers	Secondary Clarifiers - Number of secondary clarifiers	none	5	5	4	4	4	4	5	4	5	4	5	4
Depth	Secondary Clarifiers - Depth	ft	14	14	14	14	14	14	14	14	14	14	14	14
Clarifier area (Total)	Secondary Clarifiers - Clarifier area (Total)	sq ft	38,100	38,100	30,480	30,480	30,480	30,480	38,100	30,480	38,100	30,480	38,100	30,480
Hydraulic surface loading rate	Secondary Clarifiers - Hydraulic surface loading rate	gpd/sq ft	390	462	277	368	487	577	462	368	462	368	462	368
Solids loading rate	Secondary Clarifiers - Solids loading rate	lb/sq ft/d	5.7	6.9	2.4	3.7	7.2	10.4	13.3	8.1	19.0	11.2	18.3	10.3
Hydraulic retention time (with recycle)	Secondary Clarifiers - Hydraulic retention time (with recycle)	hr	4.3	3.6	5.9	4.5	3.4	2.9	3.6	4.5	3.6	4.5	3.6	4.5
RAS concentration	Secondary Clarifiers - RAS concentration	mg/L	3,397	3,487	1,976	2,268	3,422	4,204	6,831	5,166	9,788	7,235	9,432	6,648
Membrane Biorector														
Number of units	Membrane Biorector - Number of units	none	0	0	2	2	0	0	0	2	0	2	0	2
Volume of each unit	Membrane Biorector - Volume of each unit	Mgal	0	0	0.40	0.40	0	0	0	0.40	0	0.40	0	0.40
Total Volume (AS + membrane)	Membrane Biorector - Total Volume (AS + membrane)	mgal	0	0	0.87	0.87	0	0	0	0.87	0	0.87	0	0.87
Anaerobic volume fraction	Membrane Biorector - Anaerobic volume fraction	none	0	0	0	0	0	0	0	0	0	0	0	0
Anoxic volume fraction	Membrane Biorector - Anoxic volume fraction	none	0	0	0.25	0.25	0	0	0	0.25	0	0.25	0	0.25
Depth (aerobic)	Membrane Biorector - Depth (aerobic)	ft	0	0	18	18	0	0	0	18	0	18	0	18
Sludge age (aerobic)	Membrane Biorector - Sludge age (aerobic)	days	0	0	10	10	0	0	0	10	0	10	0	10
Effluent ammonia (when nitrifying)	Membrane Biorector - Effluent ammonia (when nitrifying)	mg/L	0	0	0.5	0.5	0	0	0	0.5	0	0.5	0	0.5
Detention time (total)	Membrane Biorector - Detention time (total)	hr	0	0	5.2	5.2	0	0	0	5.2	0	5.2	0	5.2
MLSS aeration basin	Membrane Biorector - MLSS aeration basin	mg/L	0	0	10,230	10,570	0	0	0	10,570	0	10,570	0	10,570
Yield total	Membrane Biorector - Yield total	lb TSS/lb BOD	0	0	0.73	0.75	0	0	0	0.75	0	0.75	0	0.75
Total Oxygen Required	Membrane Biorector - Total Oxygen Required	lb/d	0	0	11,930	11,520	0	0	0	11,520	0	11,520	0	11,520
Membrane Area (Total)	Membrane Biorector - Membrane Area (Total)	sq ft	0	0	320,000	320,000	0	0	0	320,000	0	320,000	0	320,000
Filtration														
Area (total)	GM Filters - Area (total)	sq ft	875	875	875	875	875	875	875	875	875	875	875	875
Hydraulic Loading (average)	GM Filters - Hydraulic Loading (average)	gpm/sq ft	8.4	10.0	4.8	6.4	8.4	10.0	10.0	6.4	10.0	6.4	10.0	6.4
Solids loading	GM Filters - Solids loading	lb/sq ft/d	0.63	0.75	0.23	0.31	0.41	0.48	0.48	0.31	0.48	0.31	3.88	2.47
Membrane Filtration														
Area (total)	Membrane Filters - Area (total)	sq ft	205	205	205	205	205	205	205	205	205	205	205	205
Flow into filter	Membrane Filters - Flow into filter	mgd	0.16	0.19	0.09	0.12	0.16	0.19	0.19	0.12	0.19	0.12	0.19	0.12
DAFT														
Number of thickener units	DAFT - Number of thickener units	none	1	1	1	1	1	1	1	1	1	1	1	1
Diameter	DAFT - Diameter	ft	60	60	60	60	60	60	60	60	60	60	60	60
TSS removal efficiency	DAFT - TSS removal efficiency	%	94	94	94	94	94	94	94	94	94	94	94	94
Thickened sludge TSS concentration	DAFT - Thickened sludge TSS concentration	%	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Hydraulic surface loading rate	DAFT - Hydraulic surface loading rate	gpd/sq ft	586	698	421	536	591	666	589	411	565	390	576	397
Anaerobic Digestion														
Number of digesters	Anaerobic Digestion - Number of digesters	none	586	698	421	536	591	666	589	411	565	390	576	397
Digester volume (total)	Anaerobic Digestion - Digester volume (total)	Mgal	297	297	297	297	297	297	297	297	297	297	297	297
Detention time	Anaerobic Digestion - Detention time	days	20.2	17.3	26.4	21.3	19.7	17.3	19.1	23.4	19.5	23.8	18.2	23.0
Percentage of VSS destroyed during digestion	Anaerobic Digestion - Percentage of VSS destroyed during digestion	%	62	62	62	62	62	62	62	62	62	62	62	62
Cap Water														
Flow	Cap Water - Flow	mgd	297	297	297	297	297	297	297	297	297	297	297	297
Alum Feed (Sidestream)														
Chemical dosage concentration	Alum Feed (Sidestream) - Chemical dosage concentration	mg alum/L	20.2	17.3	26.4	21.3	19.7	17.3	19.1	23.4	19.5	23.8	18.2	23.0
Methanol Influent														
Flow	Methanol Influent - Flow	mgd	62	62	62	62	62	62	62	62	62	62	62	62
Biochemical oxygen demand concentration (total)	Methanol Influent - Biochemical oxygen demand concentration (total)	mg/L	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000
Alum Feed (Filters)														
Chemical dosage concentration	Alum Feed (Filters) - Chemical dosage concentration	mg alum/L	0	0	0	0	0	0	0	0	0	0	100	100
Polymer Feed (Filters)														
Chemical dosage concentration	Polymer Feed (Filters) - Chemical dosage concentration	mg poly/L	0	0	0	0	0	0	0	0	0	0	1	1

APPENDIX K

Subject Comparison Details

APPENDIX K-1

Non-economic Cost comparison of Alternatives for
Addressing Secondary Clarifier Capacity Limitations
Secondary Clarification

Non-Economic Cost Comparison of Alternatives for Addressing Secondary Clarifier Capacity Limitations							
	Additional Secondary Clarifier		Alum Addition for Year-Round Anaerobic Selector Operation		Parallel Stream MBR		
Criteria	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	Criteria Weight
Reliability	3.3	**7.0**	3.0	**5.7**	2.7	**5.0**	2.0
Reliability: Technology status	5.0	**10.0**	4.0	**8.0**	5.0	**10.0**	2.0
Reliability: Ease of operation	3.0	**9.0**	2.0	**6.0**	1.0	**3.0**	3.0
Reliability: Potential for construction impacts	2.0	**2.0**	3.0	**3.0**	2.0	**2.0**	1.0
Flexibility	2.7	**4.7**	4.7	**8.2**	4.0	**7.0**	1.75
Flexibility for future technological innovation	2.0	**3.5**	4.0	**7.0**	5.0	**8.8**	1.75
Flexibility for future regulatory requirements	4.0	**7.0**	5.0	**8.8**	5.0	**8.8**	1.75
Flexibility for future space planning	2.0	**3.5**	5.0	**8.8**	2.0	**3.5**	1.75
Odor generation potential	N/A	**-**	N/A	**-**	N/A	**-**	1.5
Maximize Available Water Storage Volume	3.0	**3.8**	3.0	**3.8**	2.0	**2.5**	1.25
Energy Management	3.0	**3.0**	4.0	**4.0**	3.0	**3.0**	1.0
Chemical use	4.0	**4.0**	1.0	**1.0**	2.0	**2.0**	1.0
Resource Recovery	3.0	**2.3**	3.5	**2.6**	3.0	**2.3**	0.75
Resource recovery: Water	3.0	**2.3**	3.0	**2.3**	5.0	**3.8**	0.75
Resource recovery: Nitrogen	3.0	**2.3**	3.0	**2.3**	2.0	**1.5**	0.75
Resource recovery: Phosphorous	3.0	**2.3**	4.0	**3.0**	3.0	**2.3**	0.75
Resource recovery: Biosolids	3.0	**2.3**	4.0	**3.0**	2.0	**1.5**	0.75
Potential for Ancillary Impacts	N/A	**-**	N/A	**-**	N/A	**-**	0.5
Weighted Subjective Ranking		**24.7**		**25.2**		**21.8**	**-**

Secondary Clarifier Capacity Alternatives
Non-Economic Evaluation Summary

Reliability:

Technology Status

- Alternatives that use more established technologies and techniques are scored higher than alternatives that rely on less proven or emerging technologies.
- While using alum to bind phosphorus in the FSL return stream is an established technology, there could be other factors contributing to poor settleability in the winter months that may not be addressed by operating an anaerobic selector year-round. Thus, using alum addition to allow for year-round anaerobic selector operation scores slightly lower than an alternative that increases the clarification capacity (and thus provides capacity under all settleability conditions).

Ease of Operation

- Alternatives that require more new equipment and facilities were deemed to be less favorable.
- Alum addition is a new facility, but operation is straightforward, and District staff are familiar with chemical addition operations.
- MBR is an entirely new treatment process that would require District staff to learn a new treatment system and would require ongoing operator support.

Potential for Construction Impacts

- Alternatives that had less impact on existing WWTP site were deemed more favorable.
- A new clarifier and parallel stream MBR would be constructed at the existing site and need to be tied into the existing facilities.
- Alum addition would be constructed at the FSL site and would have no real impact on operation.

Flexibility:

Technological Innovation

- Alternatives were scored higher if they either allow for deferral of capital investments or otherwise are more accommodating for constructing additional facilities in the future.
- Parallel stream MBR ranks the highest because this alterative supports a potential future potable reuse treatment system.
- Alum addition allows for deferral of construction of a fourth clarifier.

Regulatory Requirements

- Alternatives that have inherent flexibility to expand or modify to meet future discharge requirements were deemed more favorable.
- All of the alternatives support a future nitrogen removal requirement. The MBR option and alum addition options also provide for phosphorus removal.

Space Planning

- Alternatives that require a smaller footprint were deemed more favorable.
- The alternative that facilitates year-round biological P removal by added alum to the FSL supernatant saves the District from adding an additional secondary clarifier. Thus, this alternative was scored higher than the status quo alternative that requires a new secondary clarifier.

Odor Generation Potential:

- This criterion is not applicable because these alternatives will not have significant differential impacts on the potential for odor generation.

Maximize Available Water Storage Volume:

- Alternatives that did not impact existing flow EQ volume basin areas were deemed more favorable.
- The MBR alternatives requires construction in a portion of the current EQ storage area.
- Alternatives that did not impact FSL storage were deemed more favorable.
- None of the alternatives carried forward to costing impacted the FSL storage.

Energy Management:

- Alternatives that have the potential to increase energy generating potential are deemed more favorable.
- The alum addition option requires very little energy and has the potential to reduce energy demands for the aeration system due to the year-round anaerobic selector operation. It could also support increased solids capture.

Chemical Use:

- Alternatives that require more chemical demand were deemed less favorable.

Resource Recovery:

Water

- Alternatives that enhance the District’s recycled water production were deemed more favorable.

- The MBR alternative increases the District's recycled water production capacity and could serve as pre-treatment for a potable reuse treatment system.

Nitrogen

- This was modified to reflect an alternatives ability to remove ammonia and/or nitrogen was deemed more favorable.
- The MBR system provides for nitrogen removal, eliminating opportunity for recovery.

Phosphorous

- This was modified to reflect an alternatives ability to remove phosphorus was deemed more favorable.
- The alternative that has year-round biological P removal scored more favorably than the status quo that has seasonal biological P removal.

Biosolids

- This was modified to reflect an alternatives biosolids yield where those that yielded less biosolids were deemed more favorable.
- The MBR alternative will have a lower yield than the comparable alternatives without MBR.
- The alum addition alternative would slightly increase solids production.

Potential for Ancillary Impacts:

- Focused on greenhouse gas (GHG) emissions and other key ancillary environmental impacts that are not addressed in other headings (e.g., chemical use). Alternatives with less GHG emissions were deemed more favorable.
- None of the alternatives were identified has having additional potential for ancillary impacts.

APPENDIX K-2

Non-Economic Comparison of Pretreatment Alternatives
Upstream of FAT Process

Non-Economic Comparison of Pretreatment Alternatives Upstream of FAT Process

Criteria	No Pretreatment		Ozonation		Ozonation + BAC		Full NDN		Parallel Stream MBR		Criteria Weight
	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	
Reliability	2.3	**4.0**	2.3	**4.3**	2.3	**4.3**	2.3	**5.0**	2.7	**5.3**	2.0
Reliability: Technology status	3	**6.0**	2	**4.0**	2	**4.0**	4	**8.0**	4	**8.0**	2.0
Reliability: Ease of operation	1	**3.0**	2	**6.0**	2	**6.0**	2	**6.0**	2	**6.0**	3.0
Reliability: Potential for construction impacts	3	**3.0**	3	**3.0**	3	**3.0**	1	**1.0**	2	**2.0**	1.0
Flexibility	3.7	**6.4**	3.3	**5.8**	3.3	**5.8**	2.0	**3.5**	3.0	**5.3**	1.75
Flexibility for future technological innovation	4	**7.0**	3	**5.3**	3	**5.3**	1	**1.8**	2	**3.5**	1.75
Flexibility for future regulatory requirements	2	**3.5**	4	**7.0**	5	**8.8**	4	**7.0**	4	**7.0**	1.75
Flexibility for future space planning	5	**8.8**	3	**5.3**	2	**3.5**	1	**1.8**	3	**5.3**	1.75
Odor generation potential	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	-	**-**	1.5
Maximize Available Water Storage Volume	3	**3.8**	3	**3.8**	3	**3.8**	3	**3.8**	2	**2.5**	1.25
Energy Management	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	1.0
Chemical use	2	**2.0**	2	**2.0**	2	**2.0**	3	**3.0**	2	**2.0**	1.0
Resource Recovery	2.0	**1.5**	3.0	**2.3**	4.0	**3.0**	3.0	**2.3**	3.0	**2.3**	0.75
Resource recovery: Water	2	**1.5**	3	**2.3**	4	**3.0**	3	**2.3**	3	**2.3**	0.75
Resource recovery: Nitrogen	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	0.75
Resource recovery: Phosphorous	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	0.75
Resource recovery: Biosolids	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	0.75
Potential for Ancillary Impacts	3.0	**1.5**	2.0	**1.0**	2.0	**1.0**	3.0	**1.5**	3.0	**1.5**	0.5
Weighted Subjective Ranking		**19.2**		**19.2**		**19.9**		**19.1**		**18.9**	**-**

FAT Facilities Pretreatment Alternatives
Non-Economic Evaluation Summary

Reliability:

Technology Status

- Alternatives were scored higher if they include more established technologies and techniques and lower if they include newer, less proven or less reliable technologies.
- Full NDN and Parallel Stream MBR are established technologies for wastewater treatment and have been used successfully upstream of membrane filtration (FAT) processes.
- The Ozonation and Ozonation + BAC alternatives were lower ranked because Ozonation treatment is not used as frequently for wastewater treatment and efforts to assess their viability as a pretreatment for microfiltration are currently being developed.

Ease of Operation

- Alternatives were scored lower if they include new equipment and other processes with which District staff have no prior experience.
- Alternatives were scored lower if they could increase operational requirements of other processes (e.g. no pretreatment alternative).

Potential for Construction Impacts

- Alternatives were considered neutral if they do not require connection to, or construction near, existing facilities that operate year-round. This applied to Ozonation and Ozonation + BAC.
- Alternatives were scored lower if they require medication to existing facilities. This applied for Full NDN.
- Alternatives were scored lower if they require construction near existing facilities that operate year-round. This applied to both Full NDN and Parallel Stream MBR.

Flexibility:

Technological Innovation

- Alternatives were scored higher if they either allow for deferral of capital investments or otherwise are more accommodating for constructing additional facilities in the future.

- Full NDN ranked lowest because it locks the District into a conventional nitrogen removal approach. The Parallel Stream MBR option was not a low because it only treats part of the flow.
- The No Pretreatment option ranked the highest because it does not require any commitment to a technology now.

Regulatory Requirements

- Alternatives were considered more flexible to future regulatory requirements if they include processes that are recognized as treatment process that reduces pathogens. Both the Ozonation and Ozonation + BAC alternatives are currently recognized in this regard. The Full Nit/Deni and Parallel Stream MBR options are currently under investigation and may be recognized in the future.
- No pretreatment ranked the lowest because it does not provide for any additional removal credits in the future.

Space Planning

- Alternatives were considered more flexible and thus scored higher for future requirements if they would have less impact on land use.

Odor Generation Potential

- This criterion is not applicable because potable reuse alternatives will not have significant differential impacts on the potential for odor generation.

Maximize Available Water Storage Volume:

- Alternatives were scored higher if they did not impact existing flow equalization basin areas.
- The Parallel Stream MBR option would need to be constructed in the footprint of the equalization basins and thus ranks lower.
- Alternatives were scored higher if they preserved FSL volume.
- None of the alternatives have an impact the FSL volume.

Energy Management

- This criterion is not applicable because potable reuse alternatives will not have significant differential impacts on energy recovery or available space for energy generating facilities that are not captured by other criteria.

Chemical Use

- Alternatives are scored lower if they would require more types and amounts of chemicals. This evaluation is based on how many treatment trains, and hence how much chemicals, are used to control and remove biofouling and mineral scale, as well as to control microbial regrowth for the alternative.

- The no pretreatment alternative ranks the highest because it will require more chemical use for cleaning and maintenance of the membranes.

Resource Recovery:

Water

- Alternatives were ranked higher if they currently provide for higher levels of potable reuse. This applies to the Ozonation + BAC alternative.
- Alternatives were scored higher if they minimized the fraction of waste streams. The No Pretreatment option will decrease total recovery volumes.

Nitrogen

- This criterion is not applicable to potable reuse alternatives. Nitrogen recovery is not expected to be enhanced by any of the potable reuse alternatives.

Phosphorous

- This criterion is not applicable to potable reuse alternatives.

Biosolids

- This criterion is not applicable to potable reuse alternatives.

Potential for Ancillary Impacts

- Alternatives were scored lower if they have a potential for Ozonation release to the environment, which is considered a GHG.

APPENDIX K-3

Non-Economic Comparison of Alternatives for
Addressing Anaerobic Digestion Capacity Limitations

Non-Economic Comparison of Alternatives for Addressing Anaerobic Digestion Capacity Limitations

Criteria	Fourth Digester		Recuperative Thickening in Two Existing Digesters		Criteria Weight
	Value	Weighted Value	Value	Weighted Value	
Reliability	4.7	**9.7**	2.0	**4.0**	2.0
Reliability: Technology status	5.0	**10.0**	2.0	**4.0**	2.0
Reliability: Ease of operation	5.0	**15.0**	2.0	**6.0**	3.0
Reliability: Potential for construction impacts	4.0	**4.0**	2.0	**2.0**	1.0
Flexibility	3.00	**5.3**	3.00	**5.3**	1.75
Flexibility for future technological innovation	4.00	**7.0**	3.00	**5.3**	1.75
Flexibility for future regulatory requirements	N/A	**-**	N/A	**-**	1.75
Flexibility for future space planning	2.00	**3.5**	3.00	**5.3**	1.75
Odor generation potential	3.0	**4.5**	1.0	**1.5**	1.5
Maximize Available Water Storage Volume	N/A	**-**	N/A	**-**	1.25
Energy Management	4.0	**4.0**	5.0	**5.0**	1.0
Chemical use	3.0	**3.0**	2.0	**2.0**	1.0
Resource Recovery	3.00	**2.3**	4.00	**3.0**	0.75
Resource recovery: Water	3.00	**2.3**	4.00	**3.0**	0.75
Resource recovery: Nitrogen	3.00	**2.3**	4.00	**3.0**	0.75
Resource recovery: Phosphorous	3.00	**2.3**	4.00	**3.0**	0.75
Resource recovery: Biosolids	N/A	**-**	N/A	**-**	0.75
Potential for Ancillary Impacts	N/A	**-**	N/A	**-**	0.5
Weighted Subjective Ranking		**28.7**		**20.8**	**-**

DSRSD – WWTP Master Plan

Biosolids Treatment Alternatives
Non-Economic Eluviation Summary

Reliability:

Technology Status

- Alternatives that use more established technologies and techniques, or technologies that the District is familiar with, are scored higher than alternatives that rely on less proven or emerging technologies.
- The fourth digester alternative scored significantly higher than recuperative thickening.

Ease of Operation

- The fourth digester alternative ranked higher because is uses the same elements as the existing solids management system were deemed to be more favorable.
- The recuperative thinking alternatives also ranked lower because it includes more types of equipment to operate, including management of a high strength return stream flow.

Potential for Construction Impacts

- The recuperative thinking alternative has less impact on existing WWTP site, and ranked higher.
- However, installation of the recuperative thickening requires tying into two of the existing digesters, which is more complicated for construction.

Flexibility:

Technological Innovation

- The recuperative thickening alternative ranked lower because it locks the District into one approach for high solids digestion. In an emerging field, new technologies may develop that would be more efficient than high solids digestion.

Regulatory Requirements

- Regulatory requirements are not expected to change for solids digestion. Therefore, this criterion does not apply.

Space Planning

- Alternatives that had less impact on land use were deemed to be more flexible for space planning. Therefore, high solids digestion ranked higher.

Odor Generation Potential

- Recuperative thickening involves removing solids out of the digesters for thickening. This thickening process has a potential for odor generation and is a particularly sensitive area near the adjacent park.

Maximize Available Water Storage Volume

- Neither of the alternatives impact existing flow EQ volume. Therefore, this criterion does not apply.

Energy Management

- Both alternatives provide more opportunity for generating more energy at the WWTP site through co-digestion. However, the recuperative thickening process ranked the highest because it increases the co-digestion potential more than the fourth digester alternative.

Chemical Use

- Recuperative thickening requires the use of polymer, and is thus scored lower.

Resource Recovery:

Water

- The recuperative thickening alternative ranked slightly higher because it provides for solids thickening at the WWTP site, which allow for more recovery of the water that would otherwise be lost in the FSL process.

Nitrogen

- The recuperative thickening alternative would result in an increase in biosolids nitrogen concentrations. Therefore, it would potentially be easier to recover the nitrogen from the biosolids, and this alternative ranked slightly higher.

Phosphorous

- The recuperative thickening alternative would result in an increase in biosolids phosphorus concentrations. Therefore, it would potentially be easier to recover the phosphorus from the biosolids, and this alternative ranked slightly higher.

Biosolids

- Neither of the alternatives affect the volume of biosolids generated. Therefore, this criterion is not applicable to this analysis.

Potential for Ancillary Impacts:

- Ancillary impacts such as added truck traffic and Greenhouse Gas Emissions are not expected to differ between the two alternatives. Therefore, this criterion is not applicable to this analysis.

APPENDIX K-4

Non-Economic Comparison of Alternatives for
Reducing DLD Site Hydraulic Loadings

Non-Economic Comparison of Alternatives for Reducing DLD Site Hydraulic Loadings

Criteria	Thicken All FSL Solids to Apply DLDs		Dewatering Portion of Digested Solids		Dewatering Portion of FSL Solids		Dewatering All of FSL Solids to Apply to DLDs		Criteria Weight
	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	
Reliability	1.0	**3.0**	2.5	**7.5**	3.0	**9.0**	2.0	**6.0**	2.0
Reliability: Technology status	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	2.0
Reliability: Ease of operation	1.0	**3.0**	2.5	**7.5**	3.0	**9.0**	2.0	**6.0**	3.0
Reliability: Potential for construction impacts	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	1.0
Flexibility	2.00	**3.5**	3.50	**6.1**	3.50	**6.1**	3.0	**5.3**	1.75
Flexibility for future technological innovation	2.00	**3.5**	3.00	**5.3**	3.00	**5.3**	3.0	**5.3**	1.75
Flexibility for future regulatory requirements	2.00	**3.5**	4.00	**7.0**	4.00	**7.0**	3.0	**5.3**	1.75
Flexibility for future space planning	N/A	**-**	N/A	**-**	N/A	**-**	N/A	**-**	1.75
Odor generation potential	2.5	**3.8**	1.0	**1.5**	2.5	**3.8**	2.0	**3.0**	1.5
Maximize Available Water Storage Volume	3.0	**3.8**	4.0	**5.0**	3.0	**3.8**	3.0	**3.8**	1.25
Energy Management	3.0	**3.0**	4.0	**4.0**	3.0	**3.0**	3.0	**3.0**	1.0
Chemical use	1.0	**1.0**	2.0	**2.0**	2.0	**2.0**	1.0	**1.0**	1.0
Resource Recovery	2.5	**1.9**	3.9	**2.9**	3.4	**2.5**	3.4	**2.5**	0.75
Resource recovery: Water	4.0	**3.0**	3.0	**2.3**	3.0	**2.3**	4.5	**3.4**	0.75
Resource recovery: Nitrogen	2.0	**1.5**	4.0	**3.0**	3.5	**2.6**	4.0	**3.0**	0.75
Resource recovery: Phosphorous	3.0	**2.3**	4.0	**3.0**	3.0	**2.3**	3.0	**2.3**	0.75
Resource recovery: Biosolids	1.0	**0.8**	4.5	**3.4**	4.0	**3.0**	2.0	**1.5**	0.75
Potential for Ancillary Impacts	2.0	**1.0**	2.0	**1.0**	2.5	**1.3**	2.5	**1.3**	0.5
Weighted Subjective Ranking		**20.9**		**30.0**		**31.4**		**25.8**	**-**

DSRSD – WWTP MASTER PLAN

DLD Hydraulic Capacity Alternatives
Non-Economic Evaluation Summary

Reliability:

Technology Status

- Alternatives that use more established technologies and techniques are scored higher than alternatives that rely on less proven or emerging technologies. However, all of the alternatives rely on similar technologies for thickening or dewatering of solids. Therefore, this criterion does not apply.

Ease of Operation

- Alternatives that used more elements of the existing solids management system were deemed to be more favorable.
- Alternatives that includes more equipment and other processes, were deemed to be less favorable.
- The Thicken all FSL Solids for DLD application also ranked slightly lower than the other alternatives because it is not clear how this approach would impact operations of the DLD.

Potential for Construction Impacts

- All alternatives had no impact on existing WWTP site. Therefore, this criterion is not applicable to the analysis.

Flexibility:

Technological Innovation

- Alternatives were scored higher if they either allow for deferral of capital investments or otherwise are more accommodating for constructing additional facilities in the future.
- The dewatering alternatives ranked slightly higher because a dewatering approach lends itself to future innovation more than thickening with DLD application.

Regulatory Requirements

- Sending thickened solids to DLD was deemed to be the least flexible with respect to future requirements. Impacts on the DLD site and underlying groundwater are a potential long-term concern for the site.
- Sending dewatered solids to the DLD ranked slightly higher, because the dewatering process itself allows for future offsite diposal.

- The two alternatives that involve sending solids offsite now have the highest score, as these alternatives involve developing an alternative disposal option. Such an option may be needed if land application on the DLD become regulatorily more complex.

Space Planning

- All the alternatives require a similar footprint with respect to new facilities. Therefore, this criterion does not apply to this analysis.

Odor Generation Potential:

- Alternatives utilize FSL solids have less of an odor generation potential due to the reduction in volatile solids that occurs in the FSLs.
- Alternatives that only thicken or dewater a portion of solids have a smaller likelihood of odor generation than alternatives for thickening/dewatering of all solids.
- The thicken all FSL solids to Apply to DLD alternative has a potential for impact due to the dewatering system. However, all solids are applied subsurface, so the impact is lower than if the solids were applied to the DLD surface.

Maximize Available Water Storage Volume:

- The dewatering of digested solids alternatives requires the use of less FSLs volume, and was deemed more favorable.

Energy Management:

- The dewatering a portion of digested solids alternative has the highest potential for future energy generation from biosolids, as this alternative produces as dewatered solids with a higher volatile solids content.

Chemical Use:

- Evaluation based on how much polymer is used for alternative. The alternatives that dewaters more solids, uses more polymer and is scored lower.

Resource Recovery:

Water

- Alternatives that provided the ability to recover bound water in biosolids were deemed more favorable. The alternatives that dewaters more solids have the potential to recovery more water.
- Dewatering all the solids will recover more water than thickening and therefore ranked the highest.

Nitrogen

- Alternatives that included dewatering were assumed to be more favorable from an ability to recover nitrogen through beneficial reuse of biosolids as soil amendment.

- Dewatering all the solids will provide for a greater ability to recover nitrogen (versus partial dewatering).
- Dewatering from the digester also ranked slightly higher than the other alternatives, as it is likely that some nitrogen is lost in the FSL process through nitrification and volatilization.

Phosphorous

- Recovery of phosphorous from biosolids dewatering return stream through struvite precipitation was considered viable only when digested solids were dewatered.

Biosolids

- If applied to the DLD site, solids not being used beneficially.
- Dewatering does allow for offsite disposal, so the dewatering options ranked higher than the thickening option.
- The two alternatives that include offsite disposal, assume solids will be applied to beneficial reuse.
- Dewatering the digested solids ranked slightly higher than dewatering FSL solids because digested solids could have a higher value than solids with respect to volatile solids and nutrient content.

Potential for Ancillary Impacts:

- Added truck traffic from hauling to and from DSRSD will adversely impact environmental impact of operation.
- Increasing the application of biosolids to the DLD increases the potential for groundwater impacts, and thus ranks lower. Liquid biosolids applications have an even greater potential for impacts.

APPENDIX L

Wastewater Treatment Plant Nutrient Removal Fundamentals

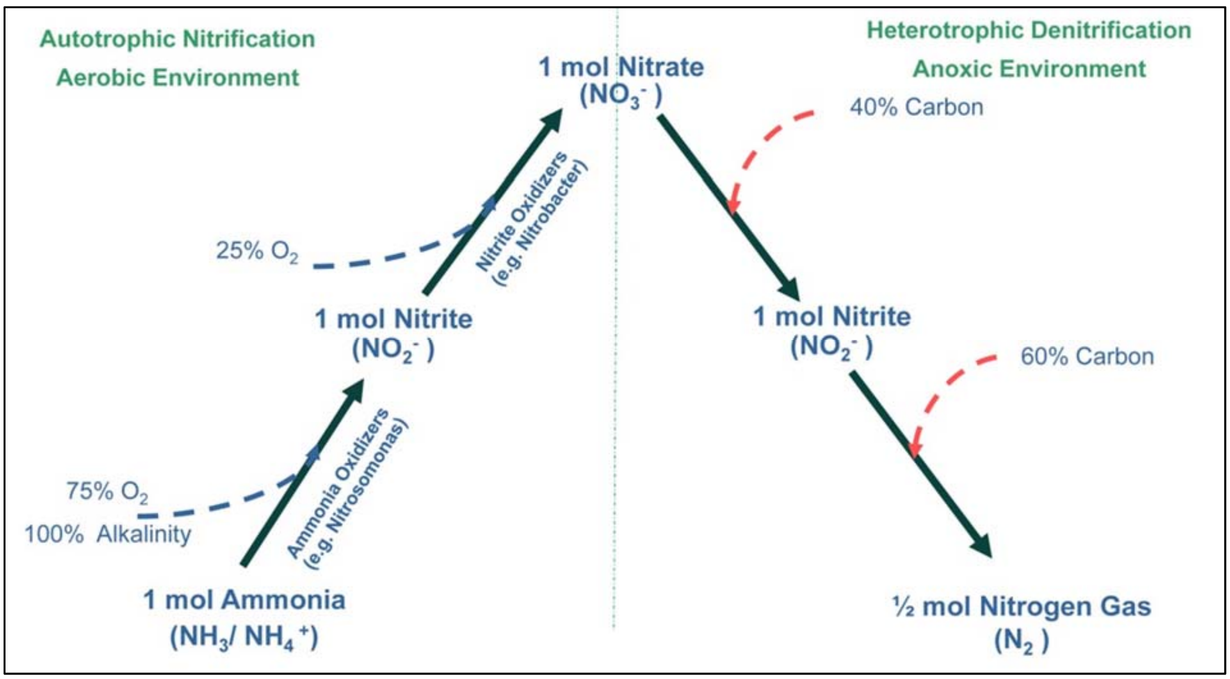
1.0 BIOLOGICAL NITROGEN REMOVAL IN WASTEWATER TREATMENT PLANTS

The removal of nitrogen in wastewater treatment plants typically occurs via conventional nitrification and denitrification. Nitrification is an aerobic, two-step process where ammonia (NH_3/NH_4^+) is first oxidized to nitrite (NO_2^-) (nitritation) using ammonia oxidizing bacteria (AOBs), followed by nitrite oxidation to nitrate (NO_3^-) (nitratation) using nitrite oxidizing bacteria (NOBs). The two-step process is carried out by autotrophic nitrifying organisms (AOBs and NOBs) and is commonly referred to as nitrification.

The nitrate end-point of nitrification can be followed by denitrification if the treatment objective is to remove nitrogen. Denitrification is a biological process where heterotrophic, denitrifying bacteria reduce nitrate first to nitrite, followed by subsequent reduction of nitrite to nitrogen gas. Denitrification requires a carbon source (such as biochemical oxygen demand (BOD)) as the electron donor for reduction of nitrate and nitrite.

A schematic of the carbon, oxygen, and alkalinity requirements for conventional nitrification/ denitrification is provided in Figure 1, below.

Figure 1. Schematic of Carbon, Oxygen, and Alkalinity Requirements for Nitrification/Denitrification



2.0 PHOSPHORUS REMOVAL IN WASTEWATER TREATMENT PLANTS

Phosphorous can be removed from treatment plants by biological and/or chemical/physical means. Biological phosphorous removal methods involve (a) assimilation of phosphorous (macro-nutrient) into cellular mass, and (b) enhanced phosphorus uptake by culturing phosphorus accumulating organisms (PAOs) in a sequential anaerobic-aerobic process. The District currently performs the latter while operating in parallel mode as previously discussed.

In addition to biological P removal, chemical precipitation using a metal salt, such as alum or ferric, is a proven and well documented approach to removing phosphate (primary phosphorus species found in municipal wastewater). Chemical addition will precipitate inorganic phosphorus. The extent of phosphorus precipitation is largely governed by pH, alkalinity, and the metal dose to orthophosphate ratio. The appropriate pH operating range is based on the coagulant used, whereby alum has a tighter operating range than ferric. Recent work has shown that the metal/phosphorus chemistry is closely tied to hydroxide formation and that covalent bonding to metal hydroxides form the major mechanism for phosphorus removal. A more detailed discussion on the fundamentals of phosphorus chemical precipitation can be found in (Smith et al., 2008).

APPENDIX M

Energy Demand Calculation Details

- Table M-1. Components of Current Energy Balance Calculations and Corresponding Assumptions
- Table M-2. Multipliers Developed to Calculate 2035 Energy Demands
- Table M-3. Components of 2035 Planned Energy Balance Calculations and Corresponding Assumptions for New Facilities
- Table M-4. Components of 2035 Potential Energy Balance Calculations and Corresponding Assumptions for New Facilities

Assets	Summer Power Demand, kW	Winter Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
East Amador Lift Station										
East Amador Lift Station Pumps	4.3	7.7	20	3	610	1,100	19	51%	Pump calculation using TDH and flow	
Total	**4.3**	**7.7**								
Influent Screening										
Barscreen Motors	3.1	3.1	3	3	N/A	N/A	N/A	N/A	70% of motor horsepower	Two operate 24/7, one standby
Grinder for Screenings Washer 1 & 2	5.2	5.2	5	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Both operate 24/7
Auger for Screenings Washer 1 & 2	3.1	3.1	3	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Both operate 24/7
Blowers for Barscreen Inlet Channel	1.6	1.6	3	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one standby
Sump Pumps for Channel	Not included in calculations		3	2	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Bin Mover	Not included in calculations		1.5	1	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Total	**13.0**	**13.0**								
Headworks Biofilter										
Barscreen Building Exhaust Fan	39.1	39.1	75	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one redundant
Total	**39.1**	**39.1**								
Influent Pumps										
Influent Pumps	38.6	42.5	200	4	6,600	7,300	21	68%	Pump calculation using TDH and	
Influent Sump Pumps	Not included in calculations		5	2	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Total	**38.6**	**42.5**								
Odor Reduction Tower										
Pump for ORT Effluent Supply	5.2	5.2	10	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one redundant
Exhaust Fan for Screen Room	3.9	3.9	7.5	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
Exhaust Fan for Grit Storage Room	7.8	7.8	15	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
Exhaust Fan for Grit Remover	2.6	2.6	5	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
REO Pump	Not included in calculations		1.5	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**19.6**	**19.6**								
Aerated Grit Tanks										
Grit Pumps	3.9	3.9	10	3	N/A	N/A	N/A	N/A	70% of motor horsepower (flow data not available)	All operate 24/7
Preaeration Blowers	26.1	26.1	1x20 HP, 2x15 HP	3	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Grit Classifier	Not included in calculations		15	1	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Total	**30.0**	**30.0**								
Primary Sedimentation Basins										
Scum Skimmers for Primary Basins	1.0	1.0	0.5	4 (one for each basin)	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Longitudinal Collectors	2.1	2.1	1	4 (one for each basin)	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Total	**3.1**	**3.1**								
Primary Sludge Pumps										
Primary Sludge Pumps	1.0	1.9	10	4	65	120	35	43%	Pump calculation using TDH and flow	
Primary Scum Pumps	Not included in calculations		10	3	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Primary Sludge Grinder	Not included in calculations		3	1	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Total	**1.0**	**1.9**								

Table M-1. Components of Current Energy Balance Calculations and Corresponding Assumptions										
Assets	Summer Power Demand, kW	Winter Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
Aeration Tanks										
Aeration Blowers	384	396	N/A	3	Calculated using MCC Amp Data					Blowers are 480 Volts
Aeration Mixers	18.8	0	9	4	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7 in summer; no operation in winter
Total	**403**	**396**								
Secondary Clarifiers										
Secondary Clarifier Collectors	1.8	1.8	2x0.75 HP, 2x1 HP	4	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Secondary Clarifier Launder Cleaners	Not included in calculations		Unkwn.	4	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**1.8**	**1.8**								
RAS Pumps										
RAS Pumps	7.8	7.8	60	4	3,700	3,700	5	45%	Pump calculation using TDH and flow	Calculated TDH of 5 ft
Total	**7.8**	**7.8**								
Mixed Liquor/WAS Pumps										
ML WAS Pumps	1.7	2.5	30	3	790	1,100	5	43%	Pump calculation using TDH and flow	Assume TDH of 5 ft
Total	**1.7**	**2.5**								
3W Pumps										
3W Pumps	60.6	68.8	75	3	870	990	200	54%	Pump calculation using TDH and flow	
Total	**60.6**	**68.8**								
FSL Cap Water Pumps										
FSL Cap Water Station Pumps	4.8	2.5	1x75HP, 1x10HP	2	72	38	200	57%	Pump calculation using TDH and flow	Assumed all flow goes through higher TDH pump
Total	**4.8**	**2.5**								
EPS 1										
EPS 1 Effluent Pumps	0.1	4.2	250	3	Unkwn.	Unkwn.	N/A	N/A	70% of motor horsepower	Operation hours based on pump hours
Total	**0.1**	**4.2**								
EPS 2										
System back calculated from DPM										
Total	**30.2**	**44.0**								
Tertiary Influent Pumps										
Tertiary Influent Pumps	29.4	6.6	50	3	3,300	750	24	51%	Pump calculation using TDH and flow	
Metering Pumps for PAC Feed	Not included in calculations		0.75	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Pump for PAC Transfer	Not included in calculations		0.75	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**29.4**	**6.6**								

Table M-1. Components of Current Energy Balance Calculations and Corresponding Assumptions										
Assets	Summer Power Demand, kW	Winter Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
Sand Filter System										
Rapid Mixers	19.2	7.9	20	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operating hours based days system was in operation
Air Compressors for Filter Air Supply	38.4	15.8	40	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operating hours based days system was in operation
Flocculators for Basins	1.9	0.8	2	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operating hours based days system was in operation
Reject Water Pumps	2.0	0.5	5	2	290	65	20	54%	Pump calculation using TDH and flow	
Pump for Filter Drain	Not included in calculations		3	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Filter Influent/Effluent Sample Pumps	Not included in calculations		0.75	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Polymer Feed System	Not included in calculations		2	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Band Screen for Final Effluent	Not included in calculations		2	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**61.6**	**24.9**								
UV System 2 (SF)										
System back calculated from DPN										
Total	**151**	**45.7**								
MF Supply Pumps										
MF Supply Pumps	0.3	7.2	40	2	21	520	40	54%	Pump calculation using TDH and flow	
Total	**0.3**	**7.2**								
MF System										
Air Compressors for MF System	0.3	5.8	40	3	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate when MF system is in use
Air Compressor for UV Channel	0.1	1.8	7.5	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates when MF system is in use
MF Feed Pumps	0.7	17.9	40	4	21	520	99	54%	Pump calculation using TDH and flow	
Total	**1.2**	**25.5**								
MF Building HVAC System										
Calculated from SG-1 data when MF System was not in operation										
Total	**12.7**	**13.3**								
UV System 1 (MF)										
System back calculated from SG-1										
Total	**0.8**	**4.9**								
Chillers, Heat Loop, Maintenance Building AC										
System Back Calculated from DPG										
Total	**76.1**	**59.2**								
FSL Aerators										
FSL Aerators	17.0	17.9	N/A	3	Direct PG&E meter data					
Total	**17.0**	**17.9**								
Anaerobic Digesters										
Digested Sludge Pumps	2.4	3.3	25	3	58	79	96	43%	Pump calculation using TDH and flow	
Digester Circulation Pumps	23.5	23.5	15	3	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Digester Mechanical Mixers	26.1	26.1	10	5	N/A	N/A	N/A	N/A	70% of motor horsepower	All operate 24/7
Digester Heat Exchanger Pumps	Not included in calculations		3	3	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Tunnel Supply Fan	Not included in calculations		Unkwn.	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**52.0**	**52.9**								

Table M-1. Components of Current Energy Balance Calculations and Corresponding Assumptions										
Assets	Summer Power Demand, kW	Winter Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
Gas Treatment										
Fuel Skid Gas Compressors	20.9	20.9	40	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one redundant
Pump for Ferrous Chloride	0.1	0.1	0.16	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
Pump for Glycol Solution	0.8	0.8	1.5	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one redundant
Total	**21.7**	**21.7**								
Recycled Water Pump Station										
Recycled Water Pumps	320.2	94.2	450	3	2,800	840	404	68%	Pump calculation using TDH and flow	
Air Compressors for Surge Tanks	Not included in calculations		15	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Recycled Water Wetwell Sump Pump	Not included in calculations		5	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**320.2**	**94.2**								
DAFT										
Pressurization Pump	78.3	78.3	150	2	N/A	N/A	N/A	N/A	70% of motor horsepower	One pump operates 24/7, one redundant
Thickened Sludge Pumps	0.8	1.1	25	2	51	71	34	43%	Pump calculation using TDH and flow	
DAFT Collector Mechanism	2.6	2.6	5	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
Air Compressors for DAFT	31.3	31.3	40	3	N/A	N/A	N/A	N/A	70% of motor horsepower	One operates 24/7, one operates 50% of the time, one redundant
Bottom Sludge Pump	Not included in calculations		25	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Sump Pumps	Not included in calculations		4	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**113**	**113**								
DAFT and Clarifier Biofilter										
Blowers for Clarifier 1&2	2.1	2.1	2	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Both operate 24/7
DAFT Blower	2.6	2.6	5	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 24/7
Exhaust Fans for DAFT Building	Not included in calculations		Unkwn.	2	N/A	N/A	N/A	N/A	Not included in calculations	Unknown HP
Fan for Main Supply of DAFT Building	Not included in calculations		Unkwn.	1	N/A	N/A	N/A	N/A	Not included in calculations	Unknown HP
Odor Reduction Tower Blower System	Not included in calculations		Unkwn.	1	N/A	N/A	N/A	N/A	Not included in calculations	Unknown HP
Total	**4.7**	**4.7**								

Appendix M-2. Multipliers Developed to Calculate 2035 Energy Demands

Asset Group	Multiplier	2035 Summer, kW	2035 Winter, kW	Reasoning	Description of Multiplier Calculation
Headworks Biofilter	1.0	39.1	39.1	No Change	No Change
Odor Reduction Tower		19.6	19.6		
Aerated Grit Tanks		30.0	30.0		
3W Pump Station		60.6	68.8		
Secondary Clarifiers		1.8	1.8		
FSL Cap Water Station		4.8	2.5		
MF Building HVAC System		12.7	13.3		
Chillers, Heat Loop & Maintenance Building AC		76.1	59.2		
FSL Aerators		17.0	17.9		
DAFT		113	113		
DAFT and Clarifier Biofilter		4.7	4.7		
Headworks Biofilter		39.1	39.1		
Odor Reduction Tower		19.6	19.6		
3W Pump Station		60.6	68.8		
Secondary Clarifiers		1.8	1.8		
East Amador Lift Station	1.29	5.5	9.9	Proportional to influent flow increase	2035 Average Combined Influent Flow (13.9 mgd)/ Current Average Combined Influent (10.8 mgd) = 1.29
Influent Screening		16.8	16.8		
Influent Pumps		49.7	54.7		
Primary Sludge Pumps		1.3	2.5		
RAS Pumps		10.1	10.1		
Mixed Liquor/WAS Pumps		2.2	3.2		
EPS 1		0.1	5.4		
EPS 2 (Winter)		N/A	56.6		
Primary Sedimentation Basins	1.75	5.5	5.5	Proportional to the increase in additional facilities	Planned Number of Basins (7)/ Current Number of Basins (4) =1.75
Anaerobic Digesters	1.47	76.5	77.8		Planned Volume of Digesters (431,000 gal)/ Current Volume of Digesters (293,000 gal) = 1.47
Aeration Tanks	0.84	340	334	80% of the reduction in TSS Loadings to Basins due to increased solids capture (65%)	1-0.8 (Current Average Primary Effluent TSS Loadings (14,800 lb/day) - 2035 Primary Effluent TSS Loadings (11,800 lb/day))/Current Average Primary Effluent TSS Loadings (14,800 lb/day) = 0.84
EPS 2 (Summer)	0.1	3.0	N/A	Proportional to reduction in flow, 10% of original flow, as more flow sent through Recycled Water system	0.1
Tertiary Influent Pump Station (Summer)	2.56	75.2	N/A	Based on summer recycled water demand and removing MF System (capped based on available flow)	(2035 SF Flows (12.2 mgd) + 2035 MF Flows (0.07 mgd))/Current SF Flow (4.8 mgd) = 2.56
Sand Filter System (Summer)		157	N/A		
UV System 2 (SF) (Summer)		387	N/A		
Recycled Water Pump Station (Summer)		819	N/A		
Tertiary Influent Pump Station (Winter)	4.07	N/A	26.9	Based on winter recycled water demand and removing MF System	(2035 SF Flows (2.75 mgd) + 2035 MF Flows (1.65 mgd))/Current SF Flow (1.08 mgd) = 4.07
Sand Filter System (Winter)		N/A	101		
UV System 2 (SF) (Winter)		N/A	186		
Recycled Water Pump Station (Winter)		N/A	208		
Gas Treatment	1.17	25.5	25.5	Proportional to increase in gas production.	2035 Gas Production (259,000 cu-ft/day)/Current Gas production (221,000 cu-ft/day) = 1.17
MF Supply Pumps	N/A	MF System No Longer in Use			
MF System					
UV System 1 (MF)					

Table M-3. Components of 2035 Planned Energy Balance Calculations and Corresponding Assumptions for New Facilities

Assets	Power Demand, kW	Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
Ballasted Flocculation										
Sand Recycle Pumps	28.8	11.9	10	6	N/A	N/A	N/A	N/A	70% of motor horsepower	Same operational hours as sand filter system
Coagulation Mixers for Trains 1 and 2	9.6	4.0	10	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Same operational hours as sand filter system
Maturation Mixers for Trains 1 and 2	14.4	5.9	15	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Same operational hours as sand filter system
Rapid Mix Pump	7.2	3.0	15	1	N/A	N/A	N/A	N/A	70% of motor horsepower	Same operational hours as sand filter system
Coagulant Pumps	Not included in calculations		Unkwn.	3	N/A	N/A	N/A	N/A	Not included in calculations	Unknown HP
Chemical Transfer Pump	Not included in calculations		2	1	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Ballasted Flocculation Gallery Sump Pumps	Not included in calculations		2	2	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Ballasted Flocculation Drain Sump Pumps	Not included in calculations		2	2	N/A	N/A	N/A	N/A	Not included in calculations	Operates infrequently
Polymer Units	Not included in calculations		1	3	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Ballasted Flocculation Train 1 and 2 Sludge	Not included in calculations		0.75	2	N/A	N/A	N/A	N/A	Not included in calculations	Negligible power consumption
Total	**60.0**	**24.7**								
Alum Addition to FSL Supernatant										
Alum Addition at FSLs	1.0	1.0	N/A	1	N/A	N/A	N/A	N/A	Average kW based on power consumption in kWhr/year	8,667 kWhr/year (from HDR)
Total	**1.0**	**1.0**								
Fourth Digester										
Assumed proportional increase from current digesters (See App. N-3).										
Three Additional Primary Sedimentation Basins										
Assumed proportional increase from current primary clarifiers (See App. N-2).										
Partial Biosolids Dewatering System										
Dewatering Equipment	0	1.44	7	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 6 hrs/day, 7 days/week, 20 weeks/year
Dewatering Return Stream Pump	0	0.13	1	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 840 hours/year
EQ Pump (from EQ Tanks)	0	0.26	1	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 1,456 hours/year
SCFI Return Stream Pump	0	0.04	0.2	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 2,184 hours/year
Existing Digested Sludge Feed Pumps	0	1.22	3	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 2,912 hours/year
Total	**0**	**3.1**								

Table M-4. Components of 2035 Potential Energy Balance Calculations and Corresponding Assumptions for New Facilities

Assets	Power Demand, kW	Power Demand, kW	HP	Number of Assets	Summer Flow, gpm	Winter Flow, gpm	TDH, ft	Estimated Pump Efficiency	Calculation Type	Assumptions
BACWA Level 2 Improvements										
Aeration Tanks	53	53	N/A	3	N/A	N/A	N/A	N/A	Average kW based on power consumption in kWhr/year	460,667 kWhr/year (from HDR)
MLE/IFAS Air Supply	642	642	N/A	1	N/A	N/A	N/A	N/A	Average kW based on power consumption in kWhr/year	5,626,667 kWhr/year (from HDR)
Additional Secondary Clarifier	25% increase in power moving from 4 to 5 secondary clarifiers (1.8kW to 2.3kW). Value not included in total below									
Total	**695**	**695**								
3.0 mgd FAT System										
MF System	10.8	64	N/A	1	243	2,550	92	0.75	Pump calculation using TDH and flow	580,000 kWhr/year
RO Membrane	80.7	479	N/A	1	228	2,390	92	0.75	Pump calculation using TDH and flow	11,499 kWhr/day (from GE Water
UV AOP System	5.5	33	N/A	N/A	228	2,390	N/A	N/A	Calculated from flow rate and energy consumed per amount of water treated.	260 kWhr/MG Treated (from WEDECO)
Total	**97.0**	**576**								
Full Biosolids Dewatering System										
Dewatering Equipment	1.9	1.9	7.1	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 6 hrs/day, 7 days/week, 52 weeks/year
Dewatering Return Stream Pump	0.1	0.1	1.1	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 6 hrs/day, 7 days/week, 52 weeks/year
EQ Pump (from EQ Tanks)	0.4	0.4	3.1	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 6 hrs/day, 7 days/week, 52 weeks/year
Digested Sludge Feed Pumps	0.6	0.6	3.5	2	N/A	N/A	N/A	N/A	70% of motor horsepower	Operates 2,912 hours/year
Total	**3.0**	**3.0**								

APPENDIX N

Energy Summary

Energy Summary

DSRSD Master Plan

March 14, 2017

Prepared by: David Reardon, PE

Reviewed by: Mike Falk, PE

Introduction

This document summarizes important energy-related issues for the Dublin San Ramon Services District (DSRSD) master planning process for the Dublin/San Ramon Wastewater Treatment Plant. The document covers two topics:

- Major energy-related items that could affect the master planning capital improvement program (CIP) process.
- Low-capital cost energy strategies that could be implemented now (an energy audit is not part of the scope of work).

Major Energy-related Items That Could Affect the Master Planning CIP Process

The following are the top five areas identified that could affect the master planning CIP process:

1. **Combined heat and power (CHP).** The existing engine generators are old but in good working condition. Their capacity is approximately 1,400 kilowatts (kW), but the engines are typically operated at approximately 1,200 kW. All engines typically operate using digester gas that is augmented with natural gas. The plant buys approximately 25 to 30 percent of its electricity from Pacific Gas and Electric Company (PG&E). The engines probably have an electrical efficiency of approximately 30 to 32 percent without parasitic losses. As a point of reference, modern reciprocating engines have efficiencies of approximately 40 percent without parasitic losses.

   These engines appear to be usable for the foreseeable future but may not last for the entire master planning period because of air quality regulations, code issues, and parts availability or catastrophic breakdown of some units. Parts availability is currently good for the existing engines and controls, but this could change in the future. If replacement of some or all of the units is anticipated, the cost will be approximately $5,000/kW or more in 2016 dollars assuming reciprocating engines are used. This cost includes gas cleaning. For example, if the CHP were replaced now, the capital cost would be approximately $10 million. Because this facility has a high replacement value and significant CHP changes could be needed during the planning period, DSRSD may want to set aside some capital funds in the master plan for this work.

2. **Aeration blowers.** The plant has three aeration blowers, each rated at approximately 8,300 cubic feet per minute (cfm). The units are Turblex and have outstanding efficiency throughout the typical flow ranges of 50 to 100 percent of design capacity. Typically, one blower operates with a second blower being used for approximately 6 hours per day. Existing flow rates average approximately 9,000 cfm, and BACWA Level 2 loads will average approximately 16,000 cfm. As flows and loads increase during the planning period, it is likely that at least one more blower will be needed to meet diurnal and maximum load demands. This should be included in the master planning capital improvements. Capital cost of the blower, piping, valves, and electrical equipment could

approach $1 million. If a membrane bioreactor is chosen to treat part of the plant flow (4 million gallons per day), blower capacity will increase yet again, with the likely addition of at least two blowers for membrane scour. This could mean that as many as six or more blowers would occupy the existing blower building. The existing blower building has space allocated for six blowers—each at 8,300 cfm.

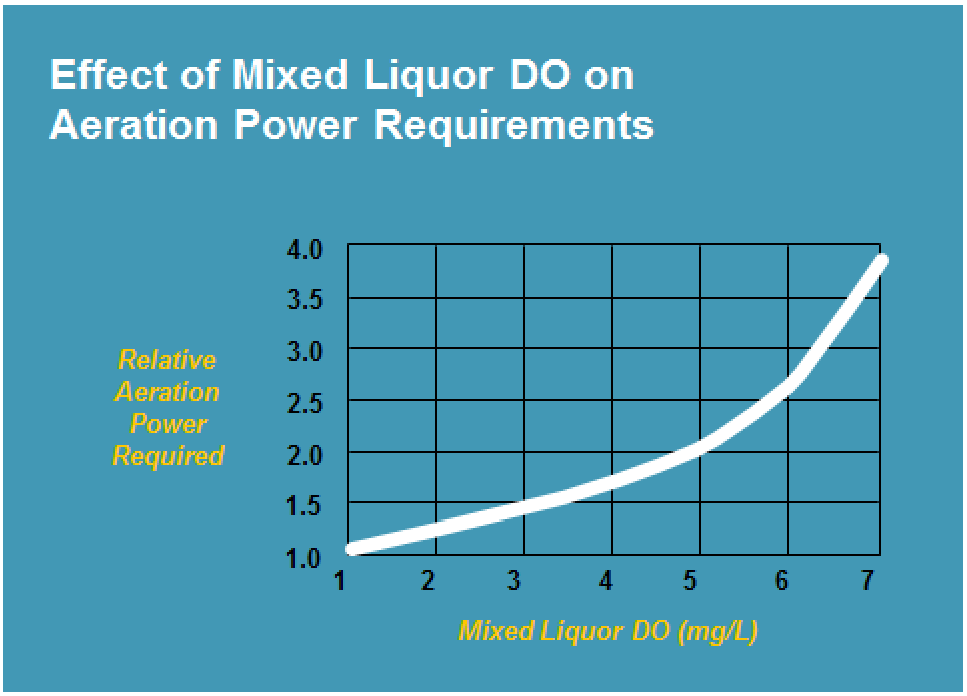
3. **Primary clarifiers.** The existing primary clarifiers are overloaded and have poor suspended solids removal compared with industry accepted textbook values. The master plan will recommend additional primary clarifiers (likely two or three). This will have a significant impact on the plant's energy balance. The increased removal efficiencies will divert more solids to anaerobic digestion, where they will produce additional biogas, thus reducing natural gas purchases for the CHP facility. Addition of baffling in existing and new primary clarifiers will further increase suspended solids removals. Increased removal of suspended solids in the primary clarifiers will reduce the carbonaceous load to the aeration basins. This will also decrease the air demand and will help to defer the installation of the additional blower previously discussed. Additional benefits will result from the addition of the primary clarifiers: waste activated sludge (WAS) production will be reduced and mixed liquor suspended solids (MLSS) concentrations will be slightly reduced. The reduction in MLSS concentrations will enhance the secondary clarifiers' capacity.

4. **Imported organics.** Importing organics for digestion will have a significant impact on the plant's energy balance. This could increase biogas production by 25 to 50 percent or more, depending on the quantity and quality of material imported. Economics for organics importing are best if excess digester capacity and CHP are available. Fortunately, the plant has available CHP capacity, and the increased biogas from digesting organics will replace some of the engines' purchased natural gas. The plant does not have excess digester capacity, so the cost of additional digester capacity and the organics receiving facility must be compared with the benefits of additional biogas production. Also, food waste will produce additional ammonia, which will affect aeration demands if nutrient limits are imposed on the plant. Fats, oil, and grease will not produce ammonia, but it can be contaminated with some food waste. Food waste is most desirable if it is preprocessed so that it can be hard-piped directly into storage or a digester. Processing food waste on site has a high potential for causing odor problems.

5. **Sludge thickening.** Raw and WAS are currently co-thickened in the Dissolved air flotation unit. Thickened solids concentration is approximately 4.5 percent. DSRSD may want to consider pumping thickened primary solids directly from the primary clarifiers to the anaerobic digesters and thickening WAS in rotating drum thickeners (RDT). This could allow thickening WAS to as high as 7 to 8 percent (or as high as is practical to pump). This change is important because the DAF unit is the fourth-highest identified energy consuming process in the plant (approximately 100 kW). Conversion to RDTs could reduce sludge thickening energy use by 80 to 90 percent. This change could also affect any decision to add recuperative thickening to the digesters.

Low-capital Cost Energy Strategies That Can Be Implemented Now

1. **Operate at the lowest practical dissolved oxygen (DO) concentration across the aeration basins.** Simply lowering the DO from 2 milligrams per liter (mg/L) to 1 mg/L can reduce energy associated with the blowers by 10 percent or more. DSRSD currently aims to operate the basins at a low DO, but it struggles to achieve this goal across the basins given a lack of probes along the basin length. A theoretical plot of the impact of DO set points on relative aeration power is provided in the figure below.

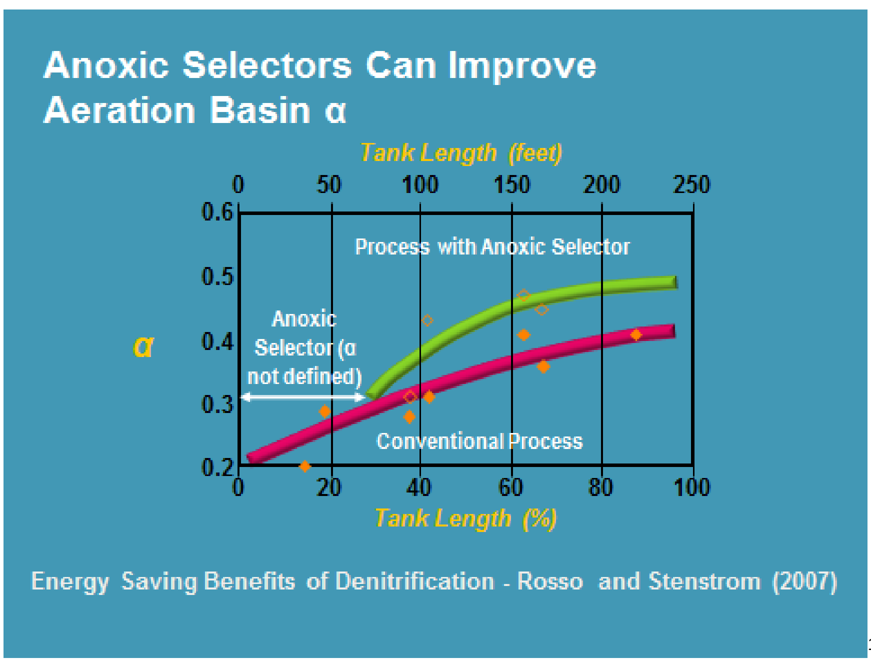


2. **Optimize aeration blower header pressure.** The system currently operates at approximately 8 pounds per square inch (psi). Blower energy is directly proportional to discharge pressure. Sufficient pressure must be maintained to overcome the static pressure at the diffusers and the dynamic pressure losses in the diffusers, valves, and piping. Often, header pressure can be lowered slightly when operating at less than maximum air demand periods. Reducing the set point header pressure by 0.1 psi will reduce blower energy consumption by approximately 6 horsepower. Further reductions in pressure will reduce power accordingly. Implementing a “most open valve” strategy will help optimize header pressure and subsequently reduce energy demand proportionally.

3. **Implement an aeration diffuser cleaning program.** DSRSD has not cleaned aeration diffusers in recent years because of the current drought. As the drought ends, DSRSD may want to consider resuming its regular cleaning program for aeration diffusers. This regular cleaning program included taking one to two aeration basins out of service every year. While diffusers are being cleaned, damaged diffusers and piping could be repaired.

Improving dirty water oxygen transfer efficiency from, for example, 10 to 12 percent, will have a dramatic impact on the blowers' energy consumption. A strict 2-year interval could also be considered for cleaning. Conversations with staffers at the LA County Sanitation Districts suggest that using pressure washers and Simple Green cleaner has been satisfactory at their plants.

4. **Operate with selectors year-round to improve alpha.** Selectors at the head end of aeration basins can improve energy efficiency by reducing alpha in the working area of the basins. Alpha is the ratio of oxygen transfer in wastewater compared with clean water. Selectors can adsorb surfactants that reduce alpha in aeration basins. When dissolved surfactant levels are reduced, oxygen transfer improves in the main aeration basin. Air delivered to the selector basin should be reduced as much as possible while still maintaining adequate mixing to prevent solids deposition. The plant currently operates an anaerobic selector (known as "in series mode") for about 4 to 6 months per year during the dry season to improve secondary clarifier effluent. During the remaining months, the plant operates with no selector (known as "parallel mode"). DSRSD may want to consider operating with the selector year-round and precipitate the phosphate in the lagoon return using ferric in the facultative sludge lagoons (FSLs) supernatant line as a means to overcome any struvite concerns. This concept has the benefits of improving secondary clarifier performance and possibly deferring construction of an additional secondary clarifier as well as reducing energy consumption. The disadvantage is the need for chemical addition at the FSLs supernatant. See the figure below for the benefits of a selector on alpha. This approach is explored in detail in the wastewater treatment plant master plan.



[1]

[1] Rosso, D, and Stenstrom, M.K., *Energy Saving Benefits of Denitrification, Environmental Engineer: Applied Research and Practice* (Summer 2007)

5. **Add coagulants such as ferric chloride ahead of the primary clarifiers rather than to the anaerobic digesters.** Benefits include reduced odors in primary clarifiers and DAF, improved removal of suspended solids in the primary clarifiers, reduced loading to the aeration system, increased biogas production, and reduced natural gas consumption in the CHP facility. Struvite reduction benefits might still be realized, but at a slightly higher overall coagulant consumption. These options have been explored in Chapter 9 of this wastewater treatment plant master plan.

6. **Reduce pressure of high-pressure air compressors used for utility air and scour air for the moving bed sand filters.** Check requirements of the filter manufacturer for recommended air pressure and ensure that no leaks exist in the system. Energy consumption is directly related to compressor pressure. Pressure of the existing system appears to be approximately 117 psi.

7. **Optimize mixing energy for anaerobic digesters.** It may be possible to reduce energy slightly to the anaerobic digesters by operating draft tube mixers on timers. A 25 to 40 percent reduction may be possible. Staff should be careful not to leave mixers off for more than ½ hour to reduce the possibility of rapid rise of digester contents when mixers are turned on. If multiple mixers are available on a single tank, mixing cycles could be staggered so that one mixer is always on.

8. **Optimize Non Potable Water (NPW) water consumption.** The system is controlled to operate at approximately 60 psi, which is an optimal pressure. The plant operators should consider conducting an audit of the NPW system to reduce consumption to the lowest practical level. Electrical savings are directly proportional to the reduction in flow.

APPENDIX O

Solar Analysis

APPENDIX O-1

Solar Analysis E-20P

West Yost Associates, Inc. - Solar Project Financial Analysis Model, Summary Results

1777 Botelho Ave., Suite 240, Walnut Creek, CA 94596. Phone: (925) 949-5800

CLIENT: Dublin San Ramon Services District (DSRSD) | Result NPV = ($820,000) | West Yost Job: 406-19-15-39 | Updated: 8/31/17 | Engineer: T. Hendrey / R. Joseph | All Input Cells are Shaded; other cells are calculated

CASE: Evaluate Solar Proposal at the Wastewater Treatment Plant (WTTP) (with E20-P Tariff Schedule)

Approx New kW = 435.6 | Approx Solar Panel Area Required, SF = 100,200 | Acres = 2.30

This Financial Evaluation Compares the Total Current Electric Power Cost to the Total Power Cost After a New Solar Project is Installed (Cals. can Incl. an Existing or Prior Solar Project that Already Affects Current Power Cost; i.e., a New, Second Solar Project on a meter that already has a solar panel installation)

Spreadsheet Table near bottom of this page provides the Yearly Details Comparing the Colums labeled E (total power cost now before the new Solar project) to H (Total Power Cost after the new Solar Project)

Result: Solar Project Present Worth (Cost) Savings, $1000 = ($820)

Utilty Information & Assumptions

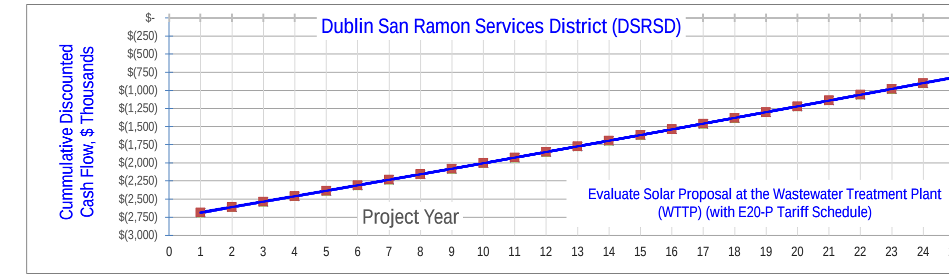
Electric Power Utility Name	PG&E
Customer Meter No. (Info Only)	
Assumed Utility Cost Escalation, % / Yr	3.5%
Customer Current Tariff:	E-20P <= Entry OK
Customer Tariff After New Solar Project:	E-20P <= Entry OK
Net Present Value (NPV) Discount Factor, % =	2.68%

Existing Solar System (if any) Information

		Solar Output Pattern % of Total by TOU	
Exist. Solar Project Provider	None		
Current Solar Output (Exist. Solar), kWh/yr =		Summer Peak, kWh	
Solar Panel Output Decline % per Yr =		Summer Part Peak, kWh	
Existing Solar, Current Price, $/kWh		Summer Off Peak, kWh	
Solar Project Cost Escalation % per Year =		Winter Part Peak, kWh	
Remaining Contract Life for Exist. Solar =		Winter Off Peak, kWh	
Solar Panel Tracking System, No. of Axis			0.0%

New/Proposed Solar System Information

		Solar Output Pattern % of Total by TOU	
Solar Proposer	unknown		
1 st Yr New Solar Output, kWh/yr	805,920	Summer Peak, kWh	21.6%
Solar Panel Output Decline % per Yr =	0.50%	Summer Part Peak, kWh	15.0%
First Yr Maint. OR kWh Purchase Price, $/kWh	$0.01	Summer Off Peak, kWh	23.4%
Purchase Cost if Owner Buys the Solar System, $ in Yr 1	$2,760,000	Winter Part Peak, kWh	24.9%
Solar Maintenance Cost Escalation % per Year =	2.68%	Winter Off Peak, kWh	15.0%
Proposed Contract & Project Life =	25		100.0%
Solar Panel Tracking System, No. of Axis	Single Axis		



25 = Project Life or Last Year Number

(1) 1st Year Utility + Existing Solar (if any) Costs & kWh on Utility Tariff = E-20P

First & Last Year Cost Comparisons

Row	Time of Use (TOU) Periods	Total Demand: Avg. Total Site kWh Use (Exist. Solar + Utility) by TOU, kWh	Exist. Solar Project (if any): Solar Output, kWh by TOU	Exist Solar PPA Cost, $/Kwh	Exist. Solar Energy Costs: Total Dollars Paid for Existing Solar, $	Exist. Tariff: Avg. Total Site kWh Use from Utility by TOU, kWh	Exist. Tariff: 1st Year Tariff Energy Only Rates, $ / kWh	Exist. Tariff: 1st Year Utility Energy Cost (Incl. Exist Solar Banking), $
			There is no Exist. Solar Project at Site			Exist. Tariff =	E-20P	E-20P
Row 1	Summer Weekday Peak (noon- 6 pm, 6 hrs)	526,569	0	$0.0000	$0	526,569	$0.1439	$ 75,789
Row 2	Summer Weekday Partial Peak (8:30-12, 6-9:30, 7 hrs)	594,470	0	$0.0000	$0	594,470	$0.1033	$ 61,415
Row 3	Summer Off Peak (11 hrs) + Weekends & Holidays	1,790,778	0	$0.0000	$0	1,790,778	$0.0783	$ 140,272
Row 4	Winter Partial Peak (8:30 am-9:30 pm, 13 hrs)	640,619	0	$0.0000	$0	640,619	$0.0980	$ 62,755
Row 5	Winter Off Peak (11 hrs)	935,114	0	$0.0000	$0	935,114	$0.0845	$ 78,989
Row 6		4,487,550	0	---	$0	4,487,550	Energy Cost =	$ 419,220

Row	Tariff Demand Charges by TOU		Avg Monthly Max Demand w. Exist Solar, kW	Exist. Tariff: 1st Yr Demand Charges, $ / kW	Exist. Tariff: 1st Yr Demand Cost for 6 Mo., $
Row 7					
Row 8	Summer Weekday Peak (noon- 6 pm, 6 hrs)	Summer Peak	1,012	$ 19.26	$ 116,947
Row 9	Summer Weekday Partial Peak (8:30-12, 6-9:30, 7 hrs)	Summer Part-Peak	1,252	$ 5.13	$ 38,537
Row 10	Summer Maximum (any time)	Summer Max.	1,383	$ 15.09	$ 125,217
Row 11	Winter Partial Peak (8:30 am-9:30 pm, 13 hrs)	Winter Part-Peak	1,037	$ 0.12	$ 747
Row 12	Winter Maximum (any time)	Winter Max.	1,016	$ 15.09	$ 91,989
Row 13				Sum. Demand $	$ 280,700
Row 14				Win.Demand $	$ 92,735

Row				E. Solar kWh		E. Solar $	Util kWh		
Row 15								Tot. Demand $	$ 373,435
Row 16	PG&E Energy + Demand Costs (no misc costs)		Sum kWh	0	Sum kWh $	$0	2,911,817	<kWh, Sum.Util, $/kWh>	$ 277,475
Row 17	Summer	$ 558,176	Win kWh	0	Win kWh $	$0	1,575,733	<kWh, Win.Util, $/kWh>	$ 141,744
Row 18	Winter	$ 234,479	Tot. kWh	0	Tot kWh $	$0	4,487,550	<kWh, Tot.Util, $/kWh>	$ 419,220
Row 19		$ 792,655						Total = Energy + Demand + Existing Solar Costs	$ 792,655
Row 20								Avg Utility Energy Only Cost (Incl. Solar Banking Effects), $/kWh =	$0.0934
Row 21								Avg Cost of Utility [kWh + Demand Chg.] w. Exist Solar Banking, $/kWh =	$0.1766
Row 22								Avg Cost of All Power [Util +Exist. Solar kWh + Demand Chg.], $/kWh =	$0.1766

(2) 1st Yr Power Cost w. New Solar Installed, Costs & kWh on Utility Tariff = E-20P

	New Tariff: % of Annual New Solar Output kWh by TOU	New Tariff: First Year Output of New Solar kWh	New Tariff: First Yr Price for New / Added Solar kWh	New Tariff: 1st Yr Cost SubTotals for NEW Solar kWh, Solar $	New Tariff: 1st Year kWh From Utilty, Total Used - (New + Exist. Solar), Utility kWh	New Tariff: 1st Yr Proposed Utility Tariff Cost per kWh, $/kWh	New Tariff: 1st Yr (Banked) / Purchased Utility kWh Cost, $
	kWh/Yr = 805,920		Evaluate Solar Proposal at the Was		New Tariff =	E-20P	E-20P
Row 1	21.6%	174,010	$0.0100	$1,740	352,559	$0.1439	$ 50,744
Row 2	15.0%	121,234	$0.0100	$1,212	473,236	$0.1033	$ 48,890
Row 3	23.4%	188,944	$0.0100	$1,889	1,601,834	$0.0783	$ 125,472
Row 4	24.9%	201,018	$0.0100	$2,010	439,601	$0.0980	$ 43,063
Row 5	15.0%	120,714	$0.0100	$1,207	814,400	$0.0845	$ 68,792
Row 6	1st Yr Solar kWh =	805,920	<= kWh	$8,059	3,681,630	Util Energy $ =	$ 336,961

		Est. Average Min. Solar Output kW by TOU	Reduction in Demand from New Solar		1st Yr Max. Demand kW with Solar	1st Yr Demand Charge Rate, $ / kW / Mo.	1st Yr Estimated Demand Costs with Solar, $ for 6 Mo.
Row 8	---	0.0	0	Sum. Peak	1,012	$ 19.26	$ 116,947
Row 9	---	0.0	0	Sum. Part-Peak	1,252	$ 5.13	$ 38,537
Row 10	---	0.0	0	Sum. Max.	1,383	$ 15.09	$ 125,217
Row 11	---	0.0	0	Win. Part-Peak	1,037	$ 0.12	$ 747
Row 12	---	0.0	0	Win. Max	1,016	$ 15.09	$ 91,989
Row 13						Sum. Demand $	$ 280,700
Row 14						Win.Demand $	$ 92,735

		N. Solar kWh		N. Solar $	Util kWh		
Row 15						Tot. Demand $	$ 373,435
Row 16	Sum kWh	484,188	Sum kWh $	$4,842	2,427,629	<kWh, Sum.Util, $/kWh>	$ 225,105
Row 17	Win kWh	321,732	Win kWh $	$3,217	1,254,001	<kWh, Win.Util, $/kWh>	$111,856
Row 18	Tot. kWh	805,920	Tot kWh $	$8,059	3,681,630	<kWh, Tot.Util, $/kWh>	$ 336,961
Row 19	1st Yr New Solar Energy Cost =	$ 8,059				1st Yr Utility Only $	$ 710,397
Row 20	Exist. Solar $ =	$0				First Yr Total Cost [Exist+New Solar,+Utility]=	$718,456
Row 21						1st Year Total Cost From Utility + Any Exist. Solar	$ 792,655
Row 22						First Year Savings (loss) from Solar Project or Tariff Change	$ 74,199.2

Avg Energy Only Price to Utility with Solar Banking Amounts Included, $/kWh = $0.0915 | kW+kWh $0.1930

(3) Last Year Utility + All Solar Costs & kWh on Utility Tariff = E-20P

	Total Demand: Avg. Total Site kWh Use (Exist. Solar + Utility) by TOU, kWh	Exist. Solar Project (if any): Solar Output, kWh by TOU	Exist Solar PPA Cost, $/Kwh	Exist. Solar Energy Costs: Total Dollars Paid for Existing Solar, $	Exist. Tariff: Avg. Total Site kWh Use from Utility by TOU, kWh	Exist. Tariff: 1st Year Tariff Energy Rates, $ / kWh	Exist. Tariff: 1st Year Utility Energy Cost (Incl. Exist Solar Banking), $
					Exist. Tariff =>	E-20P	E-20P
Sum. Peak	526,569	0	$0.0000	$0	526,569	$0.3286	$ 173,051
Sum. Part-Peak	594,470	0	$0.0000	$0	594,470	$0.2359	$ 140,230
Sum. Off-Peak	1,790,778	0	$0.0000	$0	1,790,778	$0.1789	$ 320,286
Win. Part-Peak	640,619	0	$0.0000	$0	640,619	$0.2237	$ 143,290
Win. Off-Peak	935,114	0	$0.0000	$0	935,114	$0.1929	$ 180,358
	4,487,550	0	---	$0	4,487,550	Energy Cost =	$ 957,216

		Last Yr Demand kW	Current Tariff: Last Yr Demand Charge $ / kW / Mo.	Current Tariff: Last Yr Demand Cost, $ for 6 Mo.
Sum. Peak	Summer Peak	1012	$ 43.98	$ 267,028
Sum. Part-Peak	Summer Part-Peak	1,252	$ 11.71	$ 87,992
Sum. Max.	Summer Max.	1,383	$ 34.46	$ 285,911
Win. Part-Peak	Winter Part-Peak	1,037	$ 0.27	$ 1,705
Win. Max	Winter Max.	1,016	$ 34.46	$ 210,040
			Sum. Demand $	$ 640,931
			Win.Demand $	$ 211,745

	E. Solar kWh		E. Solar $	Util kWh		
					Tot. Demand $	$ 852,676
Sum kWh	0	Sum kWh $	$0	2,911,817	<Sum.Util. kWh>	$ 633,568
Win kWh	0	Win kWh $	$0	1,575,733	< Win.Util. kWh >	$ 323,648
Tot. kWh	0	Tot kWh $	$0	4,487,550	<Tot. Util. kWh>	$ 957,216
					Avg. Total Energy + Demand Cost at Existing Utility Rate	$ 1,809,892
					Avg Cost of Utility [kWh Only] w. Exist Solar Banking, $/kWh =	$0.2133
					Avg Cost of Utility [kWh + Demand Chg.] w. Exist Solar Banking, $/kWh =	$0.4033
					Avg Cost of All Power [Util +Exist. Solar kWh + Demand Chg.], $/kWh =	$0.4033

(4) Last Yr Power Costs & kWh w. New Solar, on Utility Tariff = E-20P

	New Tariff: % of Annual New Solar Output kWh by TOU	New Tariff: First Year Output of New Solar kWh	New Tariff: First Yr Price for New / Added Solar kWh	New Tariff: 1st Yr Cost SubTotals for NEW Solar kWh, Solar $	New Tariff: Last Yr Proposed Utility Tariff Cost per kWh, $/kWh	New Tariff: Last Yr (Banked) / Purchased Utility kWh Cost, $	
Proposer = unknown				New Tariff =>	E-20P	E-20P	
154,287	$0.0189	$2,911	372,282	$0.3286	$	122,347	Row 1
107,492	$0.0189	$2,028	486,978	$0.2359	$	114,874	Row 2
167,528	$0.0189	$3,160	1,623,250	$0.1789	$	290,323	Row 3
178,233	$0.0189	$3,362	462,386	$0.2237	$	103,424	Row 4
107,032	$0.0189	$2,019	828,082	$0.1929	$	159,715	Row 5
714,572	<= kWh	$13,481	3,772,978	Energy Cost =	$	790,682	Row 6

	Reduction in Demand from New Solar		Last Yr Max. Demand kW with Solar	Last Yr Max. Demand $ / kW / Mo.	Last Yr Estimated Demand Costs, $ for 6 Mo.	Row 7
---	0	Sum. Peak	1,012	$43.98	$ 267,028	Row 8
---	0	Sum. Part-Peak	1,252	$11.71	$ 87,992	Row 9
---	0	Sum. Max.	1,383	$34.46	$ 285,911	Row 10
---	0	Win. Part-Peak	1,037	$0.27	$ 1,705	Row 11
---	0	Win. Max	1,016	$34.46	$ 210,040	Row 12
				Sum. Demand $	$ 640,931	Row 13
				Win.Demand $	$ 211,745	Row 14

N. Solar kWh		N. Solar $	Util kWh			
				Tot. Demand $	$ 852,676	Row 15
429,307	kWh, Sum.Util, $/kWh	$8,099	2,482,510	<kWh, Sum.Util, $/kWh>	$ 527,543	Row 16
285,265	kWh, Win.Util, $/kWh	$5,382	1,290,468	<kWh, Win.Util, $/kWh>	$ 263,139	Row 17
714,572	kWh, Tot.Util, $/kWh	$13,481	3,772,978	<kWh, Tot.Util, $/kWh>	$ 790,682	---
Last 1st Yr New Solar Cost =		$13,481		Last Yr Utility (Demand+Energy) $	$ 1,643,358	Row 19
Exist. Solar $ =		$0		Last Yr Total Cost, (Exist+New Solar) +Utility =	$ 1,656,838	Row 20
				Last Year Total Cost From Utility without New Solar	$ 1,809,892	Row 21
				Last Year Savings (loss) from Solar Project or Tariff Change	$ 153,053	Row 22

Avg Price to Utility with Solar Banking Amounts Included, $/kWh = $0.4356

Net Present Worth Savings (Cost) = ($819,013)

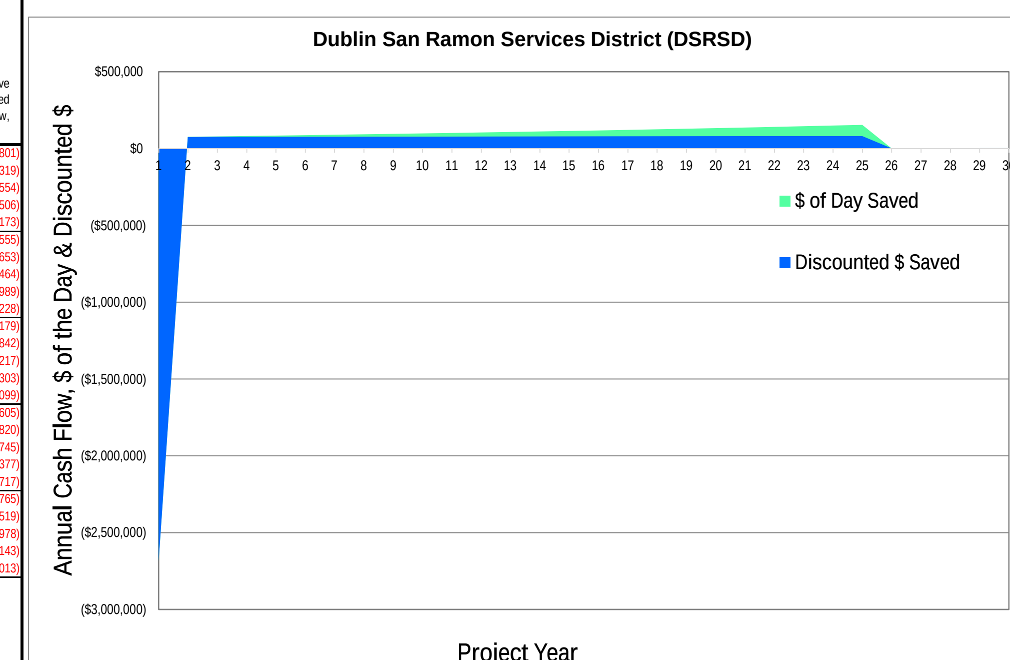
Rough Estimates of Emissions Saved in the First Year (Solar versus typical Power Plant & Distribution)

N+E Solar kWh	Lb CO2	Lb NOx	Lb SO2	Lb Particulate	Tonne CO2/Yr
805,920	1,017,000	800	190	220	460

Net Present Value Comparison: Total Power Cost with Utility and Existing Solar versus Total Power Cost with Utility, Existing Solar plus New Solar (How did the Total Customer Power Cost Change with the Addition of the New Solar Project)

Plant Demand by Year | Existing Cost Summary (Incl Exist Solar Effects) on Utility Tariff = E-20P | Total Exist Cost | Power Cost Summary with New Solar and Utility Switched to Tariff = E-20P | Tot. New Cost | Comparison Results

Project Year	Total Annual Customer Demand, kWh / Yr	Annual Energy Produced by Existing Solar, kWh / Yr	Current Price of Existing Solar, $ / kWh	A. Exist. Solar Energy Cost, Dollars of Day, $	Utiltiy Supplied kWh before New Solar Added = (Total Annual Demand) - (Exist Solar)	Effective Utility Energy Only Cost before New Solar (w. Exist. Solar), $/kWh	B. Exist. Tariff: Dollars of Day Utility Energy Costs (Incl. Exist Solar Banking), $	C. Utility Demand Charge Cost Before New Solar, Dollars of Day, $	E = A + B + C Total Cost of Power Before New Solar, $	Annual kWh Produced by New Solar, kWh / Yr	Current Price of New Solar kWh, $ / kWh	D. New Solar Cost, Dollar of Day, $/yr	S = A + D New + Existing Solar Cost, Dollars of Day, $	Utilty Supplied kWh with New Solar, kWh / Yr	Utility Effective Energy Only Cost with New Solar (cannot be negative), $ / kWh	F. Utility Energy Cost w. New Solar (cannot be negative), Dollars of Day, $ / yr	G. Utility Demand Charge Cost w. New Solar, Dollars of Day, $/yr	H. = S + F + G Total Power Cost w. New Solar, Dollars of Day, $ / Yr	P = E - H Total Power Cost Savings (Loss and/or Capital Cost) from New Solar Project, Dollars of Day, $ / Yr	K = P discounted to Yr 1, Project Annual NPV Savings (Cost), NPV $ / Yr	Cumulative Discounted Cash Flow, NPV
1	4,487,550	0	$ -	$ -	4,487,550	$ 0.0934	$ 419,220	$ 373,435	$ 792,655	805,920	$ 0.0100	$ 8,059	$ 8,059	3,681,630	$ 0.091525	$ 336,961	$ 373,435	$ 718,456	($2,685,801)	$ (2,685,801)	$ (2,685,801)
2	4,487,550	0	$ -	$ -	4,487,550	$ 0.0967	$ 433,892	$ 386,506	$ 820,398	801,890	$ 0.0103	$ 8,234	$ 8,234	3,685,660	$ 0.094740	$ 349,181	$ 386,506	$ 743,920	$76,478	$ 74,482	$ (2,611,319)
3	4,487,550	0	$ -	$ -	4,487,550	$ 0.1001	$ 449,078	$ 400,033	$ 849,112	797,881	$ 0.0105	$ 8,412	$ 8,412	3,689,669	$ 0.098068	$ 361,840	$ 400,033	$ 770,286	$78,826	$ 74,765	$ (2,536,554)
4	4,487,550	0	$ -	$ -	4,487,550	$ 0.1036	$ 464,796	$ 414,034	$ 878,831	793,892	$ 0.0108	$ 8,594	$ 8,594	3,693,658	$ 0.101513	$ 374,956	$ 414,034	$ 797,585	$81,246	$ 75,049	$ (2,461,506)
5	4,487,550	0	$ -	$ -	4,487,550	$ 0.1072	$ 481,064	$ 428,526	$ 909,590	789,922	$ 0.0111	$ 8,781	$ 8,781	3,697,628	$ 0.105079	$ 388,544	$ 428,526	$ 825,851	$83,739	$ 75,333	$ (2,386,173)
6	4,487,550	0	$ -	$ -	4,487,550	$ 0.1110	$ 497,901	$ 443,524	$ 941,425	785,972	$ 0.0114	$ 8,971	$ 8,971	3,701,578	$ 0.108770	$ 402,622	$ 443,524	$ 855,117	$86,308	$ 75,617	$ (2,310,555)
7	4,487,550	0	$ -	$ -	4,487,550	$ 0.1148	$ 515,328	$ 459,047	$ 974,375	782,043	$ 0.0117	$ 9,165	$ 9,165	3,705,507	$ 0.112591	$ 417,207	$ 459,047	$ 885,420	$88,955	$ 75,903	$ (2,234,653)
8	4,487,550	0	$ -	$ -	4,487,550	$ 0.1189	$ 533,364	$ 475,114	$ 1,008,478	778,132	$ 0.0120	$ 9,364	$ 9,364	3,709,418	$ 0.116546	$ 432,317	$ 475,114	$ 916,795	$91,683	$ 76,188	$ (2,158,464)
9	4,487,550	0	$ -	$ -	4,487,550	$ 0.1230	$ 552,032	$ 491,743	$ 1,043,775	774,242	$ 0.0124	$ 9,567	$ 9,567	3,713,308	$ 0.120639	$ 447,971	$ 491,743	$ 949,281	$94,494	$ 76,475	$ (2,081,989)
10	4,487,550	0	$ -	$ -	4,487,550	$ 0.1273	$ 571,353	$ 508,954	$ 1,080,307	770,371	$ 0.0127	$ 9,774	$ 9,774	3,717,179	$ 0.124877	$ 464,189	$ 508,954	$ 982,917	$97,390	$ 76,762	$ (2,005,228)
11	4,487,550	0	$ -	$ -	4,487,550	$ 0.1318	$ 591,351	$ 526,767	$ 1,118,118	766,519	$ 0.0130	$ 9,986	$ 9,986	3,721,031	$ 0.129263	$ 480,990	$ 526,767	$ 1,017,743	$100,375	$ 77,049	$ (1,928,179)
12	4,487,550	0	$ -	$ -	4,487,550	$ 0.1364	$ 612,048	$ 545,204	$ 1,157,252	762,686	$ 0.0134	$ 10,202	$ 10,202	3,724,864	$ 0.133802	$ 498,396	$ 545,204	$ 1,053,802	$103,450	$ 77,337	$ (1,850,842)
13	4,487,550	0	$ -	$ -	4,487,550	$ 0.1412	$ 633,469	$ 564,286	$ 1,197,756	758,873	$ 0.0137	$ 10,423	$ 10,423	3,728,677	$ 0.138502	$ 516,428	$ 564,286	$ 1,091,137	$106,619	$ 77,625	$ (1,773,217)
14	4,487,550	0	$ -	$ -	4,487,550	$ 0.1461	$ 655,641	$ 584,037	$ 1,239,677	755,078	$ 0.0141	$ 10,649	$ 10,649	3,732,472	$ 0.143366	$ 535,108	$ 584,037	$ 1,129,794	$109,884	$ 77,914	$ (1,695,303)
15	4,487,550	0	$ -	$ -	4,487,550	$ 0.1512	$ 678,588	$ 604,478	$ 1,283,066	751,303	$ 0.0145	$ 10,880	$ 10,880	3,736,247	$ 0.148400	$ 554,461	$ 604,478	$ 1,169,818	$113,248	$ 78,204	$ (1,617,099)
16	4,487,550	0	$ -	$ -	4,487,550	$ 0.1565	$ 702,339	$ 625,635	$ 1,327,973	747,546	$ 0.0149	$ 11,115	$ 11,115	3,740,004	$ 0.153612	$ 574,509	$ 625,635	$ 1,211,259	$116,714	$ 78,494	$ (1,538,605)
17	4,487,550	0	$ -	$ -	4,487,550	$ 0.1620	$ 726,921	$ 647,532	$ 1,374,453	743,809	$ 0.0153	$ 11,356	$ 11,356	3,743,741	$ 0.159006	$ 595,279	$ 647,532	$ 1,254,167	$120,286	$ 78,785	$ (1,459,820)
18	4,487,550	0	$ -	$ -	4,487,550	$ 0.1677	$ 752,363	$ 670,195	$ 1,422,558	740,090	$ 0.0157	$ 11,602	$ 11,602	3,747,460	$ 0.164590	$ 616,795	$ 670,195	$ 1,298,592	$123,966	$ 79,076	$ (1,380,745)
19	4,487,550	0	$ -	$ -	4,487,550	$ 0.1735	$ 778,696	$ 693,652	$ 1,472,348	736,389	$ 0.0161	$ 11,854	$ 11,854	3,751,161	$ 0.170370	$ 639,084	$ 693,652	$ 1,344,590	$127,758	$ 79,367	$ (1,301,377)
20	4,487,550	0	$ -	$ -	4,487,550	$ 0.1796	$ 805,950	$ 717,930	$ 1,523,880	732,707	$ 0.0165	$ 12,110	$ 12,110	3,754,843	$ 0.176352	$ 662,175	$ 717,930	$ 1,392,215	$131,665	$ 79,660	$ (1,221,717)
21	4,487,550	0	$ -	$ -	4,487,550	$ 0.1859	$ 834,158	$ 743,058	$ 1,577,216	729,044	$ 0.0170	$ 12,373	$ 12,373	3,758,506	$ 0.182544	$ 686,095	$ 743,058	$ 1,441,525	$135,691	$ 79,953	$ (1,141,765)
22	4,487,550	0	$ -	$ -	4,487,550	$ 0.1924	$ 863,354	$ 769,065	$ 1,632,418	725,398	$ 0.0174	$ 12,641	$ 12,641	3,762,152	$ 0.188954	$ 710,874	$ 769,065	$ 1,492,580	$139,839	$ 80,246	$ (1,061,519)
23	4,487,550	0	$ -	$ -	4,487,550	$ 0.1991	$ 893,571	$ 795,982	$ 1,689,553	721,771	$ 0.0179	$ 12,915	$ 12,915	3,765,779	$ 0.195589	$ 736,544	$ 795,982	$ 1,545,441	$144,113	$ 80,540	$ (980,978)
24	4,487,550	0	$ -	$ -	4,487,550	$ 0.2061	$ 924,846	$ 823,841	$ 1,748,687	718,163	$ 0.0184	$ 13,195	$ 13,195	3,769,387	$ 0.202456	$ 763,136	$ 823,841	$ 1,600,171	$148,516	$ 80,835	$ (900,143)
25	4,487,550	0	$ -	$ -	4,487,550	$ 0.2133	$ 957,216	$ 852,676	$ 1,809,892	714,572	$ 0.0189	$ 13,481	$ 13,481	3,772,978	$ 0.209564	$ 790,682	$ 852,676	$ 1,656,838	$153,053	$ 81,130	$ (819,013)
26	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
27	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
28	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
29	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
30	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
																		Sums	($31,505)	-819,013	$ (819,013)



APPENDIX O-2

Solar Analysis E-20R-P

West Yost Associates, Inc. - Solar Project Financial Analysis Model, Summary Results

1777 Botelho Ave., Suite 240, Walnut Creek, CA 94596. Phone: (925) 949-5800

CLIENT: Dublin San Ramon Services District (DSRSD) | Result NPV = $730,000 | West Yost Job: 406-19-15-39 | Updated: 8/31/17 | Engineer: T. Hendrey / R. Joseph | All Input Cells are Shaded; other cells are calculated

CASE: Evaluate Solar Proposal at the Wastewater Treatment Plant (WTTP) (with E20R-P Tariff Schedule)

Approx New kW = 435.6 | Approx Solar Panel Area Required, SF = 100,200 | Acres = 2.30

This Financial Evaluation Compares the Total Current Electric Power Cost to the Total Power Cost After a New Solar Project is Installed (Cals. can Incl. an Existing or Prior Solar Project that Already Affects Current Power Cost; i.e., a New, Second Solar Project on a meter that already has a solar panel installation)

Spreadsheet Table near bottom of this page provides the Yearly Details Comparing the Colums labeled E (total power cost now before the new Solar project) to H (Total Power Cost after the new Solar Project)

Result: Solar Project Present Worth (Cost) Savings, $1000 = $730

Utilty Information & Assumptions

Electric Power Utility Name	PG&E
Customer Meter No. (Info Only)	
Assumed Utility Cost Escalation, % / Yr	3.5%
Customer Current Tariff:	E-20P <= Entry OK
Customer Tariff After New Solar Project:	E-20R-P <= Entry OK
Net Present Value (NPV) Discount Factor, % =	2.68%

--

Existing Solar System (if any) Information

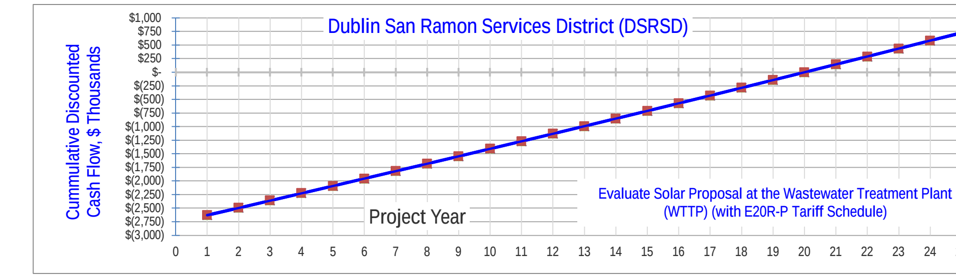
Exist. Solar Project Provider	None
Current Solar Output (Exist. Solar), kWh/yr =	
Solar Panel Output Decline % per Yr =	
Existing Solar, Current Price, $/kWh	
Solar Project Cost Escalation % per Year =	
Remaining Contract Life for Exist. Solar =	
Solar Panel Tracking System, No. of Axis	

Solar Output Pattern % of Total by TOU	
Summer Peak, kWh	
Summer Part Peak, kWh	
Summer Off Peak, kWh	
Winter Part Peak, kWh	
Winter Off Peak, kWh	
	0.0%

New/Proposed Solar System Information

Solar Proposer	unknown
1 st Yr New Solar Output, kWh/yr	805,920
Solar Panel Output Decline % per Yr =	0.50%
First Yr Maint. OR kWh Purchase Price, $/kWh	$0.01
Purchase Cost if Owner Buys the Solar System, $ in Yr 1	$2,760,000
Solar Maintenance Cost Escalation % per Year =	2.68%
Proposed Contract & Project Life =	25
Solar Panel Tracking System, No. of Axis	Single Axis

Solar Output Pattern % of Total by TOU	
Summer Peak, kWh	21.6%
Summer Part Peak, kWh	15.0%
Summer Off Peak, kWh	23.4%
Winter Part Peak, kWh	24.9%
Winter Off Peak, kWh	15.0%
	100.0%



25 = Project Life or Last Year Number --

1 — 1st Year Utility + Existing Solar (if any) Costs & kWh on Utility Tariff = E-20P

First & Last Year Cost Comparisons

Row	Time of Use (TOU) Periods	Total Demand: Avg. Total Site kWh Use (Exist. Solar + Utility) by TOU, kWh	Exist. Solar Project (if any): Solar Output, kWh by TOU	Exist Solar PPA Cost, $/Kwh	Exist. Solar Energy Costs: Total Dollars Paid for Existing Solar, $	Exist. Tariff: Avg. Total Site kWh Use from Utility by TOU, kWh	Exist. Tariff: 1st Year Tariff Energy Only Rates, $ / kWh	Exist. Tariff: 1st Year Utility Energy Cost (Incl. Exist Solar Banking), $
			There is no Exist. Solar Project at Site			Exist. Tariff =	E-20P	E-20P
Row 1	Summer Weekday Peak (noon- 6 pm, 6 hrs)	526,569	0	$0.0000	$0	526,569	$0.1439	$ 75,789
Row 2	Summer Weekday Partial Peak (8:30-12, 6-9:30, 7 hrs)	594,470	0	$0.0000	$0	594,470	$0.1033	$ 61,415
Row 3	Summer Off Peak (11 hrs) + Weekends & Holidays	1,790,778	0	$0.0000	$0	1,790,778	$0.0783	$ 140,272
Row 4	Winter Partial Peak (8:30 am-9:30 pm, 13 hrs)	640,619	0	$0.0000	$0	640,619	$0.0980	$ 62,755
Row 5	Winter Off Peak (11 hrs)	935,114	0	$0.0000	$0	935,114	$0.0845	$ 78,989
Row 6		4,487,550	0	---	$0	4,487,550	Energy Cost =	$ 419,220

Row	Tariff Demand Charges by TOU		Avg Monthly Max Demand w. Exist Solar, kW	Exist. Tariff: 1st Yr Demand Charges, $ / kW	Exist. Tariff: 1st Yr Demand Cost for 6 Mo., $
Row 7					
Row 8	Summer Weekday Peak (noon- 6 pm, 6 hrs)	Summer Peak	1,012	$ 19.26	$ 116,947
Row 9	Summer Weekday Partial Peak (8:30-12, 6-9:30, 7 hrs)	Summer Part-Peak	1,252	$ 5.13	$ 38,537
Row 10	Summer Maximum (any time)	Summer Max.	1,383	$ 15.09	$ 125,217
Row 11	Winter Partial Peak (8:30 am-9:30 pm, 13 hrs)	Winter Part-Peak	1,037	$ 0.12	$ 747
Row 12	Winter Maximum (any time)	Winter Max.	1,016	$ 15.09	$ 91,989
Row 13				Sum. Demand $	$ 280,700
Row 14				Win.Demand $	$ 92,735

Row				E. Solar kWh		E. Solar $	Util kWh		
Row 15								Tot. Demand $	$ 373,435
Row 16	PG&E Energy + Demand Costs (no misc costs)		Sum kWh	0	Sum kWh $	$0	2,911,817	<kWh, Sum.Util, $/kWh>	$ 277,475
Row 17	Summer	$ 558,176	Win kWh	0	Win kWh $	$0	1,575,733	<kWh, Win.Util, $/kWh>	$ 141,744
Row 18	Winter	$ 234,479	Tot. kWh	0	Tot kWh $	$0	4,487,550	<kWh, Tot.Util, $/kWh>	$ 419,220
Row 19		$ 792,655						Total = Energy + Demand + Existing Solar Costs	$ 792,655
Row 20								Avg Utility Energy Only Cost (Incl. Solar Banking Effects), $/kWh =	$0.0934
Row 21								Avg Cost of Utility [kWh + Demand Chg.] w. Exist Solar Banking, $/kWh =	$0.1766
Row 22								Avg Cost of All Power [Util +Exist. Solar kWh + Demand Chg.], $/kWh =	$0.1766

2 — 1st Yr Power Cost w. New Solar Installed, Costs & kWh on Utility Tariff = E-20R-P

Row	New Tariff: % of Annual New Solar Output kWh by TOU	New Tariff: First Year Output of New Solar kWh	New Tariff: First Yr Price for New / Added Solar kWh	New Tariff: 1st Yr Cost SubTotals for NEW Solar kWh, Solar $	New Tariff: 1st Year kWh From Utilty, Total Used - (New + Exist. Solar), Utility kWh	New Tariff: 1st Yr Proposed Utility Tariff Cost per kWh, $/kWh	New Tariff: 1st Yr (Banked) / Purchased Utility kWh Cost, $
	kWh/Yr = 805,920		Evaluate Solar Proposal at the Was		New Tariff =	E-20R-P	E-20R-P
Row 1	21.6%	174,010	$0.0100	$1,740	352,559	$0.3268	$ 115,209
Row 2	15.0%	121,234	$0.0100	$1,212	473,236	$0.1467	$ 69,424
Row 3	23.4%	188,944	$0.0100	$1,889	1,601,834	$0.0783	$ 125,472
Row 4	24.9%	201,018	$0.0100	$2,010	439,601	$0.0984	$ 43,270
Row 5	15.0%	120,714	$0.0100	$1,207	814,400	$0.0845	$ 68,792
Row 6	1st Yr Solar kWh =	805,920	<= kWh	$8,059	3,681,630	Util Energy $ =	$ 422,167

Row		Est. Average Min. Solar Output kW by TOU	Reduction in Demand from New Solar		1st Yr Max. Demand kW with Solar	1st Yr Demand Charge Rate, $ / kW / Mo.	1st Yr Estimated Demand Costs with Solar, $ for 6 Mo.
Row 8	---	0.0	0	Sum. Peak	1,012	$ 1.46	$ 8,865
Row 9	---	0.0	0	Sum. Part-Peak	1,252	$ 0.49	$ 3,681
Row 10	---	0.0	0	Sum. Max.	1,383	$ 15.09	$ 125,217
Row 11	---	0.0	0	Win. Part-Peak	1,037	$ 0.03	$ 187
Row 12	---	0.0	0	Win. Max	1,016	$ 15.09	$ 91,989
Row 13						Sum. Demand $	$ 137,763
Row 14						Win.Demand $	$ 92,175

Row		N. Solar kWh		N. Solar $	Util kWh		
Row 15						Tot. Demand $	$ 229,938
Row 16	Sum kWh	484,188	Sum kWh $	$4,842	2,427,629	<kWh, Sum.Util, $/kWh>	$ 310,105
Row 17	Win kWh	321,732	Win kWh $	$3,217	1,254,001	<kWh, Win.Util, $/kWh>	$112,062
Row 18	Tot. kWh	805,920	Tot kWh $	$8,059	3,681,630	<kWh, Tot.Util, $/kWh>	$ 422,167
Row 19			1st Yr New Solar Energy Cost = $	8,059		1st Yr Utility Only $	$ 652,105
Row 20	Exist. Solar $ =	$0				First Yr Total Cost [Exist+New Solar,+Utility]=	$660,164
Row 21						1st Year Total Cost From Utility + Any Exist. Solar	$ 792,655
Row 22						First Year Savings (loss) from Solar Project or Tariff Change	$ 132,490.7

Avg Energy Only Price to Utility with Solar Banking Amounts Included, $/kWh = $0.1147 | kW+kWh $0.1771

Net Present Worth Savings (Cost) = $725,718

3 — Last Year Utility + All Solar Costs & kWh on Utility Tariff = E-20P

	Total Demand: Avg. Total Site kWh Use (Exist. Solar + Utility) by TOU, kWh	Exist. Solar Project (if any): Solar Output, kWh by TOU	Exist Solar PPA Cost, $/Kwh	Exist. Solar Energy Costs: Total Dollars Paid for Existing Solar, $	Exist. Tariff: Avg. Total Site kWh Use from Utility by TOU, kWh	Exist. Tariff: 1st Year Tariff Energy Rates, $ / kWh	Exist. Tariff: 1st Year Utility Energy Cost (Incl. Exist Solar Banking), $
					Exist. Tariff =>	E-20P	E-20P
Sum. Peak	526,569	0	$0.0000	$0	526,569	$0.3286	$ 173,051
Sum. Part-Peak	594,470	0	$0.0000	$0	594,470	$0.2359	$ 140,230
Sum. Off-Peak	1,790,778	0	$0.0000	$0	1,790,778	$0.1789	$ 320,286
Win. Part-Peak	640,619	0	$0.0000	$0	640,619	$0.2237	$ 143,290
Win. Off-Peak	935,114	0	$0.0000	$0	935,114	$0.1929	$ 180,358
	4,487,550	0	---	$0	4,487,550	Energy Cost =	$ 957,216

		Last Yr Demand kW	Current Tariff: Last Yr Demand Charge $ / kW / Mo.	Current Tariff: Last Yr Demand Cost, $ for 6 Mo.
Sum. Peak	Summer Peak	1012	$ 43.98	$ 267,028
Sum. Part-Peak	Summer Part-Peak	1,252	$ 11.71	$ 87,992
Sum. Max.	Summer Max.	1,383	$ 34.46	$ 285,911
Win. Part-Peak	Winter Part-Peak	1,037	$ 0.27	$ 1,705
Win. Max	Winter Max.	1,016	$ 34.46	$ 210,040
			Sum. Demand $	$ 640,931
			Win.Demand $	$ 211,745

	E. Solar kWh		E. Solar $	Util kWh		
					Tot. Demand $	$ 852,676
Sum kWh	0	Sum kWh $	$0	2,911,817	<Sum.Util. kWh>	$ 633,568
Win kWh	0	Win kWh $	$0	1,575,733	< Win.Util. kWh >	$ 323,648
Tot. kWh	0	Tot kWh $	$0	4,487,550	<Tot. Util. kWh>	$ 957,216
					Avg. Total Energy + Demand Cost at Existing Utility Rate	$ 1,809,892
					Avg Cost of Utility [kWh Only] w. Exist Solar Banking, $/kWh =	$0.2133
					Avg Cost of Utility [kWh + Demand Chg.] w. Exist Solar Banking, $/kWh =	$0.4033
					Avg Cost of All Power [Util +Exist. Solar kWh + Demand Chg.], $/kWh =	$0.4033

4 — Last Yr Power Costs & kWh w. New Solar, on Utility Tariff = E-20R-P

New Tariff: % of Annual New Solar Output kWh by TOU	New Tariff: First Year Output of New Solar kWh	New Tariff: First Yr Price for New / Added Solar kWh	New Tariff: 1st Yr Cost SubTotals for NEW Solar kWh, Solar $	New Tariff: Last Yr Proposed Utility Tariff Cost per kWh, $/kWh	New Tariff: Last Yr (Banked) / Purchased Utility kWh Cost, $		Row
Proposer =	unknown		New Tariff =>	E-20R-P	E-20R-P		
154,287	$0.0189	$2,911	372,282	$0.7461	$	277,777	Row 1
107,492	$0.0189	$2,028	486,978	$0.3350	$	163,120	Row 2
167,528	$0.0189	$3,160	1,623,250	$0.1789	$	290,323	Row 3
178,233	$0.0189	$3,362	462,386	$0.2247	$	103,920	Row 4
107,032	$0.0189	$2,019	828,082	$0.1929	$	159,715	Row 5
714,572	<= kWh	$13,481	3,772,978	Energy Cost =	$	994,855	Row 6

	Reduction in Demand from New Solar		Last Yr Max. Demand kW with Solar	Last Yr Max. Demand $ / kW / Mo.	Last Yr Estimated Demand Costs, $ for 6 Mo.	Row
						Row 7
---	0	Sum. Peak	1,012	$3.33	$ 20,242	Row 8
---	0	Sum. Part-Peak	1,252	$1.12	$ 8,405	Row 9
---	0	Sum. Max.	1,383	$34.46	$ 285,911	Row 10
---	0	Win. Part-Peak	1,037	$0.07	$ 426	Row 11
---	0	Win. Max	1,016	$34.46	$ 210,040	Row 12
				Sum. Demand $	$ 314,558	Row 13
				Win.Demand $	$ 210,466	Row 14

N. Solar kWh		N. Solar $	Util kWh			Row
				Tot. Demand $	$ 525,024	Row 15
429,307	<kWh, Sum.Util, $/kWh>	$8,099	2,482,510	<kWh, Sum.Util, $/kWh>	$ 731,221	Row 16
285,265	<kWh, Win.Util, $/kWh>	$5,382	1,290,468	<kWh, Win.Util, $/kWh>	$ 263,635	Row 17
714,572	<kWh, Tot.Util, $/kWh>	$13,481	3,772,978	<kWh, Tot.Util, $/kWh>	$ 994,855	---
Last 1st Yr New Solar Cost =		$13,481		Last Yr Utility (Demand+Energy) $	$ 1,519,880	Row 19
Exist. Solar $ =		$0		Last Yr Total Cost, (Exist+New Solar) +Utility =	$ 1,533,360	Row 20
				Last Year Total Cost From Utility without New Solar	$ 1,809,892	Row 21
				Last Year Savings (loss) from Solar Project or Tariff Change	$ 276,531	Row 22

Avg Price to Utility with Solar Banking Amounts Included, $/kWh = $0.4028

Rough Estimates of Emissions Saved in the First Year (Solar versus typical Power Plant & Distribution)

N+E Solar kWh	Lb CO2	Lb NOx	Lb SO2	Lb Particulate	Tonne CO2/Yr
805,920	1,017,000	800	190	220	460

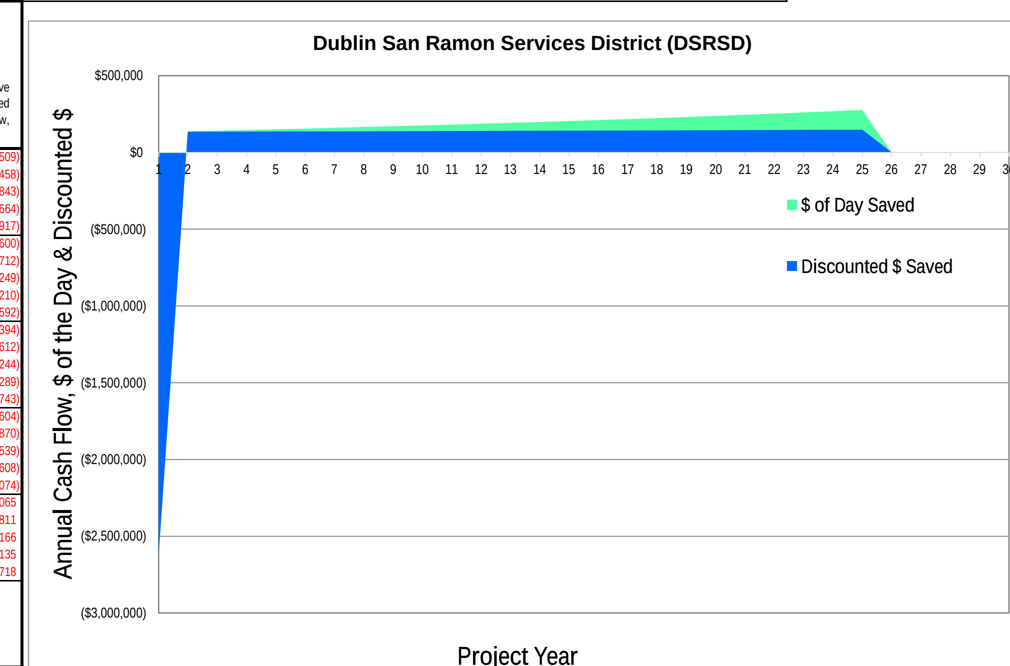
Net Present Value Comparison: Total Power Cost with Utility and Existing Solar versus Total Power Cost with Utility, Existing Solar plus New Solar (How did the Total Customer Power Cost Change with the Addition of the New Solar Project)

Plant Demand by Year | Existing Cost Summary (Incl Exist Solar Effects) on Utility Tariff = E-20P | Total Exist Cost

Project Year	Total Annual Customer Demand, kWh / Yr	Annual Energy Produced by Existing Solar, kWh / Yr	Current Price of Existing Solar, $ / kWh	A. Exist. Solar Energy Cost, Dollars of Day, $	Utiltiy Supplied kWh before New Solar Added = (Total Annual Demand) - (Exist Solar)	Effective Utility Energy Only Cost before New Solar (w. Exist. Solar), $/kWh	B. Exist. Tariff: Dollars of Day Utility Energy Costs (Incl. Exist Solar Banking), $	C. Utility Demand Charge Cost Before New Solar, Dollars of Day, $	E = A + B + C Total Cost of Power Before New Solar, $
1	4,487,550	0	$ -	$ -	4,487,550	$ 0.0934	$ 419,220	$ 373,435	$ 792,655
2	4,487,550	0	$ -	$ -	4,487,550	$ 0.0967	$ 433,892	$ 386,506	$ 820,398
3	4,487,550	0	$ -	$ -	4,487,550	$ 0.1001	$ 449,078	$ 400,033	$ 849,112
4	4,487,550	0	$ -	$ -	4,487,550	$ 0.1036	$ 464,796	$ 414,034	$ 878,831
5	4,487,550	0	$ -	$ -	4,487,550	$ 0.1072	$ 481,064	$ 428,526	$ 909,590
6	4,487,550	0	$ -	$ -	4,487,550	$ 0.1110	$ 497,901	$ 443,524	$ 941,425
7	4,487,550	0	$ -	$ -	4,487,550	$ 0.1148	$ 515,328	$ 459,047	$ 974,375
8	4,487,550	0	$ -	$ -	4,487,550	$ 0.1189	$ 533,364	$ 475,114	$ 1,008,478
9	4,487,550	0	$ -	$ -	4,487,550	$ 0.1230	$ 552,032	$ 491,743	$ 1,043,775
10	4,487,550	0	$ -	$ -	4,487,550	$ 0.1273	$ 571,353	$ 508,954	$ 1,080,307
11	4,487,550	0	$ -	$ -	4,487,550	$ 0.1318	$ 591,351	$ 526,767	$ 1,118,118
12	4,487,550	0	$ -	$ -	4,487,550	$ 0.1364	$ 612,048	$ 545,204	$ 1,157,252
13	4,487,550	0	$ -	$ -	4,487,550	$ 0.1412	$ 633,469	$ 564,286	$ 1,197,756
14	4,487,550	0	$ -	$ -	4,487,550	$ 0.1461	$ 655,641	$ 584,037	$ 1,239,677
15	4,487,550	0	$ -	$ -	4,487,550	$ 0.1512	$ 678,588	$ 604,478	$ 1,283,066
16	4,487,550	0	$ -	$ -	4,487,550	$ 0.1565	$ 702,339	$ 625,635	$ 1,327,973
17	4,487,550	0	$ -	$ -	4,487,550	$ 0.1620	$ 726,921	$ 647,532	$ 1,374,453
18	4,487,550	0	$ -	$ -	4,487,550	$ 0.1677	$ 752,363	$ 670,195	$ 1,422,558
19	4,487,550	0	$ -	$ -	4,487,550	$ 0.1735	$ 778,696	$ 693,652	$ 1,472,348
20	4,487,550	0	$ -	$ -	4,487,550	$ 0.1796	$ 805,950	$ 717,930	$ 1,523,880
21	4,487,550	0	$ -	$ -	4,487,550	$ 0.1859	$ 834,158	$ 743,058	$ 1,577,216
22	4,487,550	0	$ -	$ -	4,487,550	$ 0.1924	$ 863,354	$ 769,065	$ 1,632,418
23	4,487,550	0	$ -	$ -	4,487,550	$ 0.1991	$ 893,571	$ 795,982	$ 1,689,553
24	4,487,550	0	$ -	$ -	4,487,550	$ 0.2061	$ 924,846	$ 823,841	$ 1,748,687
25	4,487,550	0	$ -	$ -	4,487,550	$ 0.2133	$ 957,216	$ 852,676	$ 1,809,892
26	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -
27	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -
28	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -
29	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -
30	0	0	$ -	$ -	0	$ -	$ -	$ -	$ -

Power Cost Summary with New Solar and Utility Switched to Tariff = E-20R-P | Tot. New Cost | Comparison Results

Project Year	Annual kWh Produced by New Solar, kWh / Yr	Current Price of New Solar kWh, $ / kWh	D. New Solar Cost, Dollar of Day, $/yr	S = A + D New + Existing Solar Cost, Dollars of Day, $	Utilty Supplied kWh with New Solar, kWh / Yr	Utility Effective Energy Only Cost with New Solar (cannot be negative), $ / kWh	F. Utility Energy Cost w. New Solar (cannot be negative), Dollars of Day, $ / yr	G. Utility Demand Charge Cost w. New Solar, Dollars of Day, $/yr	H. = S + F + G Total Power Cost w. New Solar, Dollars of Day, $ / Yr	P = E - H Total Power Cost Savings (Loss and/or Capital Cost) from New Solar Project, Dollars of Day, $ / Yr	K = P discounted to Yr 1, Project Annual NPV Savings (Cost), NPV $ / Yr	Cumulative Discounted Cash Flow, NPV
1	805,920	$ 0.0100	$ 8,059	$ 8,059	3,681,630	$ 0.114668	$ 422,167	$ 229,938	$ 660,164	($2,627,509)	$ (2,627,509)	$ (2,627,509)
2	801,890	$ 0.0103	$ 8,234	$ 8,234	3,685,660	$ 0.118720	$ 437,561	$ 237,986	$ 683,781	$136,617	$ 133,051	$ (2,494,458)
3	797,881	$ 0.0105	$ 8,412	$ 8,412	3,689,669	$ 0.122914	$ 453,512	$ 246,315	$ 708,240	$140,872	$ 133,614	$ (2,360,843)
4	793,892	$ 0.0108	$ 8,594	$ 8,594	3,693,658	$ 0.127256	$ 470,040	$ 254,937	$ 733,571	$145,259	$ 134,180	$ (2,226,664)
5	789,922	$ 0.0111	$ 8,781	$ 8,781	3,697,628	$ 0.131751	$ 487,167	$ 263,859	$ 759,807	$149,783	$ 134,747	$ (2,091,917)
6	785,972	$ 0.0114	$ 8,971	$ 8,971	3,701,578	$ 0.136405	$ 504,913	$ 273,094	$ 786,978	$154,447	$ 135,317	$ (1,956,600)
7	782,043	$ 0.0117	$ 9,165	$ 9,165	3,705,507	$ 0.141222	$ 523,301	$ 282,653	$ 815,119	$159,257	$ 135,888	$ (1,820,712)
8	778,132	$ 0.0120	$ 9,364	$ 9,364	3,709,418	$ 0.146210	$ 542,353	$ 292,546	$ 844,263	$164,216	$ 136,463	$ (1,684,249)
9	774,242	$ 0.0124	$ 9,567	$ 9,567	3,713,308	$ 0.151373	$ 562,095	$ 302,785	$ 874,446	$169,329	$ 137,039	$ (1,547,210)
10	770,371	$ 0.0127	$ 9,774	$ 9,774	3,717,179	$ 0.156718	$ 582,550	$ 313,382	$ 905,706	$174,601	$ 137,618	$ (1,409,592)
11	766,519	$ 0.0130	$ 9,986	$ 9,986	3,721,031	$ 0.162252	$ 603,745	$ 324,350	$ 938,081	$180,037	$ 138,199	$ (1,271,394)
12	762,686	$ 0.0134	$ 10,202	$ 10,202	3,724,864	$ 0.167981	$ 625,705	$ 335,703	$ 971,610	$185,643	$ 138,782	$ (1,132,612)
13	758,873	$ 0.0137	$ 10,423	$ 10,423	3,728,677	$ 0.173911	$ 648,458	$ 347,452	$ 1,006,334	$191,422	$ 139,368	$ (993,244)
14	755,078	$ 0.0141	$ 10,649	$ 10,649	3,732,472	$ 0.180051	$ 672,034	$ 359,613	$ 1,042,296	$197,381	$ 139,956	$ (853,289)
15	751,303	$ 0.0145	$ 10,880	$ 10,880	3,736,247	$ 0.186406	$ 696,461	$ 372,200	$ 1,079,540	$203,526	$ 140,546	$ (712,743)
16	747,546	$ 0.0149	$ 11,115	$ 11,115	3,740,004	$ 0.192986	$ 721,769	$ 385,227	$ 1,118,111	$209,862	$ 141,139	$ (571,604)
17	743,809	$ 0.0153	$ 11,356	$ 11,356	3,743,741	$ 0.199798	$ 747,992	$ 398,709	$ 1,158,058	$216,395	$ 141,734	$ (429,870)
18	740,090	$ 0.0157	$ 11,602	$ 11,602	3,747,460	$ 0.206850	$ 775,161	$ 412,664	$ 1,199,427	$223,131	$ 142,331	$ (287,539)
19	736,389	$ 0.0161	$ 11,854	$ 11,854	3,751,161	$ 0.214150	$ 803,310	$ 427,108	$ 1,242,271	$230,077	$ 142,931	$ (144,608)
20	732,707	$ 0.0165	$ 12,110	$ 12,110	3,754,843	$ 0.221707	$ 832,475	$ 442,056	$ 1,286,642	$237,239	$ 143,534	$ (1,074)
21	729,044	$ 0.0170	$ 12,373	$ 12,373	3,758,506	$ 0.229530	$ 862,692	$ 457,528	$ 1,332,593	$244,623	$ 144,139	$ 143,065
22	725,398	$ 0.0174	$ 12,641	$ 12,641	3,762,152	$ 0.237630	$ 893,998	$ 473,542	$ 1,380,181	$252,237	$ 144,746	$ 287,811
23	721,771	$ 0.0179	$ 12,915	$ 12,915	3,765,779	$ 0.246014	$ 926,434	$ 490,116	$ 1,429,465	$260,089	$ 145,356	$ 433,166
24	718,163	$ 0.0184	$ 13,195	$ 13,195	3,769,387	$ 0.254694	$ 960,039	$ 507,270	$ 1,480,503	$268,184	$ 145,968	$ 579,135
25	714,572	$ 0.0189	$ 13,481	$ 13,481	3,772,978	$ 0.263679	$ 994,855	$ 525,024	$ 1,533,360	$276,531	$ 146,583	$ 725,718
26	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
27	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
28	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
29	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
30	0	$ -	$ -	$ -	0	$ -	$ -	$ -	$ -	$0	$ -	-
									Sums	$2,143,250	725,718	$ 725,718



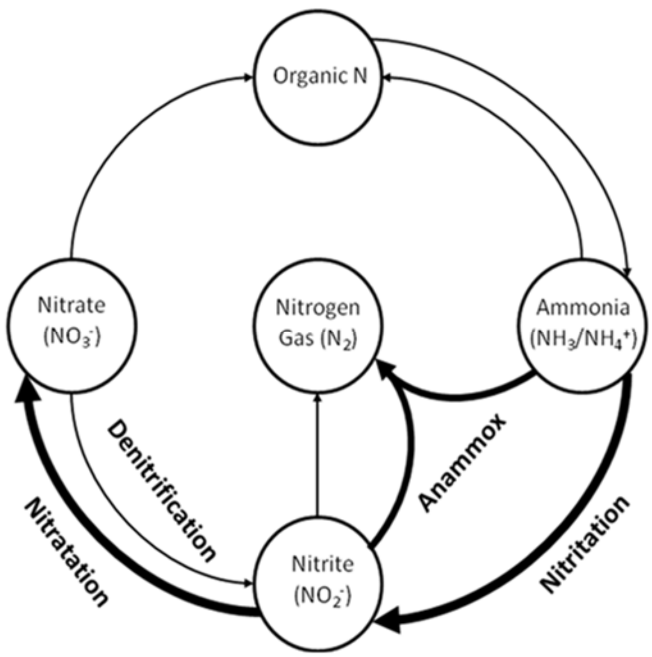
APPENDIX P

Wastewater Treatment Plant Nitrogen Removal Fundamentals

Wastewater Treatment Plant Nitrogen Removal Fundamentals

The removal of nitrogen during wastewater treatment plants follow three removal pathways, often referred to as Nitrogen Removal 1.0, 2.0, and 3.0. All three of these nitrogen removal pathways are shown under the nitrogen cycle shown in Figure 1. Details for each nitrogen removal pathway are provided on the following pages.

Figure 1. Primary Biological Nitrogen Transformations



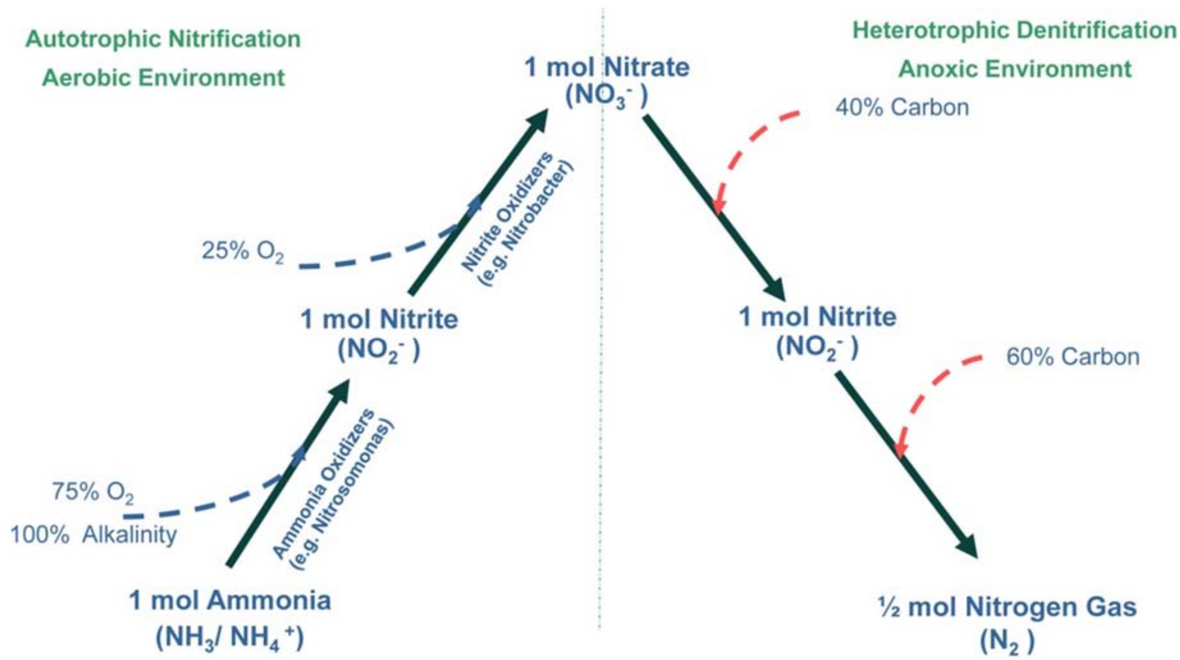
NITROGEN REMOVAL 1.0 - NITRIFICATION/DENITRIFICATION

Nitrogen Removal 1.0 represents conventional nitrification and denitrification. Nitrification is an aerobic, two-step process where ammonia (NH_3/NH_4^+) is first oxidized to nitrite (NO_2^-) (nitritation) using ammonia oxidizing bacteria (AOBs), followed by nitrite oxidation to nitrate (NO_3^-) (nitratation) using nitrite oxidizing bacteria (NOBs). The two-step process is carried out by autotrophic nitrifying organisms (AOBs and NOBs) and is commonly referred to as nitrification.

The nitrate end-point of nitrification can be followed by denitrification if the treatment objective is to remove nitrogen. Denitrification is a biological process where heterotrophic, denitrifying bacteria reduce nitrate first to nitrite, followed by subsequent reduction of nitrite to nitrogen gas. Denitrification requires a carbon source (such as biochemical oxygen demand (BOD)) as the electron donor for reduction of nitrate and nitrite.

A schematic of the carbon, oxygen, and alkalinity requirements for conventional nitrification/ denitrification is provided in Figure 2, below.

Figure 2. Nitrogen Removal 1.0: Schematic of Carbon, Oxygen, and Alkalinity Requirements for Nitrification/Denitrification

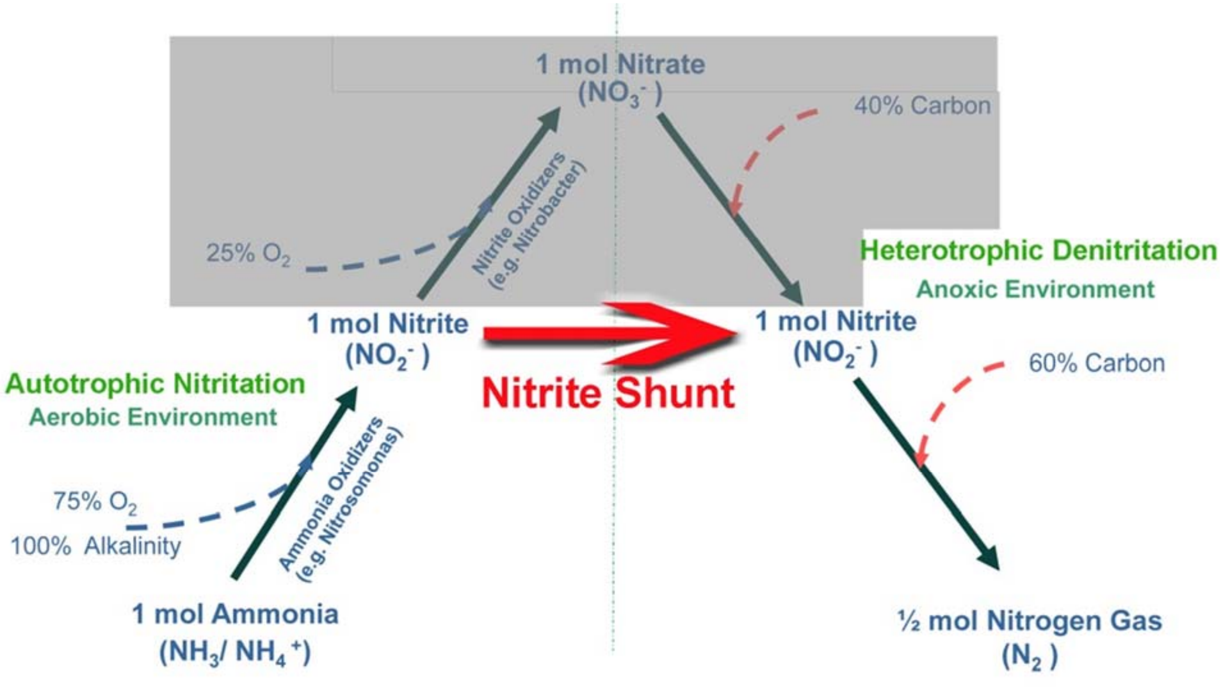


NITROGEN REMOVAL 2.0 - NITRITATION/DENITRITATION (NITRITE SHUNT)

Nitrogen Removal 2.0 represents a short-cut over conventional nitrification and denitrification (Nitrogen Removal 1.0). The ammonia oxidation step stops at nitrite (known as nitritation), which is subsequently reduced to nitrogen gas (known as denitritation;). Stopping the ammonia oxidation at nitrite reduces both oxygen and carbon requirements by 25 percent and 40 percent, respectively. Thus, Nitrogen Removal 2.0 requires less energy than Nitrogen Removal 1.0 Additionally, biomass production is reduced by 40 percent in comparison to conventional nitrification/denitrification (Nitrogen Removal 1.0).

A schematic displaying the carbon and oxygen requirements for the nitritation/denitritation process is shown below in Figure 3.

Figure 3. Nitrogen Removal 2.0: Schematic of Carbon, Oxygen, and Alkalinity Requirements for Nitritation/Denitritation

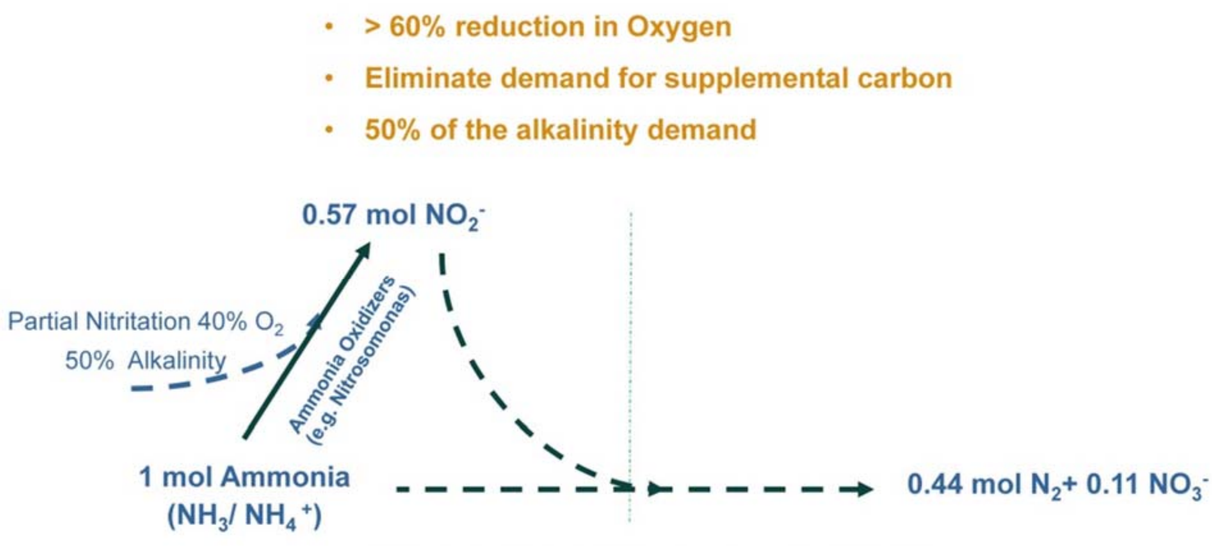


NITROGEN REMOVAL 3.0 - DEAMMONIFICATION

Nitrogen Removal 3.0 represents a further enhanced short-cut over Nitrogen Removal 1.0 and 2.0. Nitrogen Removal 3.0, known as deammonification, is a two-step process that during the first step converts about half the ammonia load to nitrite using nitritation. The subsequent second step removes the formed nitrite and the remaining ammonia load simultaneously to form nitrogen gas using anaerobic ammonia oxidizing (anammox) bacteria. Combined, the two steps of nitritation and anammox are known as deammonification. The inherent advantage of deammonification compared to Nitrogen Removal 1.0 reduces power consumption (about 60 percent less per pound N removed), requires little or no external carbon source, a low biomass yield (<0.15 lb TSS/lb N removed), and reduced CO_2 emissions. Anammox bacteria are also autotrophic and do not require a carbon source like denitrifying organisms for nitrite reduction.

A schematic displaying the carbon and oxygen requirements for the deammonification process is shown in Figure 4.

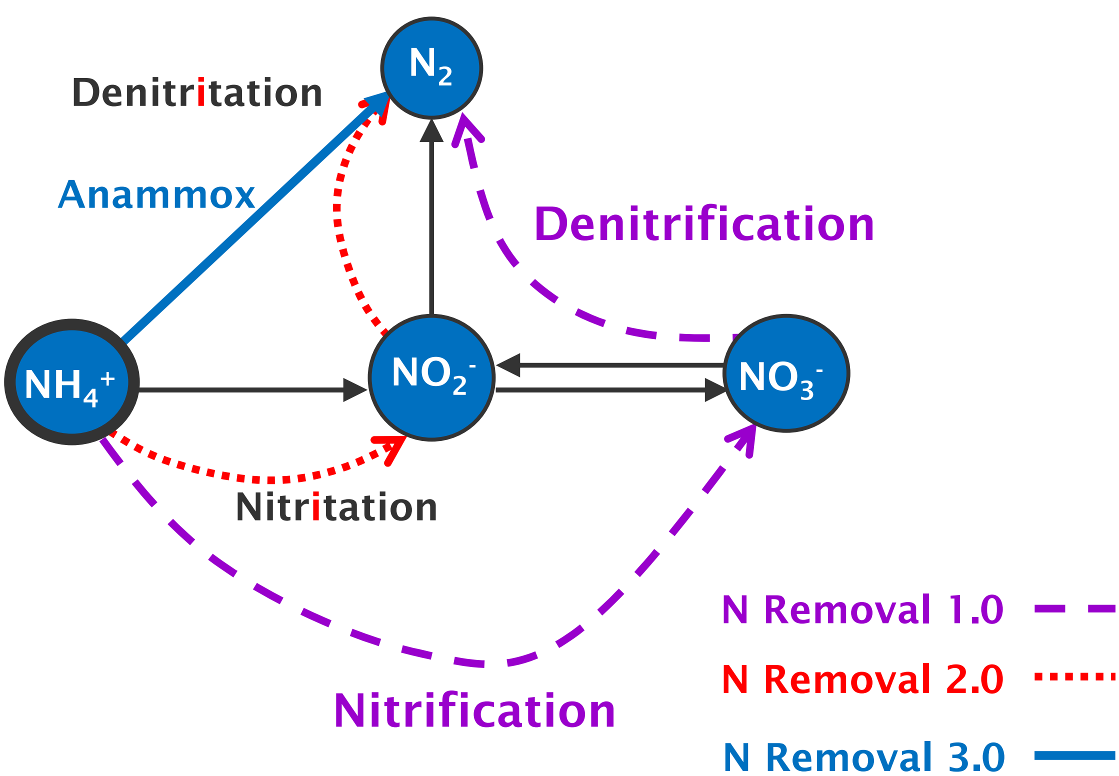
Figure 4. Schematic of Deammonification with Anammox Bacteria (Developed by Wett et al, 2007)



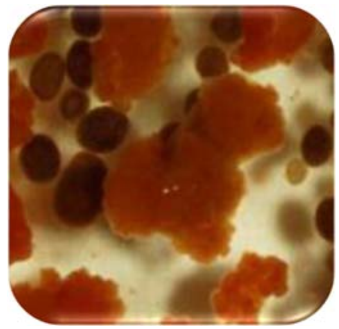
BIOLOGICAL NITROGEN REMOVAL SUMMARY

A summary of Nitrogen Removal 1.0 to 3.0 pathways is presented in Figure 5.

Figure 5. Nitrogen Removal Pathways (1.0, 2.0, 3.0)



Pictures of deammonification (Nitrogen Removal 3.0) are provided below.



Pictures of a Deammonification Reactor (Left) and
Anammox Granules from a Deammonification Reactor (Right)

APPENDIX Q

Options for High-Strength Return Flow Treatment if Annamox Seeding is Required

Appendix Q. Options for High-Strength Return Flow Treatment if Annamox Seeding is Required

Scenario		No Recuperative Thickening	With Recuperative Thickening
FSLs are in operation	Deammonification treatment of the combined high-strength flow is not viable	**Construct two treatment facilities:** Treatment of mechanical dewatering return flows using a deammonification treatment process, and treatment of FSL return flows using a nitrification treatment process. The nitrification process would be located at the DLD site. The deammonification treatment process could be located at the DLD site or the main WWTP site. Deammonification Treatment at DLD Site: • **Construct new conveyance facilities:** Needed to deliver annamox bacteria to the main WWTP site. • **Relocate the alum addition facilities:** Both treatment systems could discharge to a common effluent line, where alum addition would occur. Deammonification Treatment at WWTP Site: • **Construct new conveyance facilities:** Needed to deliver high strength return stream to the main WWTP site • **Construct new alum addition facilities:** Needed at the WWTP site. • **Relocate the alum addition facilities:** Needed to accommodate new FSL return flow treatment system.	• **Construct two treatment facilities:** Treatment of recuperative thickening return flows using a deammonification treatment process at the WWTP site, and treatment of FSL and mechanical dewatering return flows using a nitrification treatment process at the DLD site. • **Construct new alum addition facilities:** Needed at the WWTP site. • **Relocate the alum addition facilities:** Needed to accommodate new FSL/mechanical dewatering return flow treatment system.
	• Deammonification treatment of the combined high-strength flow stream is not viable • FSL return can be mitigated through equalization in FSLs	**Construct one deammonification treatment facility:** Treatment of the mechanical dewatering return flows either the main WWTP site or the DLD site. Deammonification Treatment at DLD Site: • **Construct new conveyance facilities:** Needed to deliver annamox bacteria to the main WWTP site. • Deammonification treatment system effluent could be discharged to the FSL return conveyance system, allowing for the alum addition facility installed in the near-term period to be used for both return streams. Deammonification Treatment at WWTP Site: • **Construct new conveyance facilities**: Needed to deliver high strength return stream to the main WWTP site. • **Construct new alum addition facilities:** Needed at the main WWTP site.	• **Construct one deammonification treatment facility:** Treatment of the combined recuperative thickening and mechanical dewatering return flows at the main WWTP site. • **Construct new conveyance facilities**: Needed to deliver high strength mechanical dewatering return stream to the main WWTP site. • **Construct new alum addition facilities:** Needed at the main WWTP site.
	Deammonification treatment of the combined high-strength flow *is possible*	**Construct one deammonification treatment facility**: Treatment of the combined flows either at the main WWTP site or the DLD site. Deammonification Treatment at DLD Site: • **Construct new conveyance facilities**: Needed to deliver annamox bacteria to the main WWTP site. • **Relocate the alum addition facilities:** Need to be relocated to accommodate the combined flows either entering or leaving the new treatment system. Deammonification Treatment at WWTP Site: • **Construct new conveyance facilities:** Needed to deliver high strength return stream to the main WWTP site. • **Relocate the alum addition facilities:** Could be relocated to either the main WWTP site (downstream of the deammonification treatment process) or to the new conveyance pipeline at the DLD site (providing treatment upstream of the deammonification process).	• **Construct one deammonification treatment facility**: Treatment of the combined recuperative thickening, mechanical dewatering, and FSL return flows at the main WWTP site. • **Construct new conveyance facilities:** Needed to deliver high strength return streams to the main WWTP site. • **Relocate the alum addition facilities:** Could be relocated to either the main WWTP site (downstream of the deammonification treatment process) or to the new conveyance pipeline at the DLD site (providing treatment upstream of the deammonification process).
FSLs are no longer in operation		**Construct one deammonification treatment facility:** Treatment of mechanical dewatering return flows either at the main WWTP site or the DLD site. Deammonification Treatment at DLD Site: • Use the FSL cap water pipeline to deliver annamox bacteria to the main WWTP site. • Effluent could be discharged to the FSL return conveyance system, allowing for the alum addition facility installed in the near-term period to be used. Deammonification Treatment at WWTP Site: • Use the FSL cap water pipeline to deliver high-strength return flow to the main WWTP site. • **Relocation of alum addition facilities:** Could be relocated to either the main WWTP site (downstream of the deammonification treatment process) or to the new conveyance pipeline at the DLD site (providing treatment upstream of the deammonification process)	• **Construct one deammonification treatment facility**: Treatment of the combined recuperative thickening and mechanical dewatering return flows at the main WWTP site. • Use the FSL cap water pipeline to bring high-strength return flows to the main WWTP site. • **Relocate the alum addition facilities:** Could be relocated to either the main WWTP site (downstream of the deammonification treatment process) or to the new conveyance pipeline at the DLD site (providing treatment upstream of the deammonification process)