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CITY OF SUNNYVALE

MASTER PLAN AND PRIMARY TREATMENT DESIGN

TECHNICAL MEMORANDUM

CIP IMPLEMENTATION (MBR): MASTER PLAN

FINAL
March 2016

carollo in association with HDR

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MASTER PLAN

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

CIP IMPLEMENTATION (MBR): MASTER PLAN

1.0 INTRODUCTION/SUMMARY

1.1 Introduction

The purpose of this technical memorandum (TM) is to summarize the proposed Capital Improvement Program (CIP) implementation for the City of Sunnyvale Water Pollution Control Plant (WPCP and Plant used interchangeably) for the WPCP Master Plan. Implementation of the CIP is the result of the evaluation and analysis described in the array of TMs developed in the Master Plan and assumes the secondary process expansion membrane bioreactor (MBR) activated sludge process. It describes projects, their schedules, costs, and linkages with other projects over the planning period defined as ultimate buildout or 2040±, including provisions for a reverse osmosis (RO)/ultraviolet (UV) disinfection facility that would be owned and operated by the Santa Clara Valley Water District (SCVWD).

While it is reflective of the Master Plan, the CIP needs to be responsive to the various planning "driver" issues that could impact the timing of the implementation of each project included in the CIP. Therefore, it is recommended that the CIP be reviewed and updated annually and updates incorporated into the Master Plan as appropriate.

The CIP implementation plan was performed with staff input received at a February 5, 2015 workshop as well as numerous focused meetings on specific CIP-related topics. The key findings and recommendations included herein were developed based on Carollo's wastewater master planning experience and the input received from City staff and the program management consultant (PMC). The February 5, 2015 workshop meeting minutes and presentation slides are included in Appendix A.

1.2 Summary

A CIP was developed for the Master Plan that identifies the capital projects required at the WPCP over the planning period through 2040±, but also identifies projects that would be more likely implemented beyond 2040± due to regulatory and growth uncertainties. The CIP project list was developed to respond to one of the following planning drivers: (1) rehabilitation and repair (R&R), (2) regulatory requirements, (3) improved performance/economic benefit, (4) increased flows and loads and (5) policy decision. In developing the overall implementation schedule for the WPCP, five major phases of improvements were identified. The project cost of implementing these five phases is summarized in Figure 1. A portion of these project costs would be jointly funded by the City and the SCVWD (i.e, MBR) and solely funded by the SCVWD (i.e., reverse osmosis).

Total Cost CIP: $852 million

Note: Based on Fiscal Planning Scenario 2.

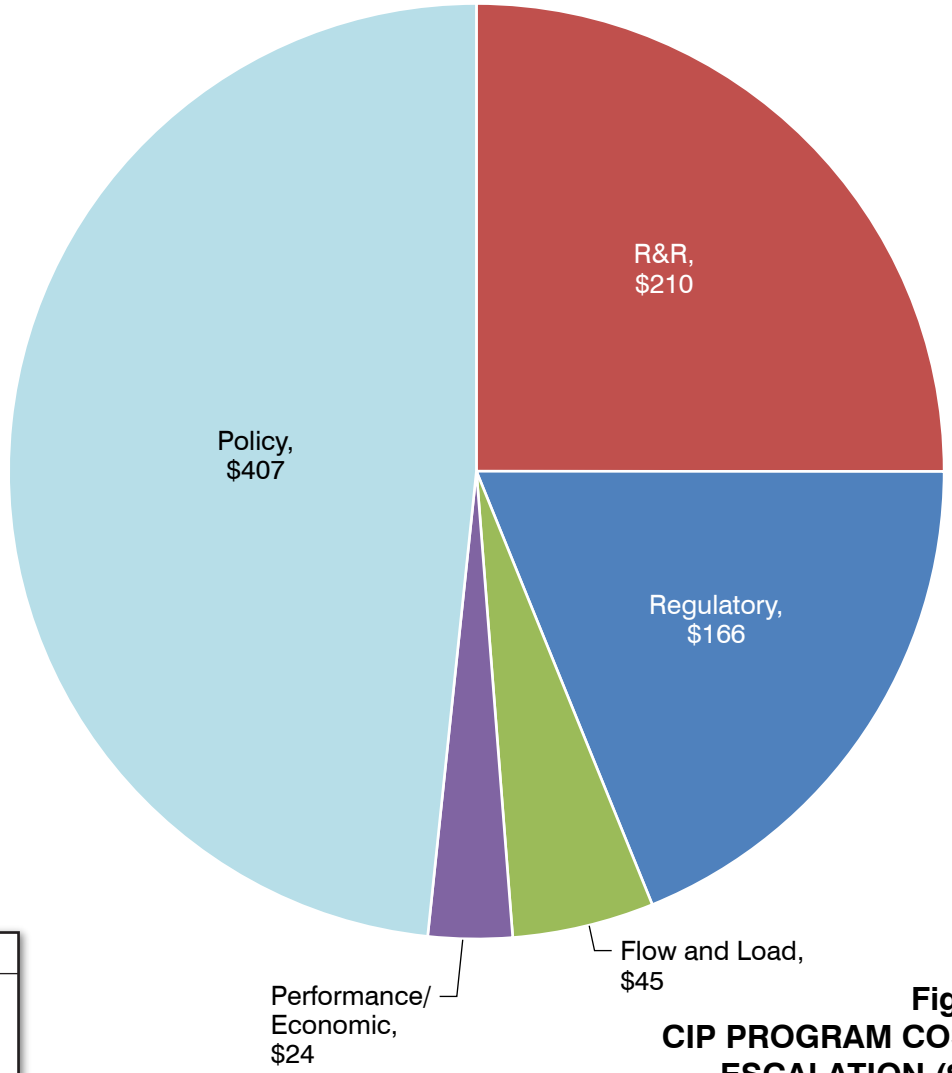

Figure 1
CIP PROGRAM COST AT TWO PERCENT ESCALATION ($ MILLION) – MBR
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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Site space has been reserved for several process upgrade projects which are dependent on future drivers (i.e., regulatory and policy) that are somewhat uncertain in scope and timing. These projects are anticipated to occur in the later stages of the planning period (beyond 2035±), so the City will have to decide how to incorporate them into long-term financial planning scenarios. Three financial planning scenarios (fiscal scenarios) are presented in Appendix E. The City has tentatively decided to base their 20 year financial planning on Scenario 2, which assumes projects driven by phosphorus regulations and stringent nitrogen regulations (total effluent nitrogen concentration = 3± mg/L) will not occur within the first 20 years of the planning period. The costs presented in Figure 1 are based on implementing Fiscal Planning Scenario 2.

Figure 2 presents the annual cash flow basis for the entire CIP based on the assumed implementation date for each project (Fiscal Planning Scenario 1). Project cost estimates are based on preliminary quantity takeoffs or vendor quotes, where available, to which estimating and construction contingencies are added, as well as additional program costs to the owner, namely engineering, legal, administrative, and construction management.

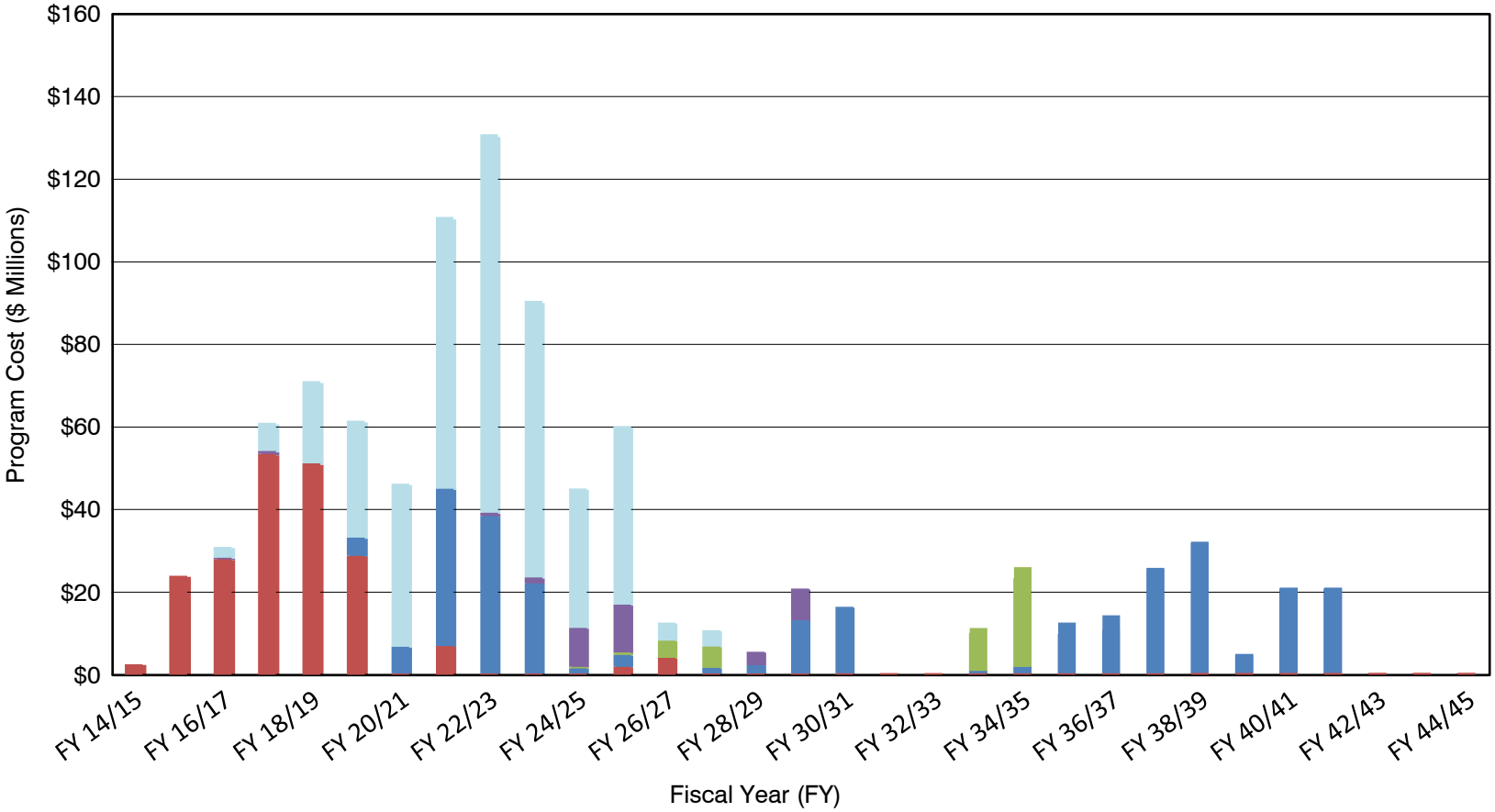
The CIP Summary Table presented in Appendix B includes a detailed list of all the CIP projects, along with their individual project cost and implementation schedule. The table was developed using the CIP model, which is a Microsoft Excel spreadsheet that is suitable for use by the City in future CIP planning. The CIP Implementation Schedule is presented in Appendix C. Individual project descriptions were prepared for each project and are included in Appendix D. Figures depicting the general site layout of the CIP projects are also included in Appendix D.

2.0 APPROACH TO DEVELOPING CIP

2.1 Project Drivers

Capital projects were identified and defined at a planning level in response to the drivers identified during the master planning process. These drivers can be grouped into six categories of potential drivers, and include the following:

1. **Condition (Rehabilitation/Replacement)** – A *condition driver* is assigned if the process or facility has reached the end of its economic useful life. This driver is established based on the need to maintain that process or facility as operationally sufficient to meet mission critical reliability and performance requirements.
2. **Regulatory Requirement** – A *regulatory driver* is assigned when the need is driven by local, state or national regulatory requirements.
3. **Improved Performance Benefit** – An improved *performance benefit/economic benefit driver* is assigned when there is a benefit in improved operations and maintenance performance related to overall reliability and/or reduced life cycle costs.



NOTE: Based on Fiscal Planning Scenario 1 (Includes All CIP projects).

LEGEND
- R&R
- Regulatory
- Flow and Load
- Performance/Economic
- Policy

Figure 2
ANNUAL CIP PROGRAM COSTS AT TWO PERCENT ESCALATION – MBR
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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4. **Increased Flows/Loads** – An *increased flow and load driver* is assigned when the need is based on an increase in capacity to accommodate increases in flows or loads into the Plant.

5. **Policy Decision** – The *policy driver* is assigned when the reason is based on a management and/or political decision from the policy-makers.

2.2 Project Durations

The estimate of a project's duration is comprised of 1) a planning and design component, and 2) a construction/startup component.

A critical part of the planning and design component is demonstrating compliance with the California Environmental Quality Act (CEQA) requirements and other permitting requirements. An Environmental Impact Report (EIR) is being conducted for select projects as part of the Master Plan on a programmatic level and not on a project level.

- **Projects included in the Master Plan EIR.** These projects are not scheduled for implementation within the first five (5) years of the CIP. It is assumed that any additional CEQA compliance requirements for these projects would be performed concurrently with their design phases (i.e., no additional time allowance for this additional CEQA effort is needed).

- **Projects not included in the Master Plan EIR.** The CEQA requirements for CIP projects not included in the EIR, due to their nature are expected to be met through a categorically exemption or mitigated negative declaration process (as is currently practiced by the City). The planning and design duration allocations for these particular projects should be sufficiently long to accommodate the necessary CEQA requirements concurrent with their design (i.e., no additional time needs to be allocated to CEQA).

Part of the construction/startup component includes time for startup of the new facilities, which is assumed to be a 3-month period on average.

2.3 Implementation Schedule

The project drivers define not only the need for the project, but also implementation timing. The implementation timing, together with the estimated project duration, assigns each project a start and completion date. As discussed above, the implementation schedule for each of the listed CIP projects is shown schematically as Gantt charts in Appendix C. In developing the overall implementation schedule for the WPCP, five major phases of improvements were identified:

- Phase 1 – Headworks/Primary Sed Tanks/Existing WPCP Rehabilitation.

- Phase 2 – Stage 1 of Activated Sludge Secondary Treatment Improvements/Administrations & Maintenance Buildings.
- Phase 3 – Process Support Facilities Upgrades.
- Phase 4 – Stage 2 of Activated Sludge Secondary Treatment Improvements.
- Phase 5 – Tertiary Treatment Upgrades.

The following implementation constraints were identified as part of developing the overall project timing:

- Constructability:
  - Contractor's access/coordination.
  - Contractor's site limitations on parking and laydown (limits the number of large contractors that can work on the site at the same time).
  - Project sequencing to accommodate for planned phasing of improvements.
- Staff Impacts:
  - Ongoing O&M considerations (i.e., maintaining permit compliance, deliveries, shutdowns for maintenance).
  - Working/living space on the plant site (i.e., need to replace administrative and maintenance work space before existing facilities can be demolished).
- Cash flow impacts.
- Other projects near the WPCP (i.e., Santa Clara Valley Water District's flood control project).

Site space has been reserved for several process upgrade projects which are dependent on future drivers (i.e., regulatory). An example of these projects would include the following: (1) denitrification filters would replace the existing deep bed filtration system should nitrogen standards become very restrictive and (2) UV would replace sodium hypochlorite disinfection if chlorine byproduct requirements become more restrictive. These projects are anticipated to occur in the later stages of the planning period (beyond 2035±), so the City will have to decide how to incorporate them into long-term financial planning scenarios.

As discussed above, three financial planning scenarios (fiscal scenarios) are presented in Appendix E. The City has tentatively decided to base financial planning on Fiscal Planning Scenario 2, which assumes projects driven by phosphorus regulations and stringent nitrogen regulations (total effluent nitrogen concentration = 3± mg/L) will not occur within the first 20 years of the planning period. As noted earlier, the costs presented in Figure 1 are based on implementing Fiscal Planning Scenario 2.

2.4 Project Linkages

The CIP implementation schedule was developed with the understanding that many projects are linked. The linkages would impact the implementation sequence of multiple projects. Depending on a particular project's position in the sequence, a change to the timing of one project would impact the timing of all the linked projects.

Some of these linkages may be quite complex, such as with the implementation of the biosolids transition projects. For example, the construction of the new administration and maintenance buildings are tied to two projects: (1) these two buildings require that public access be relocated from Carl Road to Caribbean Drive. However, the Santa Clara Valley Water District's flood improvements project must be completed to allow the relocation to occur and (2) certain site improvements (utilidors) associated with the secondary expansion must be completed to allow the necessary access for construction of the administration and maintenance facilities. In addition, the MBR secondary plant must be fully operational before construction can begin for the RO/UV facility. This is because the proposed RO/UV facility is located on the site of the existing secondary facilities (FGRs and AFTs).

The example illustrates that due to the linkages between many projects, changes to the driver for completion of a particular project may impact the implementation schedule of multiple projects. These linkages are identified in the project schedules included in Appendix C and are described at a high level in the project descriptions in Appendix D.

2.5 Fiscal vs. Calendar Year

The CIP reflects project implementation schedules, and includes an annual cash flow estimate associated with these schedules. While the implementation schedule is based on calendar years, the City's financial planning is based on a fiscal year basis. The City's fiscal year starts on July 1st and ends on June 30th of the following year, and the nomenclature followed is to name the fiscal year according to the first date of the year. For example, fiscal year 2020 would span the second half of 2020 and the first half of 2021.

To avoid confusion, and to have the implementation schedule consistent with the cash flow estimate, dates are shown as fiscal year 2020/2021 (FY 20/21). For example, FY 20/21 would represent the second half of 2020 through the first half of 2021.

2.6 Developing Project Cost Estimates

As noted in the Basis of Costs TM, the cost estimates presented in the Master Plan were developed using multiple methods and sources of information. Where available, quotes from equipment vendors were used in conjunction with preliminary quantity takeoffs to create a construction cost estimate. In addition, the cost curve approach for estimating (total cost versus process capacity curves developed from past City and other Carollo

project cost data), was also used for some projects. In general, an estimating contingency of 15 percent is applied to account for uncertainties in the bidding environment. A construction contingency of 25 percent is added to cover possible change orders that are not included as part of the original estimated construction cost. (Note, different estimating and construction contingencies were applied for some projects as needed based on the method used to develop the estimate.)

Construction costs developed in this manner are then escalated to the approximate mid-point of project construction in order to get a better representation of future costs at time of construction. Calculating the escalation involves the use of the ENR Construction Cost Index (ENRCCI). The un-escalated costs presented herein are in 2015 dollars and are based on an ENR CCI of 11,155 (San Francisco, June 2015).

Subsequently, overall program related costs to the owner, such as engineering, legal, administrative, project contingencies, and construction management costs, are added to the construction costs to arrive at total project costs. For this master plan, a program cost multiplier of 1.42 was utilized as detailed in Table 1 and summarized in Appendix B.

Table 1 Program Factor Applied to Construction Cost
Master Plan and Primary Treatment Design
City of Sunnyvale

Item	Cost Factor
Engineering design	12%
Engineering Costs During Construction	3%
Third-party construction management fees	7%
Program management costs	7%
Environmental mitigation	1.5%
CEQA/permitting	0.5%
City costs	
City project management costs	1%
City legal/administrative costs/fees	0%
Construction change order allowance (construction contingency)	10%
Total Program Cost Factor	**42%**

2.7 Annual Project Cost Distribution: S-Curve

The project cost estimated for each of the CIP projects will typically not be expended in equal annual amounts over the project duration. Instead, the annual expenditure will typically be lower during the initial planning and design phases of the project, and then ramp up significantly during the construction phase of the project. When presented on a cumulative basis, the cash flow calculations are based on an S-Curve. Figure 3 includes

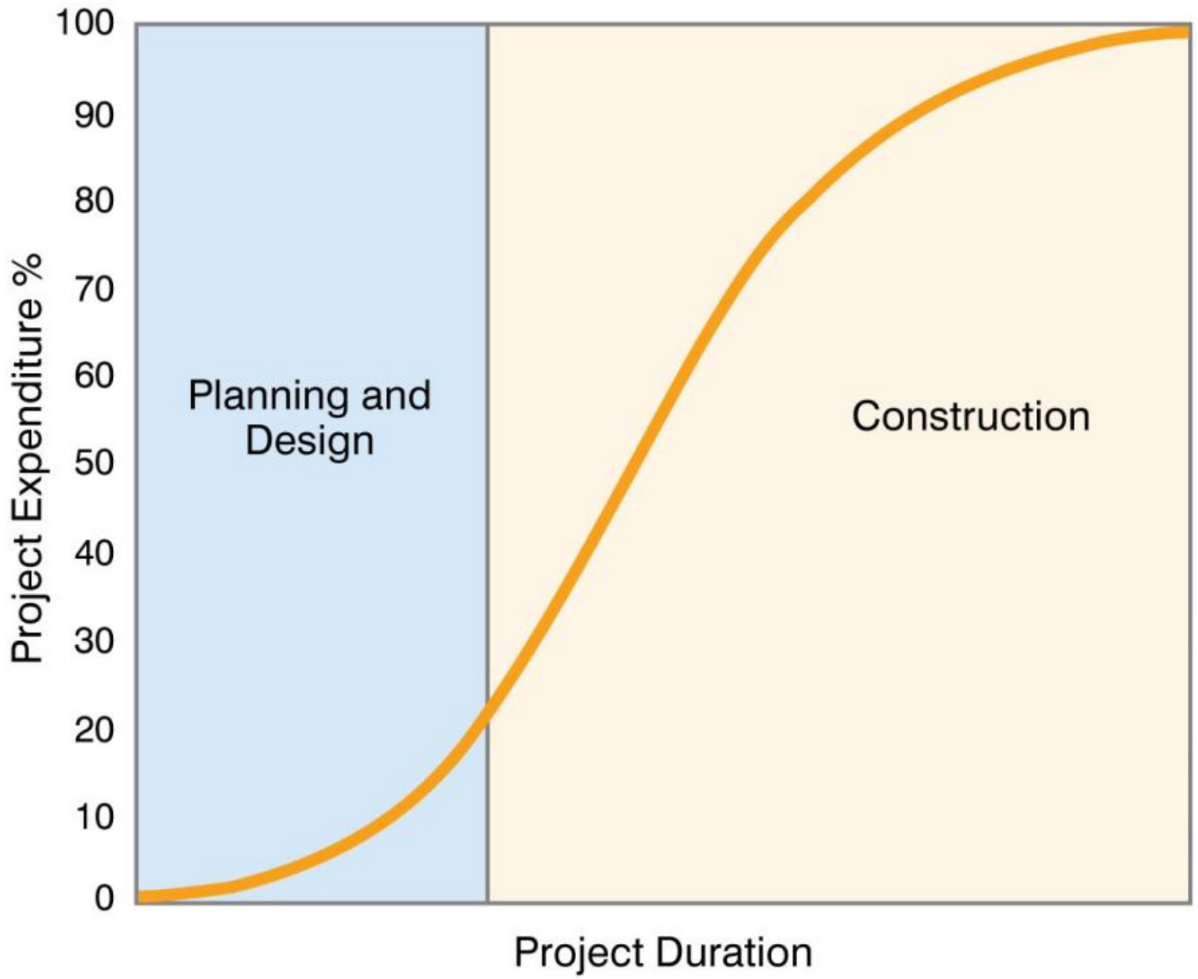

Figure 3
SCHEMATIC OF S-CURVE
DISTRIBUTION OF PROJECT COSTS
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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an example S-curve. Appendix B includes the S-Curve values that were used to estimate annual expenditures of the CIP projects. Unless specifically noted, this approach was applied to all the CIP projects with durations of up to 15 years.

A modification to this approach is to follow the S-Curve distribution up to the start of the construction phase, at which point the entire remaining portion of the project cost estimate is encumbered. Some key components of the encumbered cash flow distribution are the following:

Engineering Design:	evenly distributed over design phase
Engineering Services During Construction (ESDC):	evenly distributed over construction phase
City Staff:	evenly distributed over both phases
Construction:	fully encumbered at start of construction phase

Depending on the calculation desired, either the S-Curve or custom cash flow mode of calculation can be selected on the CIP cash flow Excel spreadsheet.

2.8 Capital Replacement Costs

While the CIP defines projects anticipated over the master planning period, unforeseen projects cannot be avoided. This is especially true of large treatment plants with a heavy investment in conveyance and treatment infrastructure, and complex mechanical equipment. These unanticipated projects are often critical in nature requiring urgent attention from City staff. To enable these projects to be accommodated, the CIP includes a budgetary line item for these repairs, calculated as follows:

- The annual allocation for Unanticipated/Critical Repairs is based on one (1) percent of the average annual (un-escalated) project cost estimate of the entire CIP.
- Based on an un-escalated total CIP cost estimate of approximately $856 million, the average annual cost over the master planning period is approximately $290,000.
- Assuming $290,000 for 2015, the allocations have been calculated for each subsequent year assuming a two (2) percent escalation.

2.9 Community Improvements

An estimate for providing community improvements to the WPCP was based on an allowance of $400,000 established by the City.

3.0 DESCRIPTION OF MASTER PLAN CIP MODEL

As described above, the CIP Summary Table presented in Appendix B includes a detailed list of all the CIP projects, along with their individual project cost, implementation schedule, and annual cash flow. The table was developed using the CIP spreadsheet, which is a Microsoft Excel spreadsheet that is suitable for use by the City in future CIP planning. Information on how to use the CIP spreadsheet is included in Appendix F.

4.0 PROJECT DESCRIPTIONS

The project descriptions, drivers, and other details for each of the CIP projects are summarized in Appendix D. All unit costs, escalation factors, and assumptions are included in Appendix D.

5.0 APPROACH TO DEVELOPING O&M PROJECTIONS

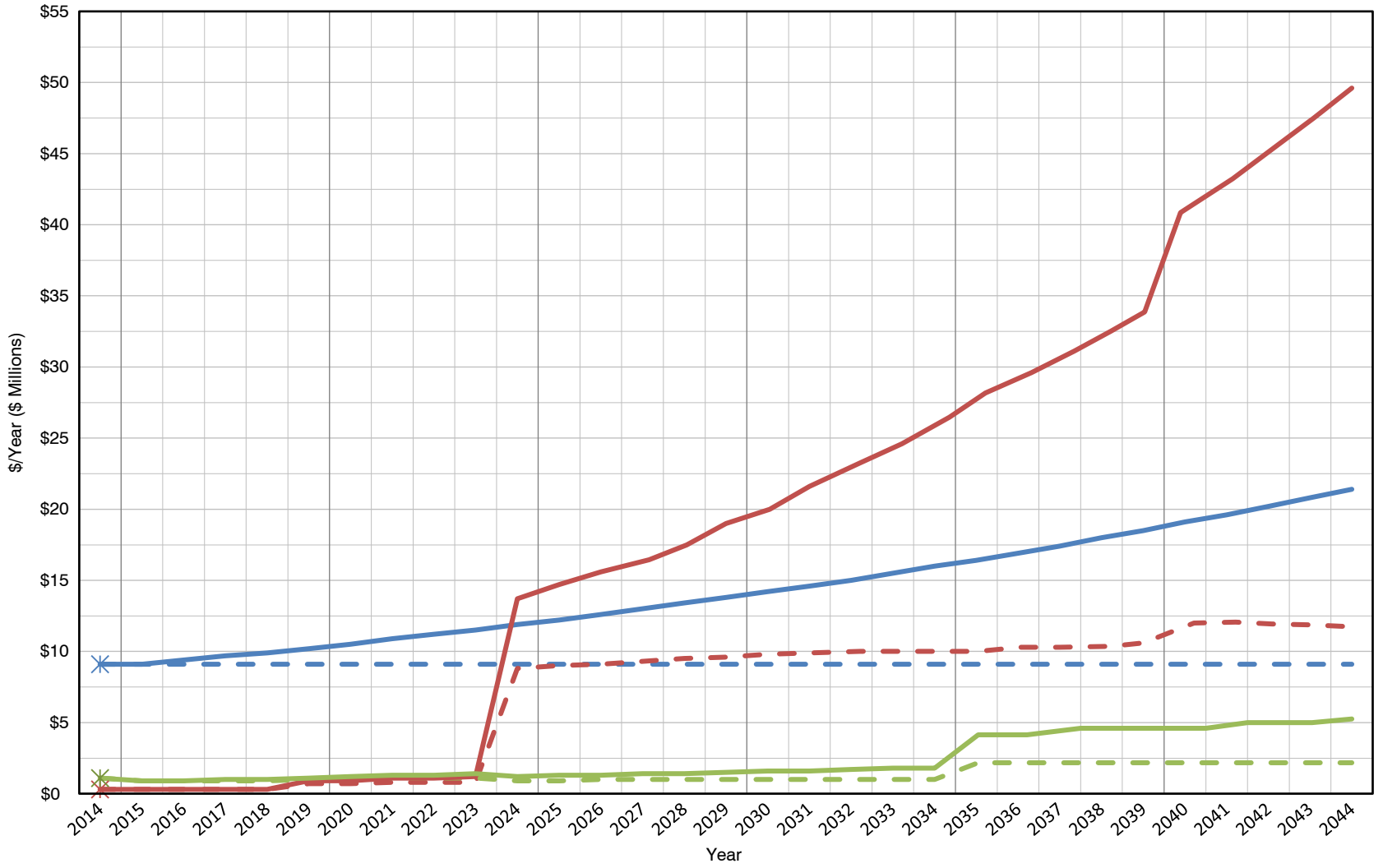
Operations and maintenance (O&M) costs were developed for Sunnyvale's WPCP through the planning period, taking into consideration the impacts of the CIP on the treatment processes. For this analysis, O&M costs were comprised of three types of costs: 1) labor, 2) power, and 3) chemical. No other O&M related costs were included in the analysis.

The O&M costs at the WPCP will typically be impacted by either an increase in flows and loads and/or the specific O&M costs for certain CIP projects at the time they are implemented. Using unit costs and projected flows and loads, the baseline and process upgrade related O&M costs were projected over the master planning period. Figure 4 shows the unescalated annual O&M cost over the master planning period. Table 2 summarizes the cost projection for each major phase of the master plan. The impact of major CIP projects on the O&M costs is also described in Table 2. Detailed projections are presented in Appendix G.

The O&M cost impacts were developed using the following step-wise process:

Step 1: Establish baseline (i.e., current) costs for labor, power and chemical usage.

Step 2: Estimate projected labor, power and chemical demand by process area over the master planning period. Projections reflect changes in flow and load over the master planning period as well as the fact that O&M costs will change at the CIP projects are implemented. It was assumed the CIP projects would be implemented as scheduled. It was assumed the O&M costs would increase proportionate to flow and load increases until a process change occurs due to a CIP project, at which time the O&M costs would change based on the process change.



LEGEND

Labor Cost Unescalated	Power Cost Unescalated	Chemical Cost Unescalated
Labor Cost Escalated	Power Escalated	Chemical Cost Escalated
Current Labor Cost	Current Power Cost	Current Chemical Cost

Figure 4
ANNUAL O&M COST OVER
MASTER PLANNING PERIOD – MBR
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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Table 2 Summary of WPCP O&M Costs through Master Planning Period (Escalated) - MBR Master Plan and Primary Treatment Design City of Sunnyvale

	Current	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Year	**2015**	**2019**	**2023±**	**2028±**	**2035±**	**> 2035± (3)**
Average Annual Flow, mgd	**15.2**	**16.2**	**17.3**	**18.6**	**20.4**	**20.4**
Annual O&M Cost (million)						
Labor(1)	$9.1	$10.2	$11.9	$13.4	$16.4	$19.1
Power(2)	$0.3	$1.1	$13.7	$17.7	$27.9	$41.0
Chemical(1)	$1.1	$1.1	$1.2	$1.4	$4.0	$4.7
Total	**$10.5**	**$12.4**	**$26.8**	**$32.5**	**$48.3**	**$64.8**
Major Process Change Impacting O&M Cost						
Primary		Primary Treatment Facility (4)				Chemical Phosphorus Removal (6)
Secondary			Secondary Treatment - MBR Stage 1 (4)		Secondary Treatment - Split Flow MBR Stage 2 (4)	Chemical Phosphorus Removal (6)
Tertiary						• UV and Ozone Disinfection (Power increase) • Microfiltration Facility (4) • Denitrification Filters (4)
Solids			Thickening/ Dewatering Stage 1 (4)	• Digester No. 5 (5) • Cogeneration Upgrade (7)	• Thickening/ Dewatering Stage 1 (4) • Biosolids Post-Processing (5)	

Notes:
(1) Costs escalated 3 percent per year.
(2) Costs escalated 5 percent per year.
(3) Estimated costs for year 2040 shown.
(4) Power and chemical increase.
(5) Power increase.
(6) Chemical increase.
(7) No change.

Step 3: Escalate projected labor, power and chemical costs using assumed escalation factors.

5.1 Labor O&M Forecast

5.1.1 Baseline

In order to establish baseline labor costs, plant operations cost data from Fiscal year 2014/2015 were obtained and analyzed to establish the current annual labor cost.

5.1.2 Projection

Based on the findings of the Operations and Staffing TM, the size of the plant staff is projected to remain essentially the same over the master planning period. As a result, it was assumed the annual labor hours would remain the same over the master planning period. It was assumed labor costs would escalate at three percent per year. This escalation rate is the standard escalation rate used per the Master Plan Basis of Cost TM.

5.2 Power O&M Forecast

5.2.1 Baseline

In order to establish baseline power costs, existing power usage data was provided by plant staff. The WPCP is currently a net energy producer. The Power Generation Facility (PGF) produces an average of 1,200 kW. The power demand at the plant averages 1,050 - 1,150 kW.

Plant operations cost data from Fiscal year 2014/2015 were obtained and analyzed. It was determined that the current annual power cost is $300,000±. Although the WPCP is a net energy producer on an average basis, there are times during the year when the power demand exceeds the power produced by the PGF. At those times, the WPCP purchases power from Pacific Gas and Electric (PG&E).

The WPCP's average cost of power is estimated to be about $0.30/kWh. In comparison, neighboring wastewater treatment plants of a similar size pay around $0.11/kWh. This average unit cost of is comprised on a baseline fixed cost for power service and the cost per kilowatt hours of power used. Given the WPCP does not use much power from PG&E, the WPCP's average cost of power is higher than neighboring facilities. In addition to this, the WPCP currently purchases power from PG&E during peak power usage times. During these peak power usage periods, PG&E charges more per kilowatt hour.

5.2.2 Projection

To estimate the projected power usage, the power demand was estimated for each process area over the master planning period. The projected power demand was

estimated based on the duty loads established for each process area as part of the Master Plan. (The duty loads for each process area are summarized in the Master Plan Basis of Design Report). Power demand was scaled by flow where appropriate.

It was assumed the PGF would continue to produce an average of 1,000 kW of power. This assumed power production was subtracted from the projected demand.

To estimate the projected power cost, the projected power demand was then multiplied by an assumed average cost of power. Based on the projected power demand, the amount of power purchased from PG&E will increase over the master planning period. As the power purchased from PG&E increases, the average cost of power is expected to decrease. For the purposes of this analysis, it was assumed the average cost of power would be about $0.20 kWh over the master planning period. The major process changes that will impact power usage and therefore the average cost of power, include:

- When the Primary Treatment Facility is implemented, the City would need to purchase a moderate amount of PG&E power on a regular basis.
- When the Secondary Treatment Improvements - Stage 1 are implemented, the City would need to purchase significantly more power than it currently purchases from PG&E.
- If the Reverse Osmosis (RO)/ UV Disinfection/ Advanced Oxidation Process (AOP) Facility is fully utilized to produce 10 mgd of recycled water, the power demand would increase significantly.

It was assumed power costs would escalate at five percent per year. This escalation rate is a typical escalation rate used by Carollo/HDR to project power costs in the SF Bay area.

5.3 Chemical O&M Forecast

5.3.1 Baseline

To establish the baseline chemical costs, current chemical usage was estimated based on information provided by plant staff (e.g., type of chemical, chemical dosage, frequency of chemical use, etc.). The unit costs established in the Master Plan Basis of Cost TM were used to estimate the current chemical cost.

5.3.2 Projection

To estimate the projected chemical cost, chemical dosages and associated costs were estimated for each process area over the master planning period. Assumptions are summarized in Table 3.

Table 3 Summary of WPCP Chemical Usage through Master Planning Period - MBR
Master Plan and Primary Treatment Design
City of Sunnyvale

	Current	Phase 1 (1)	Phase 2 (2, 3)	Phase 3	Phase 4 (4)	Phase 5 (5)
Year	2015	2019	2023±	2026±	2035±	> 2035± (6)
Polymer - Chemically Enhanced Primary Treatment						
Continuous/Intermittent Operation	None	2 mo/yr	2 mo/yr	2 mo/yr	2 mo/yr	2 mo/yr
Usage, pounds per year	0	1,700	1,800	1,900	2,100	2,100
Process Change		Primary Treatment Facility Implemented - CEPT Treatment Required Part of the Year				
Polymer - Thickening						
Continuous/Intermittent Operation	None	None	Continuous	Continuous	Continuous	Continuous
Usage, pounds per year	0	0	39,000	40,000	41,000	41,000
Process Change			Secondary Treatment Improv. Implemented - Mechanical Thickening Starts			
Polymer - Dual Media Filters (DMFs)						
Continuous/Intermittent Operation	Continuous	Continuous	None	None	None	None
Usage, pounds per year	46,000	50,000	0	0	0	0
Process Change			DMFs Fully Replaced with MBRs			
Polymer - Dewatering						
Continuous/Intermittent Operation	None	None	Continuous	Continuous	Continuous	Continuous
Usage, pounds per year	0	0	123,000	126,000	132,000	132,000
Process Change			Secondary Treatment Improv. Implemented - Mechanical Dewatering			
Polymer - Air Flotation Tanks (AFTs)						
Continuous/Intermittent Operation	Continuous	Continuous	None	None	None	None
Usage, pounds per year	255,000	272,000	0	0	0	0
Process Change			AFTs Fully Replaced with MBR Facilities			
Sodium Bisulfilte ($NaHSO_3$) - Dechlorination						
Continuous/Intermittent Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Usage, pounds per year	360,000	388,000	432,000	450,000	448,000	448,000

Table 3 Summary of WPCP Chemical Usage through Master Planning Period - MBR
Master Plan and Primary Treatment Design
City of Sunnyvale

Year	Current	Phase 1 (1)	Phase 2 (2, 3)	Phase 3	Phase 4 (4)	Phase 5 (5)
Usage, gallons per year	142,000	153,000	166,000	177,000	176,000	176,000
Process Change	None					
Ferric Chloride ($FeCl_3$) - Chemically Enhanced Primary Treatment						
Continuous/Intermittent Operation	None	2 mo/yr	2 mo/yr	2 mo/yr	None	None
Usage, pounds per year	0	165,000	178,000	189,000	0	0
Usage, gallons per year	0	38,000	42,000	44,000	0	0
Process Change		Primary Treatment Facility Implemented - CEPT Treatment Required Part of the Year			Chemical phosphorus removal implemented. Additional ferric chloride for CEPT not required.	
Sodium Hypochlorite (NaOCl) - Disinfection						
Continuous/Intermittent Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Usage, pounds per year	535,000	571,000	617,000	654,000	718,000	718,000
Usage, gallons per year	420,000	449,000	485,000	514,000	564,000	564,000
Process Change	None					
Sodium Hypochlorite (NaOCl) - MBR Cleaning						
Continuous/Intermittent Operation	None	None	Intermittent	Intermittent	Intermittent	Intermittent
Usage, pounds per year	0	0	17,000	17,000	20,000	20,000
Process Change			Secondary Treatment Improv. Implemented - MBR Cleaning Required			
Citric Acid - MBR Cleaning						
Continuous/Intermittent Operation	None	None	Intermittent	Intermittent	Intermittent	Intermittent
Usage, pounds per year	0	0	2,000	2,000	3,000	3,000
Process Change			Secondary Treatment Improv. Implemented - MBR cleaning Required			
Ferric Chloride (FeCl3) - Chemical Phosphorous Removal						
Continuous/Intermittent Operation	None	None	None	None	Continuous	Continuous
Usage, pounds per year	0	0	0	0	3,354,000	3,354,000

Table 3 Summary of WPCP Chemical Usage through Master Planning Period - MBR
Master Plan and Primary Treatment Design
City of Sunnyvale

Year	Current	Phase 1 (1)	Phase 2 (2, 3)	Phase 3	Phase 4 (4)	Phase 5 (5)
Usage, gallons per year	0	0	0	0	783,000	783,000
Process Change					Chemical Phosphorous Removal Implemented	
Methanol - Chemical Phosphorous Removal						
Continuous/Intermittent Operation	None	None	None	None	Continuous	Continuous
Usage, pounds per year	0	0	0	0	412,000	412,000
Usage, gallons per year	0	0	0	0	63,000	63,000
Process Change					Chemical Phosphorous Removal Implemented	

Notes.
(1) The Primary Treatment Facility is implemented. Polymer and ferric chloride usage at the primary sedimentation tanks (PSTs) begins for chemically enhanced primary treatment (CEPT) during wet weather flows.
(2) The Secondary Treatment - Stage 1 facilities are implemented. Chemical usage at the membrane bioreactors begins. Polymer usage at the air flotation tanks (AFTs) and dual media filters (DMFs) ends because these facilities are no longer used. Polymer usage for mechanical thickening and dewatering begins.
(3) Reverse Osmosis(RO)/ UV Disinfection/ Advanced Oxidation Process (AOP) implemented. Chemical cost for RO/UV/AOP not included. It is assumed those costs would be paid for by Santa Clara Valley Water District.
(4) The Secondary Treatment - Stage 2 facilities are implemented. More WAS sludge is produced by the secondary treatment facilities, so polymer usage for mechanical thickening and dewatering increases.
(5) Chemical phosphorous removal is implemented. Ferric chloride is added at the primary sedimentation tanks (PSTs) to facilitate chemical phosphorous removal. Chemical phosphorus removal reduces the carbon in the aeration basins, so methanol is added at the aeration basins to facilitate nitrification.
(6) Estimated costs for year 2040 shown.

It was assumed chemical costs would escalate at three percent per year. This escalation rate is the standard escalation rate used for the Master Plan per the Master Plan Basis of Cost TM.

6.0 SUMMARY

This CIP spreadsheet was developed based on numerous discussions with a wide cross-section of WPCP staff. While it aims to identify projects at the WPCP over the next 30± plus years, there is greater knowledge of the projects required in the initial than later years. For that reason, it is recommended that the project drivers be re-evaluated annually and the spreadsheet updated to reflect any possible changes. The spreadsheet has already been used to develop the current 5-year CIP. It is anticipated that the spreadsheet would be routinely updated to facilitate development of future CIPs.

APPENDIX A - DECEMBER 2014 CIP WORKSHOP MEETING MINUTES AND PRESENTATION SLIDES

Engineers...Working Wonders With Water™

CONFERENCE MEMORANDUM

Project:	Master Plan and Primary Treatment Design	**Conf. Date:**	February 5, 2014
Client:	City of Sunnyvale	**Issue Date:**	May 15, 2015
Location:			

Attendees:

City:
Bryan Berdeen (BB)
Erin McGuire (EM) (CDM)
Craig Mobeck (CM)
John Stufflebean (JS)
Bhavani Yerrapotu (BY)

Carollo/ HDR/ Subconsultants:
Jamel Demir (JD)
Jim Hagstrom (JH)
Katy Rogers (KR)

Purpose: CIP Implementation – MBR/RO

Distribution: Carollo Attendees **File:** 9265A.00

Discussion:
The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us.

1. MBR/RO Site Layout

a. BY: Do we still need the denitrification filters? JH: We may need them. It will depend on how much total nitrogen load you send to the Bay considering you will be recycling a lot of flow. BY: If we don't need the denitrification filters we could potentially use that space for brine disposal.

b. To clarify, if the City gets an ADWF of 19.5 mgd, we have reserved site space so you could produce up to 15 mgd of RO/UV/AOP effluent for reuse.

c. BY: We should share the site layout with Jeanine Larabee (SVCWD) so they understand how the RO/UV/AOP facilities are laid out. JH: The RO/UV/AOP layout is very similar to what they have seen before in our SCVWD RO/UV report.

d. BY: Jeanine is still talking about a $70± million premium to implement MBR at Sunnyvale instead of CAS.

2. MBR Implementation Schedule

a. BY: In the March 9th meeting with the Regional Board (Bruce Wolfe will be in attendance), we may get sidetracked on the issue of how much water we can divert from the bay to recycle water uses. JH: We need to have some discussion with SCVWD to set expectations on how easily they will be able to determine brine treatment options and get approval from the Board. SCVWD can continue to move forward with some assumed treatment options, but it can not be finalized for a while.

b. JH: For brine disposal, it was recommended that SCVWD assume it would be $40 million to use the EBDA outfall to dispose of brine to the middle of the Bay.

c. Oxnard has developed some costs to treat brine with wetlands.

d. JS: Is SCVWD close to getting started on the riverine flood walls? JD: They probably will not get started until next year because they do not have any permits yet.

e. BB: How much construction activity will occur on Carl Rd. for the SCVWD riverine flood wall project? JD: None. The construction activity should be focused on Caribbean Dr. Their main access points are on the east side and west side of Caribbean Dr.

f. BB: Why wouldn't you demolish the primary control building sooner? JD: You could demolish this building at your own discretion as soon as the new Maintenance Building is constructed and operational.

g. BY: For the project description, ESA is describing that the MBR effluent goes to the RO facility? JD: Yes, it is going to the RO facility, the Bay, and non-potable reuse (existing reuse).

h. JS: How fast are we planning to implement the RO facility? JD: About 10 years, and that is assuming as soon as the Primary Treatment Facility construction stops the MBR/RO Treatment Facility Construction starts.

i. JS: Will fast tracking the thickening/dewatering facility save us money because we can stop contract dewatering sooner? BY: I don't know enough yet to say. It seems if we do dewatering in house it should be cheaper.

j. JD: Big changes are there is no filter control building, no DMFs, and you can fast track the thickening/dewatering facility (set it as an early milestone of the secondary treatment facility).

k. JS: If we go with MBR, would that project qualify for RW SRF funding? BY: Yes. I'd like to know if we can obtain 1% funding for the primary treatment facility project retroactively if the State approves a loan for the secondary treatment facility.

3. Capacity Assessment

4. Action Item

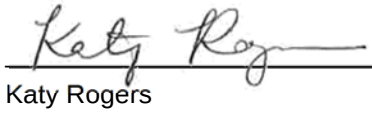
a. City to provide feedback on MBR site layout by 2/12/15.

b. Carollo to confirm with Brandon what footprint you need to implement a mechanical brine concentrator on the WPCP site.

c. Carollo to provide CIP cashflow for MBR implementation.

d. Jamel and BY to present MBR site layout and implementation schedule to the SCVWD.

Prepared By:



Katy Rogers

KR

This meeting will be a success if …

- Receive input on proposed site layout and CIP implementation approach
  - Site layout considerations
  - Implementation constraints
- Decision to be made on path forward
  - Major site & implementation adjustments
  - Finalize final CIP implementation to allow further refinement by PMC and City

Agenda

- ✓ Approach to Site Layout
- ✓ Proposed Implementation Plan
- ✓ Next Steps

Approach to CIP Implementation

Potential Implementation Constraints

- Limit on number of large contractors – no more that two on the site at one time
- Hdwks/PST Package 1 construction dictated by Army Corps permit approval
- Relocation of Bay Trail access cannot happen any earlier than mid-2017
- New Admin. & Maint. Buildings assumes relocation of Bay Trail access

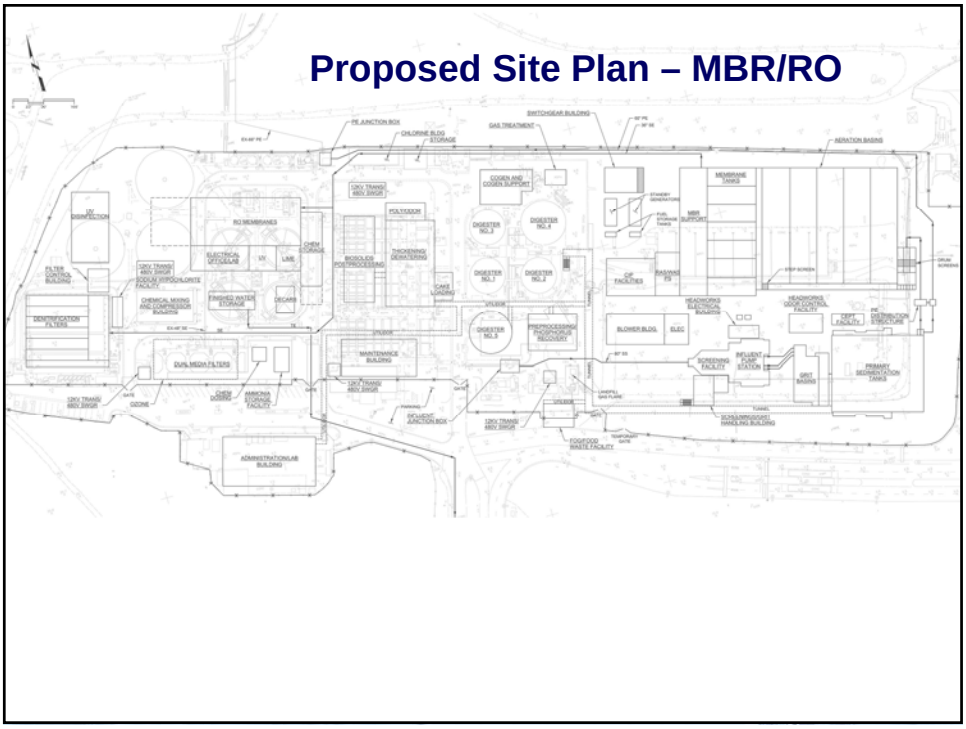
Impacts of Potential Constraints (cont)

- Timing for Admin. & Maint. Buildings assumes continued use of existing facilities
- Existing PSTs to be removed as part of the Headworks/PST project
- RO/UV/AOP facilities cannot begin construction until MBR is fully operational

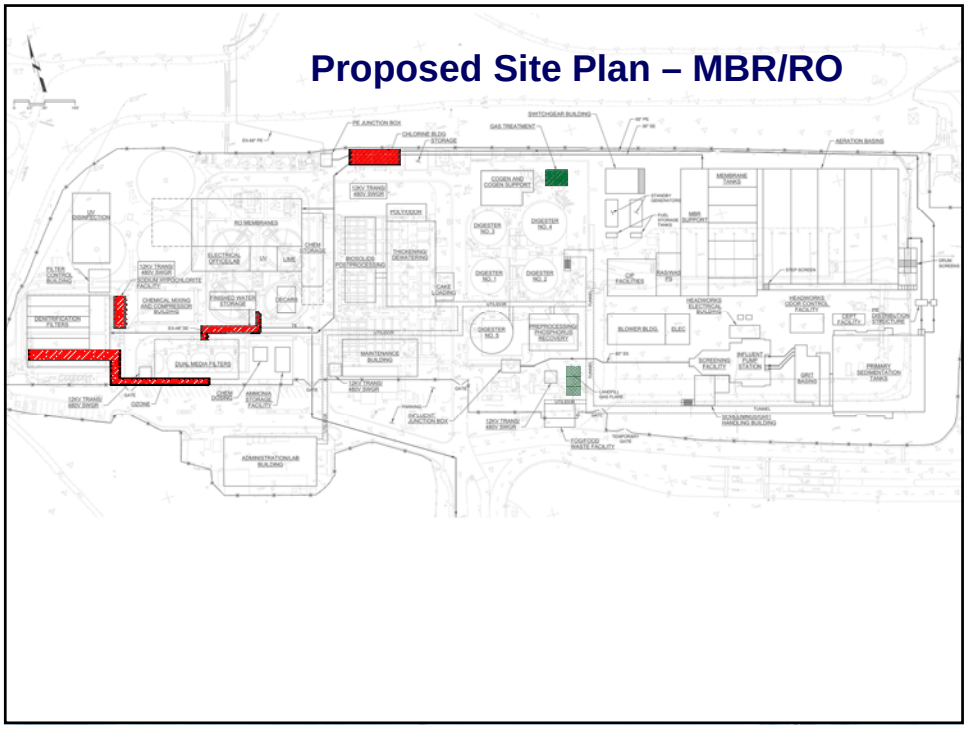
Proposed Site Layout

Sunnyvale_CIP_Sequence_Feb5.pptx/7

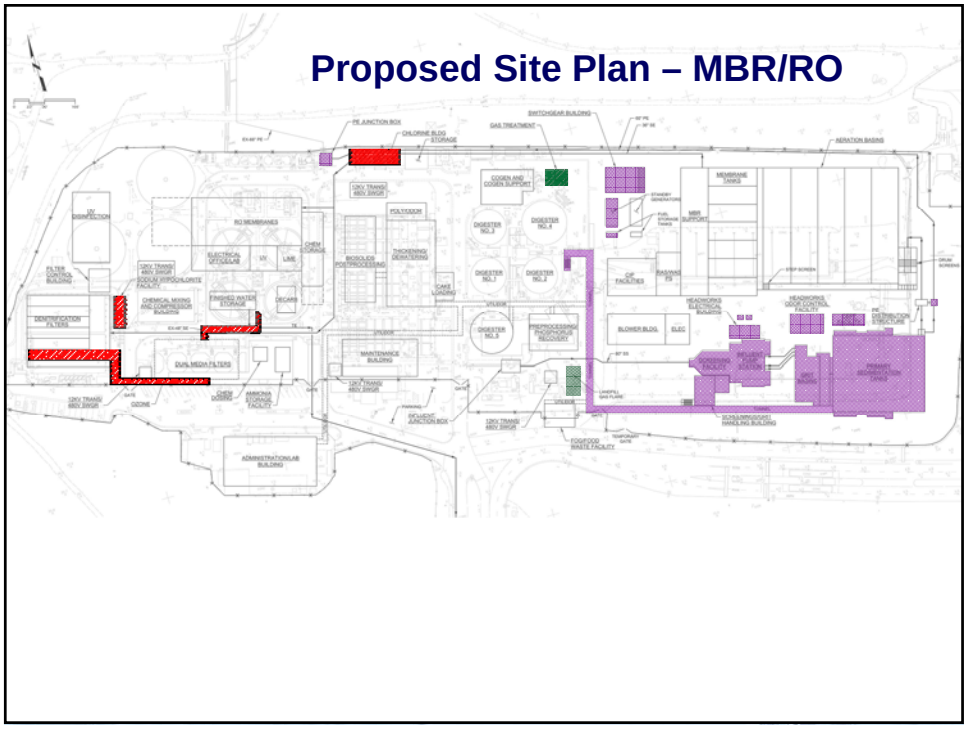
Proposed Site Plan – MBR/RO



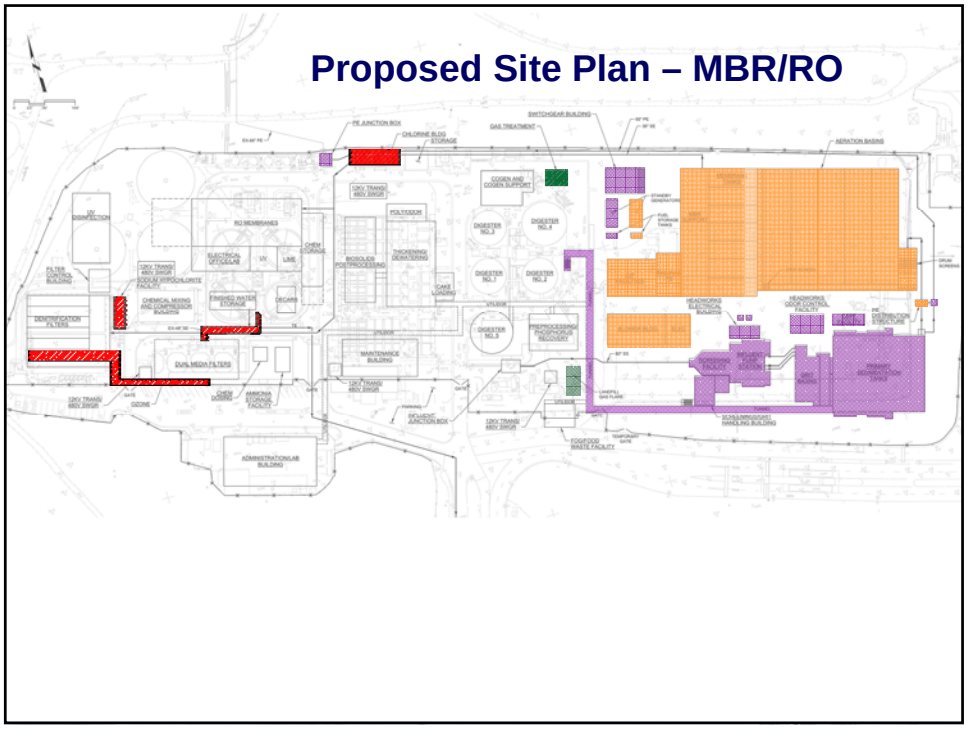
Proposed Site Plan – MBR/RO



Proposed Site Plan – MBR/RO

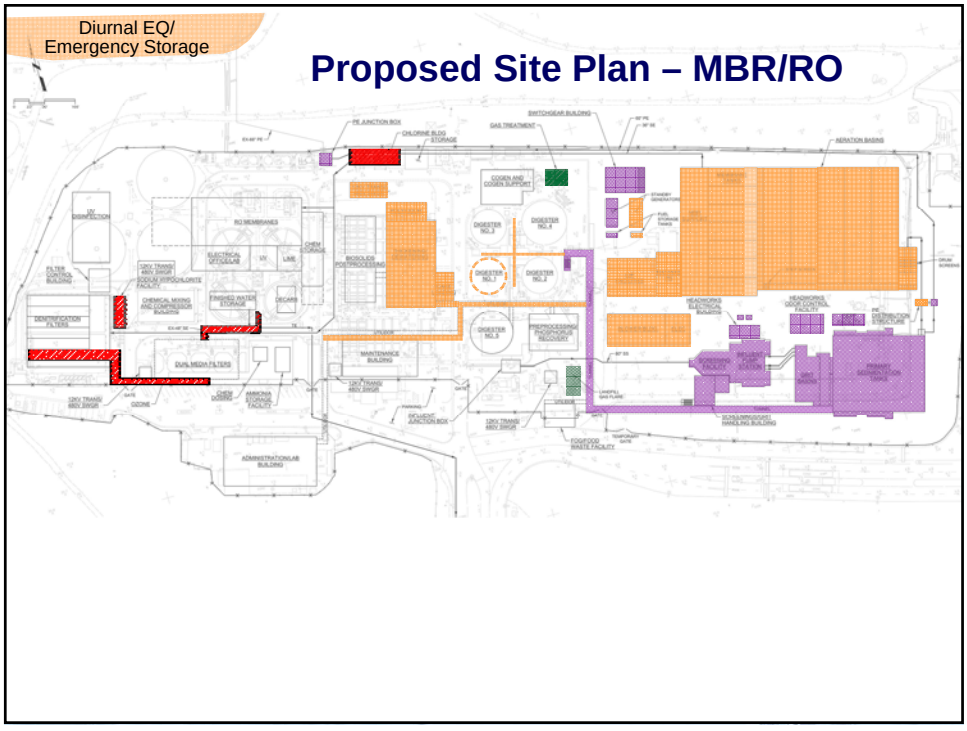


Proposed Site Plan – MBR/RO



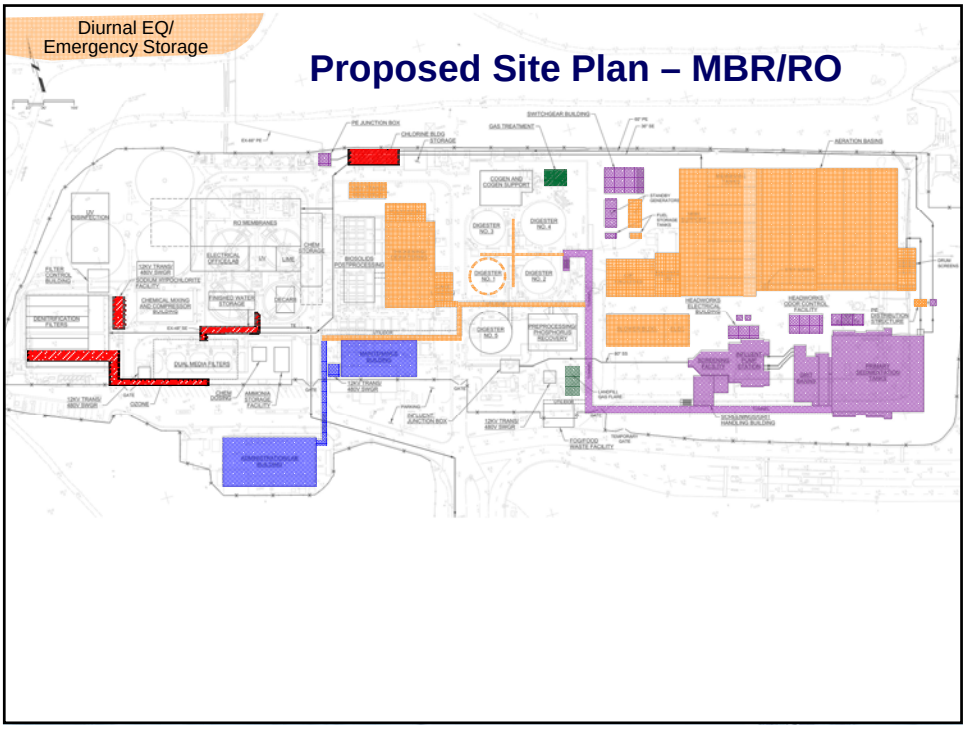
Diurnal EQ/
Emergency Storage

Proposed Site Plan – MBR/RO



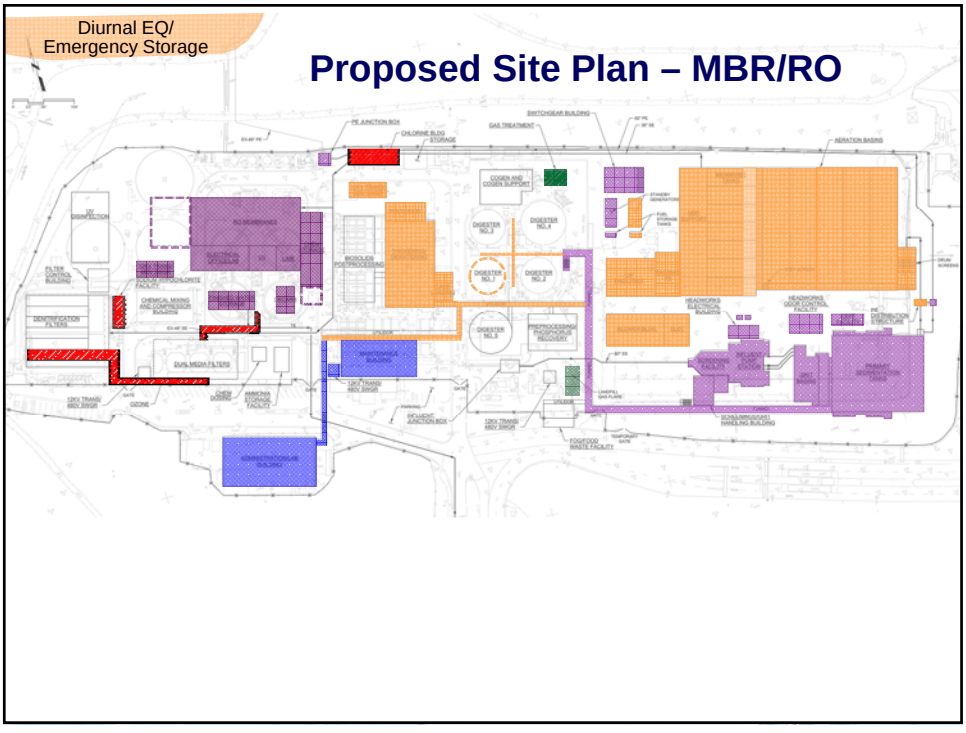
Diurnal EQ/
Emergency Storage

Proposed Site Plan – MBR/RO



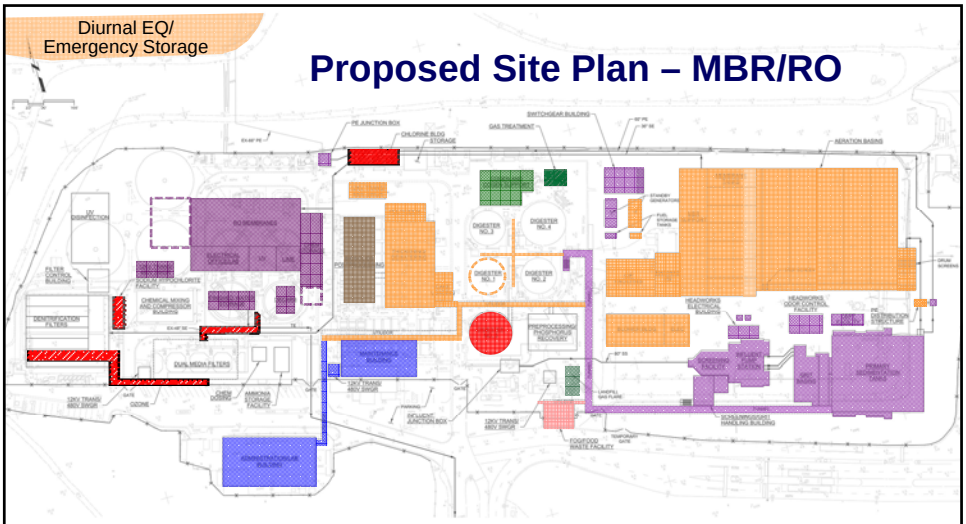
Diurnal EQ/
Emergency Storage

Proposed Site Plan – MBR/RO



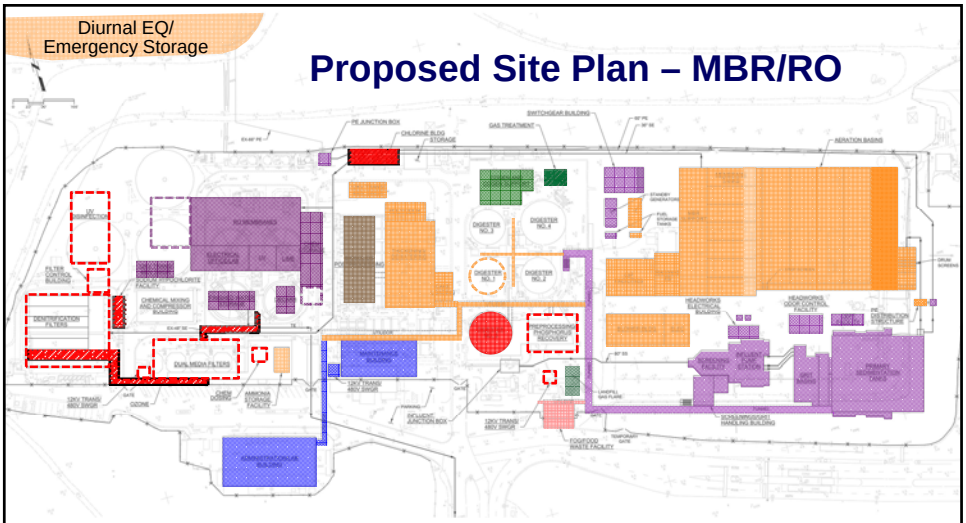
Diurnal EQ/
Emergency Storage

Proposed Site Plan – MBR/RO



Diurnal EQ/
Emergency Storage

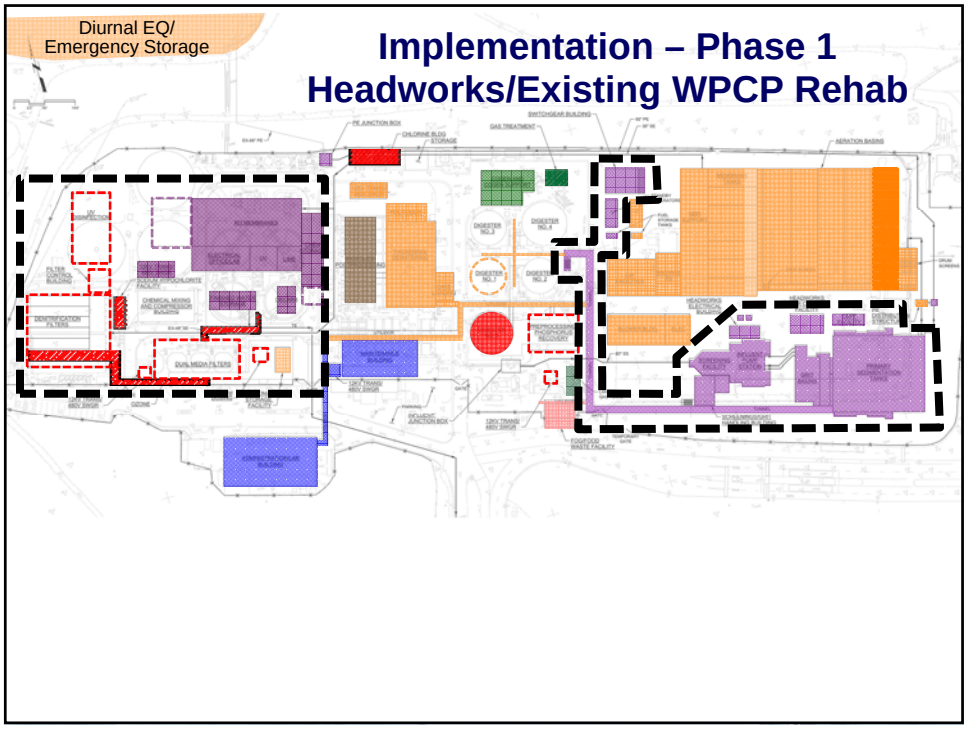
Proposed Site Plan – MBR/RO

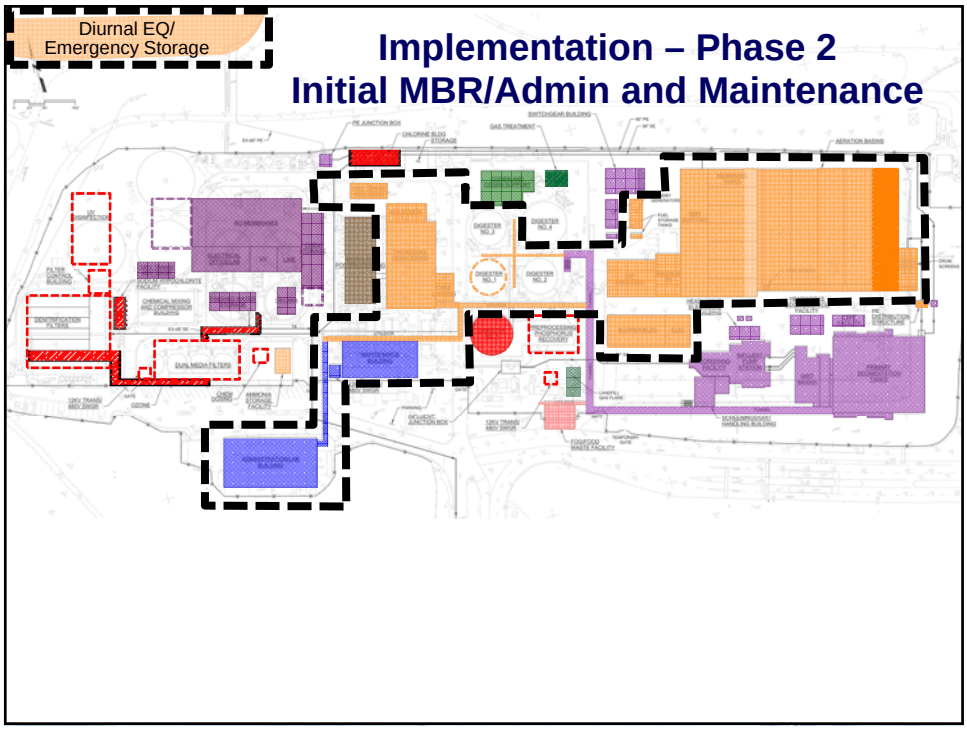


Proposed Implementation Plan

Implementation – Major Phases

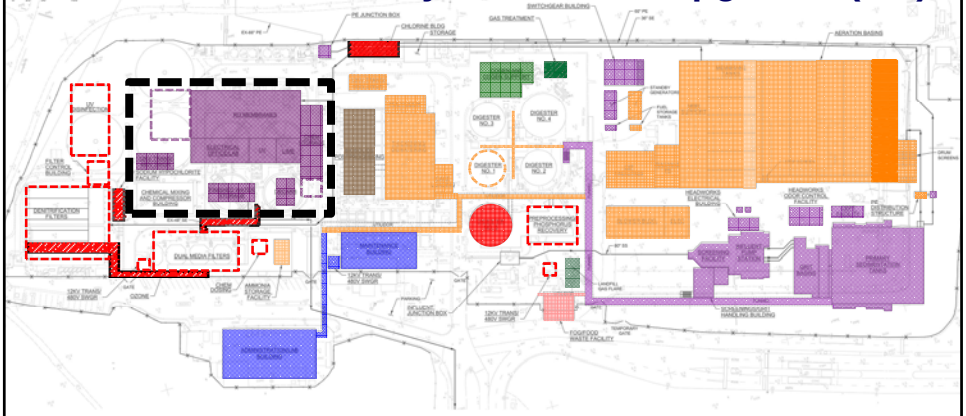
- Phase 1 – Headworks/Existing WPCP Rehab
- Phase 2 – Initial MBR/Admin and Maintenance
- Phase 3 – Tertiary Treatment (RO/UV)
- Phase 4 – Support Facilities Upgrades
- Phase 5 – Post Tertiary Treatment Upgrades


Diurnal EQ/
Emergency Storage
Implementation – Phase 1
Headworks/Existing WPCP Rehab


Diurnal EQ/
Emergency Storage
Implementation – Phase 2
Initial MBR/Admin and Maintenance

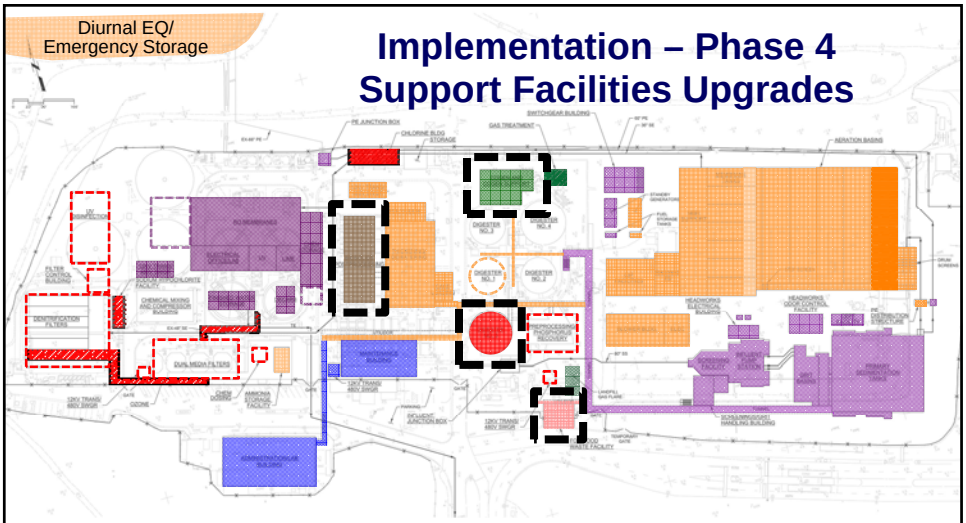
Diurnal EQ/
Emergency Storage

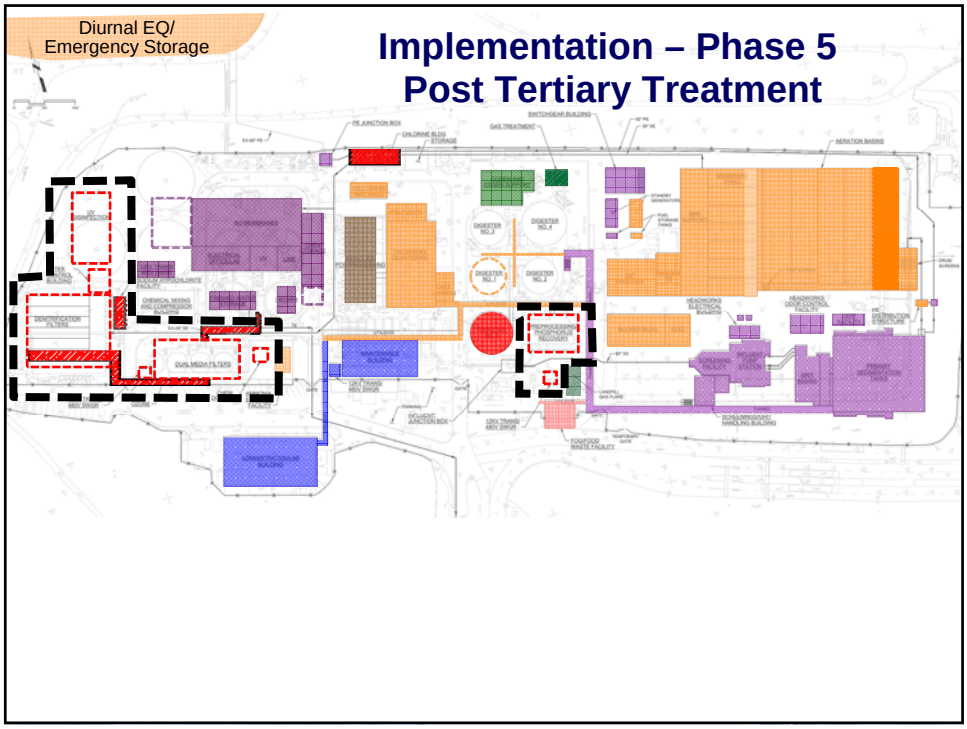
Implementation – Phase 3
Tertiary Treatement Upgrades (RO)

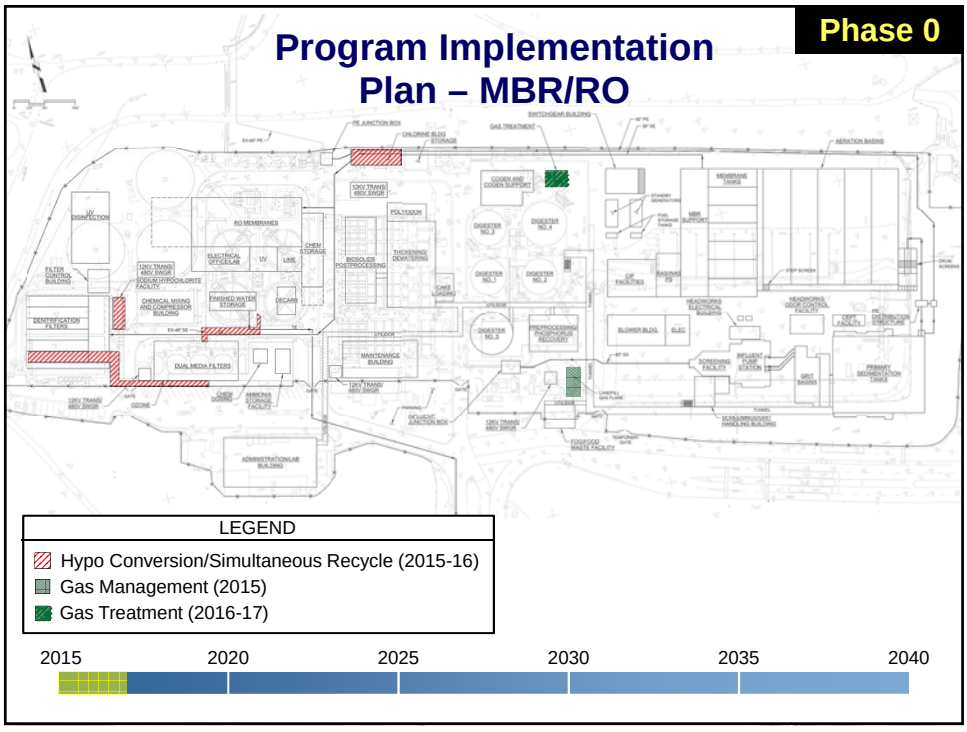


Diurnal EQ/
Emergency Storage

Implementation – Phase 4
Support Facilities Upgrades

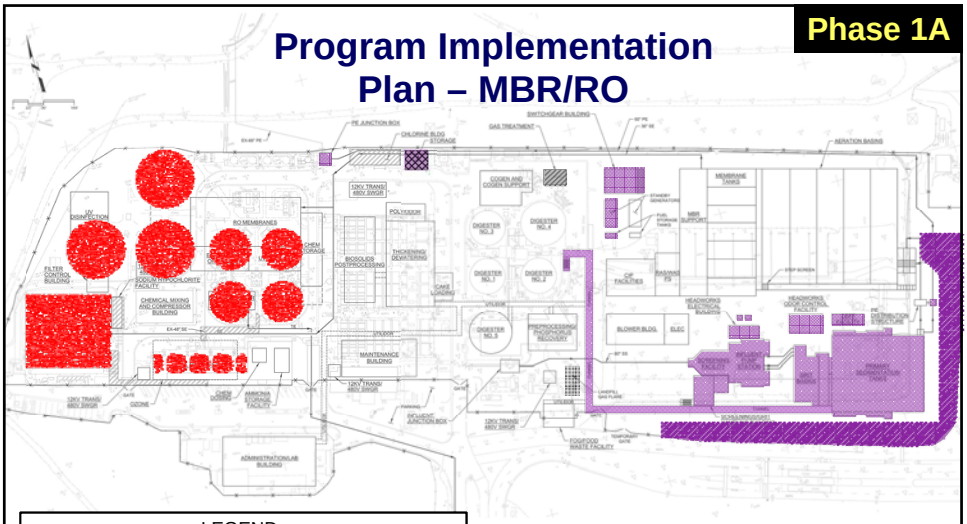



Diurnal EQ/
Emergency Storage
Implementation – Phase 5
Post Tertiary Treatment


Phase 0
Program Implementation
Plan – MBR/RO
LEGEND
Hypo Conversion/Simultaneous Recycle (2015-16)
Gas Management (2015)
Gas Treatment (2016-17)
2015
2020
2025
2030
2035
2040

Program Implementation Plan – MBR/RO

Phase 1A



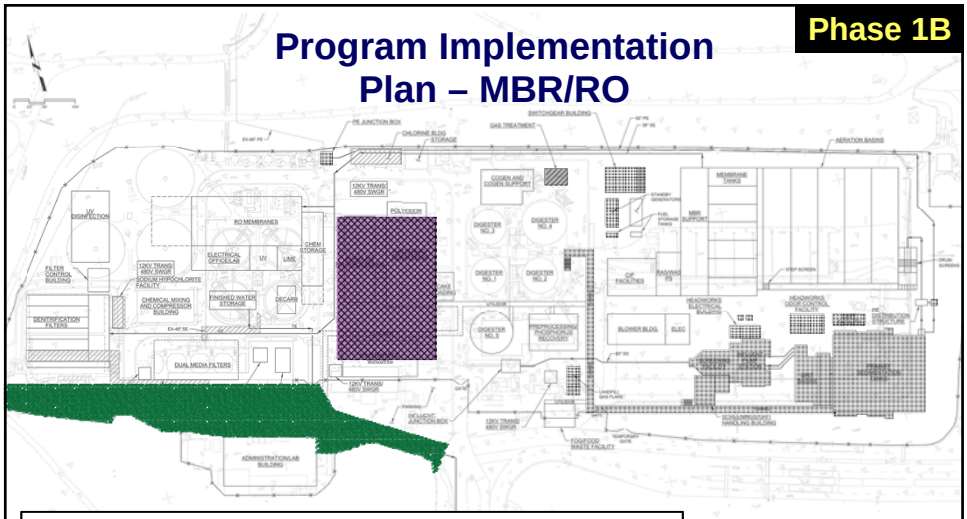
LEGEND

- Headworks/PSFs (2016-19) – Packages 1 and 2 (Includes Demo/Decommission)
- Existing Plant Rehabilitation (2018-19)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 1B



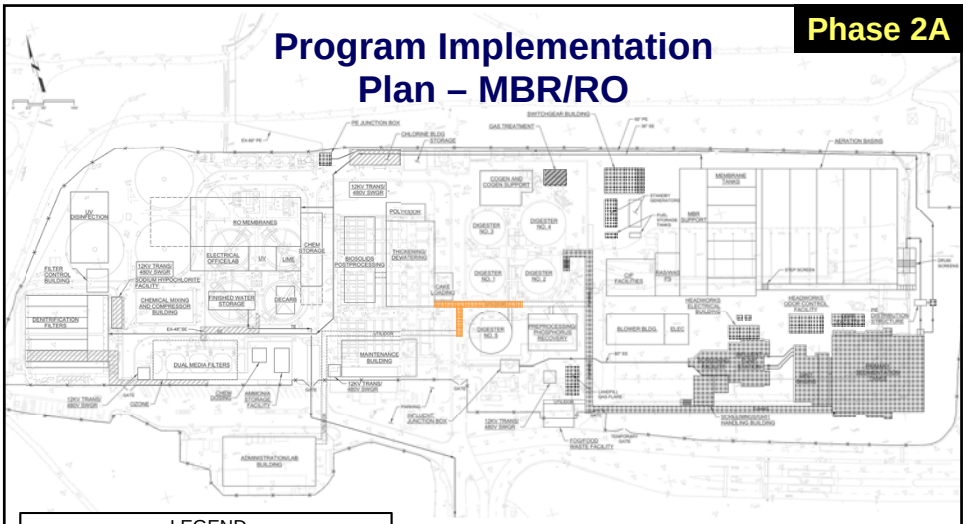
LEGEND

- Headworks/PSFs (2019-20) – Package 3 (Includes Demo/Decommission)
- Relocation of Bay Trail Access (2018)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 2A

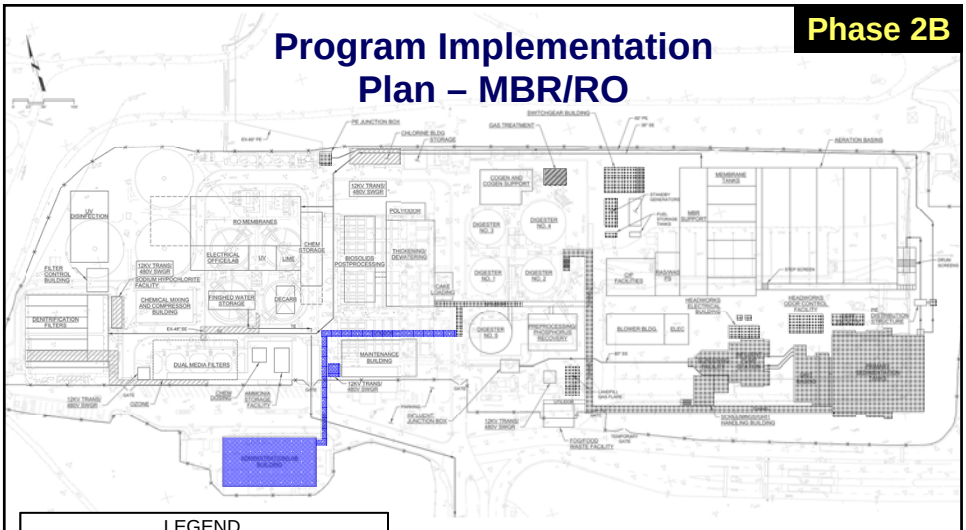


LEGEND
MBR (2020-21) – Milestone 1 (Utilidor)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 2B

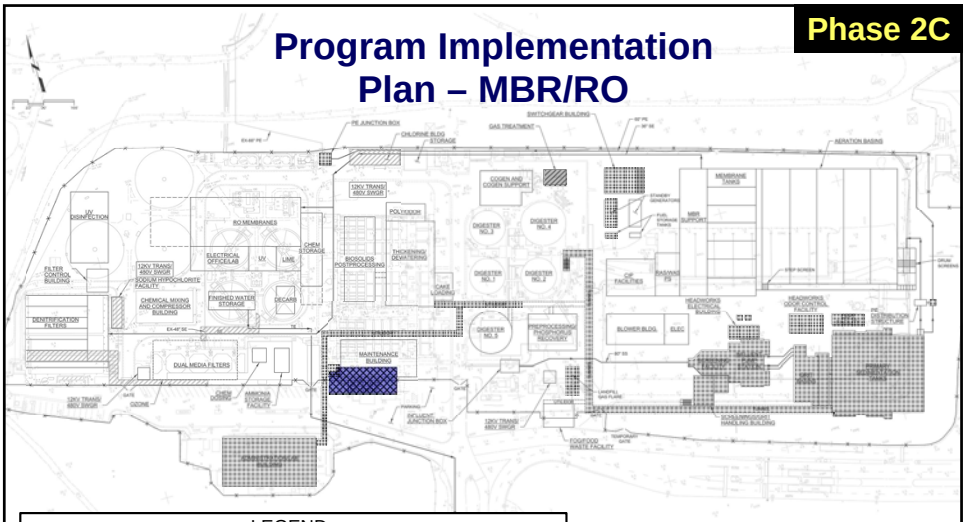


LEGEND
Administration/Lab Building (2020-21)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 2C

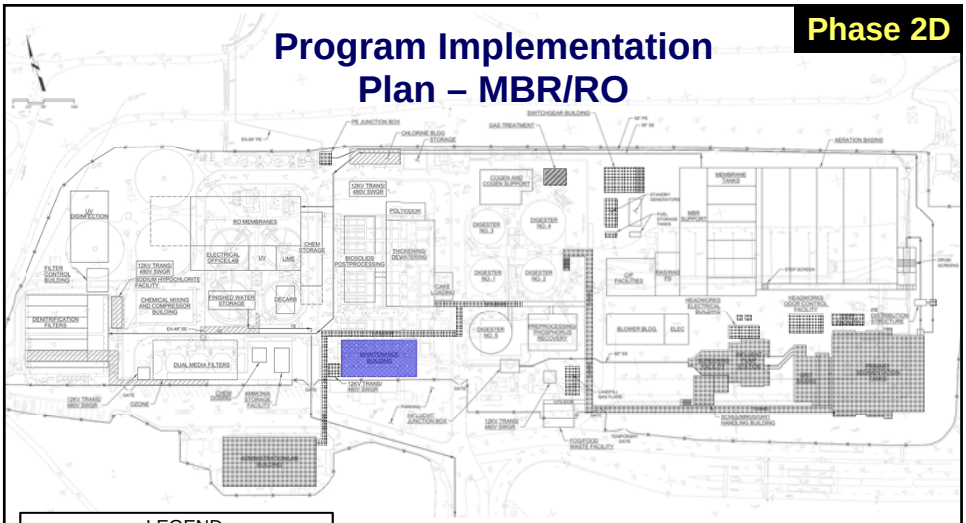


LEGEND
Maintenance Building - Administration Building Demo (2021)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 2D

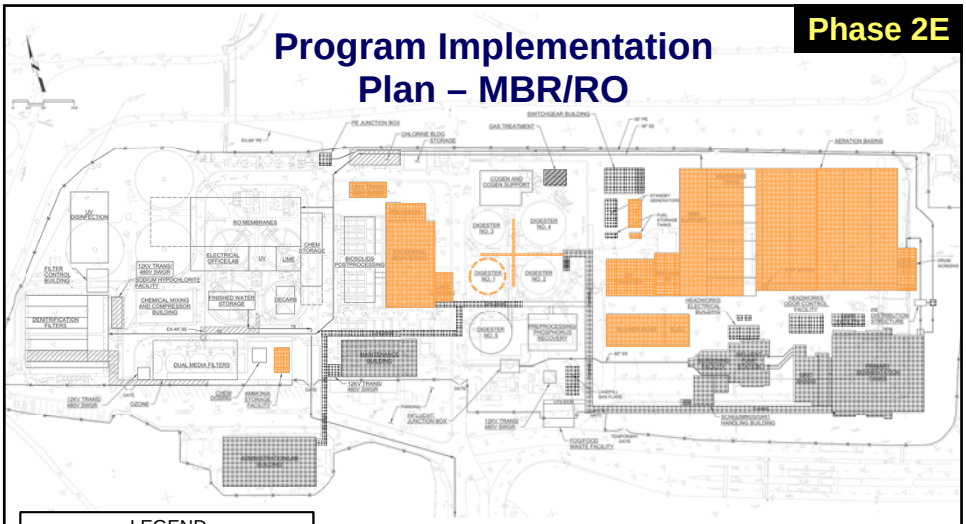


LEGEND
Maintenance Building (2021-22)

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

Phase 2E



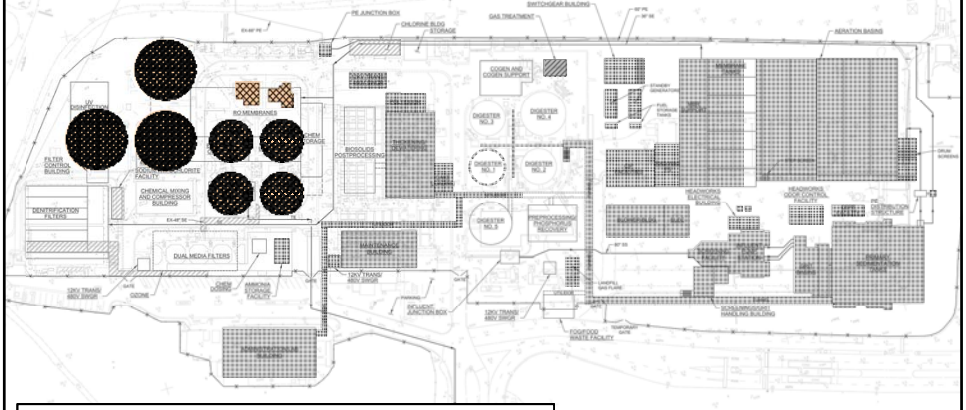
LEGEND
MBR (2020-24) – Milestone 2

2015 2020 2025 2030 2035 2040

Program Implementation Plan – MBR/RO

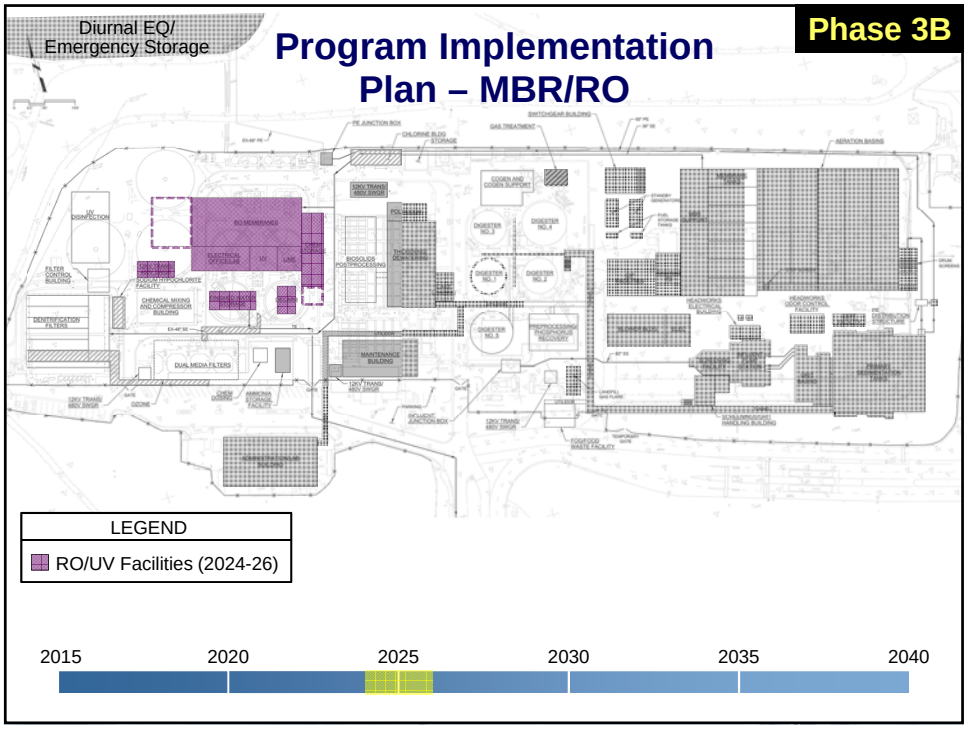
Phase 3A

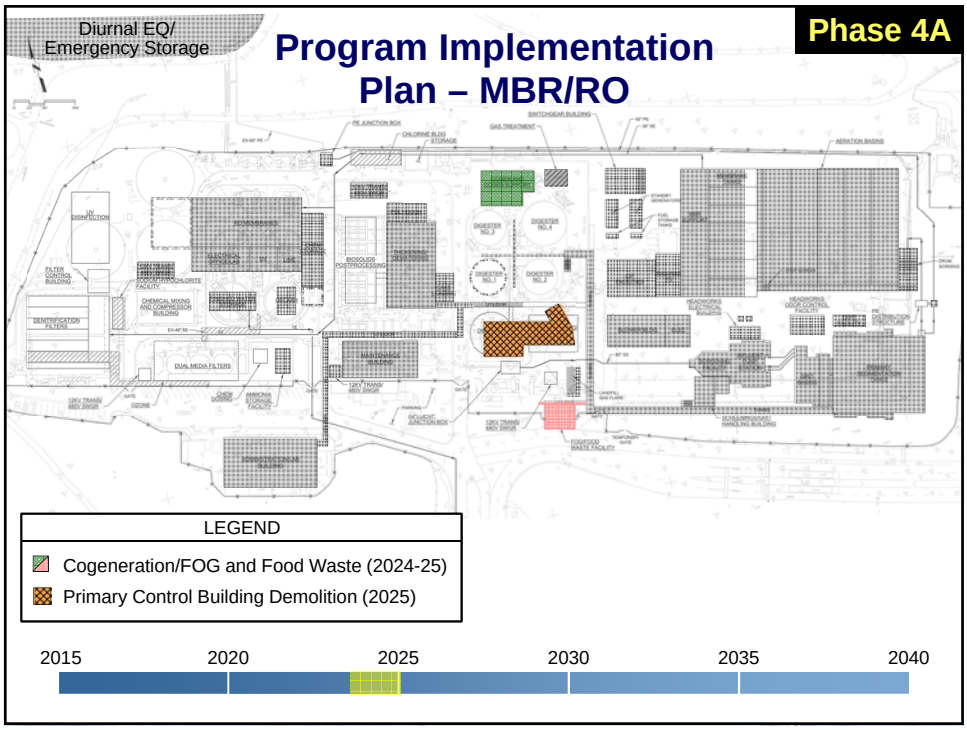
Diurnal EQ/ Emergency Storage



LEGEND
RO/UV – Demolish FGRs, Pump Station and AFTs (2024)

2015 2020 2025 2030 2035 2040

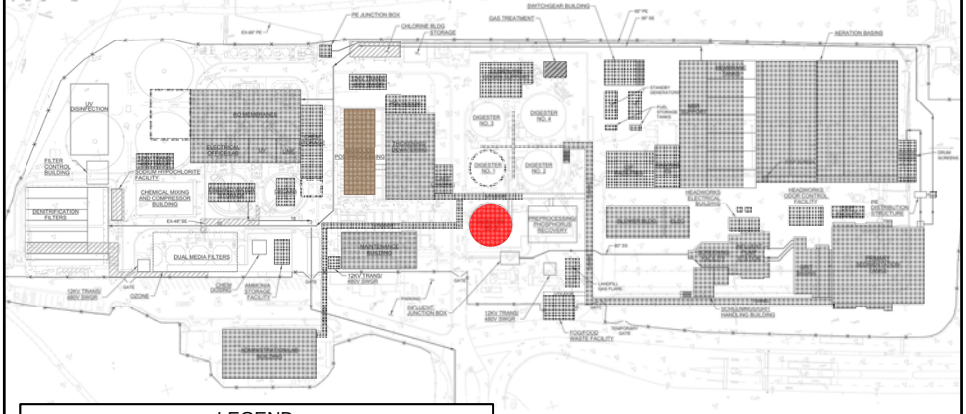

Diurnal EQ/
Emergency Storage
Program Implementation
Plan – MBR/RO
Phase 3B
LEGEND
RO/UV Facilities (2024-26)
2015
2020
2025
2030
2035
2040


Diurnal EQ/
Emergency Storage
Program Implementation
Plan – MBR/RO
Phase 4A
LEGEND
Cogeneration/FOG and Food Waste (2024-25)
Primary Control Building Demolition (2025)
2015
2020
2025
2030
2035
2040

Diurnal EQ/
Emergency Storage

Program Implementation Plan – MBR/RO

Phase 4B



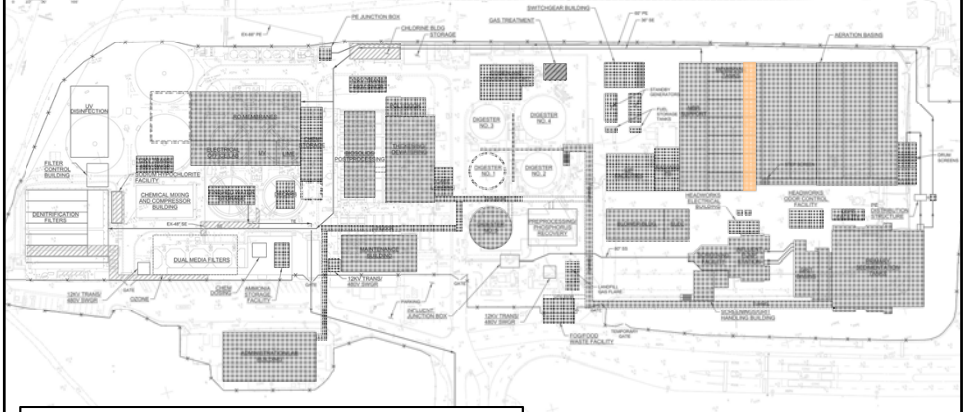
LEGEND
Biosolids Post Processing/Digester No. 5 (2025-26)

2015 2020 2025 2030 2035 2040

Diurnal EQ/
Emergency Storage

Program Implementation Plan – MBR/RO

Phase 4C



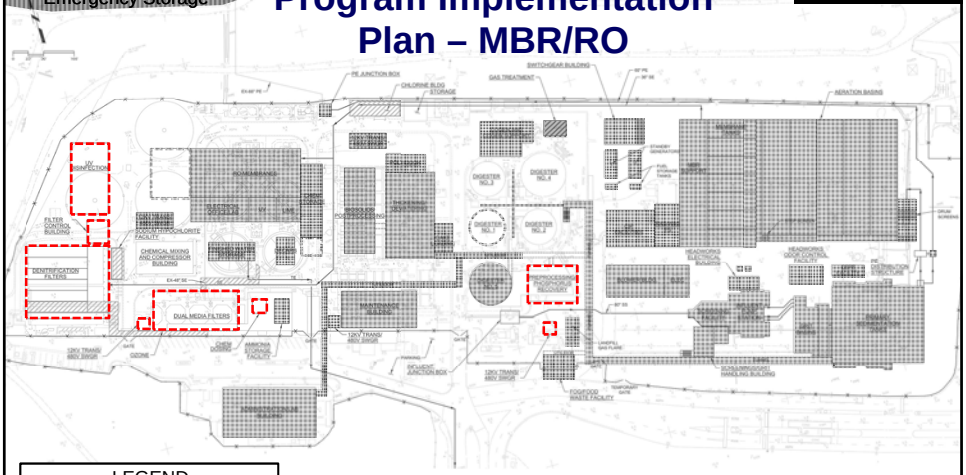
LEGEND
MBR Expansion – Add Membrane Racks (2028 -2035)

2015 2020 2025 2030 2035 2040

Diurnal EQ/
Emergency Storage

Program Implementation Plan – MBR/RO

Phase 5A



LEGEND
Future Facilities (>2035)

2015 2020 2025 2030 2035 2040

Next Steps

Next Steps

- Finalizing the Site Layout & CIP Implementation Plan
- City/PMC evaluate impacts/approach to delivering CIP

APPENDIX B - CIP SUMMARY TABLE

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	Individual Element Const. Cost (Unescalated)	Total Package Const. Cost (Unescalated)	Years to Midpoint of Const.	Total Package Const. Cost (Escalated) 2%	Total Package Project Cost (Escalated) 2%	Project Driver	Project Start Date	Fiscal Year Project Start	Planning/ Design (months)	Permitting/ CEQA (months)	Gap (months)	Construction (months)	Project Duration (months)	Project Duration (years)	Fiscal Year On-Line
1			**PRIMARY TREATMENT**																
1.1	1	Yes	Primary Treatment Facility	General	$ 99,700,000	$ 104,500,000	3	$ 112,500,000	$ 133,100,000	R&R	4/1/2014	2013	33	12	-15	54	72	6	2019
1.2	1	Yes	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds	General	$ 1,830,000	$ 1,830,000	3	$ 1,952,000	$ 2,800,000	R&R	7/1/2016	2016	12	9	0	12	24	2	2018
1.3	1	Yes	Rehabilitation Influent Pipelines to WPCP	General	$ 1,000,000	$ 1,000,000	3	$ 1,066,000	$ 1,500,000	R&R	1/1/2017	2016	12	9	0	12	24	2	2018
2			**SECONDARY TREATMENT**																
2.1M	1	No - Scope	Existing Plant Rehabilitation - MBR	MBR	n/a	$ 13,400,000	5	$ 14,795,000	$ 21,000,000	R&R	7/5/2016	2016	21	15	0	24	45	4	2020
n/a	n/a	n/a	Recirculation Pump Station Electrical Improvements	n/a	$ 500,000	Incl. in Project 2.1M													
n/a	n/a	n/a	Fixed Growth Reactor (FGR) Upgrades - MBR	n/a	$ 3,300,000	Incl. in Project 2.1M													
n/a	n/a	n/a	Air Flotation Tank (AFT) Upgrades - MBR	n/a	$ 1,600,000	Incl. in Project 2.1M													
2.2M	2	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 1 *	MBR	$171,700,000	$182,600,000	7	$ 208,714,000	$ 263,000,000	Policy	1/1/2017	2016	33	9	0	54	87	8	2024
2.3M	5	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 2	MBR	$10,700,000	$ 10,700,000	20	$ 15,979,000	$ 20,000,000	Flow and Load	7/1/2033	2033	12	9	0	12	24	2	2035
2.4	2	No - Timing	Primary Effluent Diurnal Equalization and Emergency Storage	MBR	$ 64,100,000	$ 64,100,000	9	$ 76,795,000	$ 109,000,000	Regulatory	6/20/2019	2019	15	36	0	21	57	5	2024
2.5	2	No - Timing	Active Retirement of Ponds	MBR	$ 4,700,000	$ 4,700,000	13	$ 6,095,000	$ 8,700,000	Policy	1/2/2026	2025	12	18	0	15	33	3	2028
2.7	5	Yes	Chemical Dosing (P-Removal)	MBR	$ 1,000,000	$ 1,000,000	21	$ 1,519,000	$ 2,200,000	Regulatory	7/1/2034	2034	12	9	0	9	21	2	2036
3			**TERTIARY TREATMENT**																
n/a	2	n/a	Dual Media Filter (DMF) Rehabilitation - MBR	MBR	$2,000,000	Incl. in Project 2.1M													
3.3	5	Yes	Denitrification Filters	General	$ 28,000,000	$ 28,000,000	24	$ 44,814,000	$ 63,600,000	Regulatory	7/1/2035	2035	24	9	0	24	48	4	2039
n/a	n/a	Yes	Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion	Not Included	$ 5,380,000	$ 5,680,000	2	$ 5,909,000	$ 8,400,000		7/1/2014	2014	18	9	0	18	36	3	2017
n/a	1	n/a	Chlorine Contact Tank (CCT) Rehabilitation	General	$ 2,700,000	Incl. in Project 2.1M													
n/a	2	n/a	Effluent Monitoring Stations	General	$ 400,000	Incl. in Project 2.1M													
3.4	4	Yes	Chloramine Disinfection	General	$ 2,000,000	$ 2,300,000	11	$ 2,874,000	$ 4,100,000	Regulatory	10/1/2024	2024	12	9	0	12	24	2	2026
3.5	5	Yes	UV Disinfection	General	$ 9,500,000	$ 9,500,000	22	$ 14,614,000	$ 20,800,000	Regulatory	7/1/2033	2033	24	9	0	24	48	4	2037
3.6	5	Yes	Ozone Disinfection	General	$ 16,000,000	$ 19,000,000	27	$ 32,271,000	$ 45,800,000	Regulatory	7/1/2039	2039	12	9	0	24	36	3	2042
3.8	3	No - Scope/Timing	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse *	MBR	$ 47,700,000	$ 54,500,000	11	$ 67,429,000	$ 84,300,000	Policy	7/4/2022	2022	24	9	0	24	48	4	2026
4			**SOLIDS FACILITIES**																
n/a	n/a	Yes	Digester No. 1 and 2 Upgrades	Not Included	$ 5,600,000	$ 5,600,000	0	$ 5,628,000	$ 8,000,000		7/1/2014	2014	0	9	0	12	21	2	2016
4.1	2	Yes	Digester Supernatant PS and Drainage Piping Upgrades	General	$ 800,000	$ 800,000	3	$ 853,000	$ 1,200,000	R&R	7/1/2016	2016	12	9	0	12	24	2	2018
4.2	2	No - Timing	Thickening and Dewatering Facility - Stage 1	General	$ 27,600,000	$ 31,300,000	6	$ 35,162,000	$ 49,900,000	Policy	1/1/2017	2016	33	9	6	21	60	5	2021
4.3	4	Yes	Thickening and Dewatering Facility - Stage 2	General	$ 6,800,000	$ 6,800,000	20	$ 10,055,000	$ 14,300,000	Flow and Load	10/1/2033	2033	9	6	0	12	21	2	2035
n/a	n/a	n/a	Digester Sludge Storage Tank	n/a	$ 2,700,000	Incl. in Project 4.2													
n/a	n/a	n/a	Digester Sludge Feed System	n/a	$ 1,000,000	Incl. in Project 4.2													
4.4	4	No - Timing	Digester No. 5	MBR	$ 5,800,000	$ 5,800,000	12	$ 7,374,000	$ 10,500,000	Flow and Load	10/1/2024	2024	18	9	0	21	39	4	2028
4.5	4	No - Scope	FOG/Food Waste Facility	MBR	$ 1,180,000	$ 1,180,000	11	$ 1,464,000	$ 2,100,000	Performance/Econ.	4/1/2024	2023	18	9	0	15	33	3	2026
4.6	5	Yes	Phosphorus Recovery Facility	General	$ 5,700,000	$ 5,700,000	15	$ 7,710,000	$ 10,900,000	Performance/Econ.	7/1/2028	2028	12	9	0	12	24	2	2030
4.7	4	Yes	Biosolids Post-Processing	General	$ 16,600,000	$ 16,600,000	16	$ 22,676,000	$ 32,200,000	Regulatory	1/1/2028	2027	24	9	0	24	48	4	2031
5			**COMBINED HEAT AND POWER**																
n/a	n/a	Yes	Cogeneration Gas Treatment	Not Included	$ 2,000,000	$ 2,000,000	1	$ 2,045,000	$ 2,900,000		7/1/2015	2015	0	9	0	9	18	2	2017
5.1	3	No - Timing	Cogeneration Upgrade	MBR	$ 12,000,000	$ 12,000,000	11	$ 14,957,000	$ 21,200,000	Performance/Econ.	9/2/2022	2022	24	15	0	21	45	4	2026
6			**ELECTRICAL**																
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 1 - Primary Treatment Facility	n/a	$ -	Incl. in Project 1.1													
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 2 - Secondary Treatment	n/a	$ 5,400,000	Incl. in Project 2.2M													
7			**PROCESS CONTROL AND AUTOMATION (SCADA)**																
n/a	n/a	n/a	SCADA System Improvements - Stage 1 - Headworks and Primary Treatment	n/a	$ -	Incl. in Project 1.1													
n/a	n/a	n/a	SCADA System Improvements - Stage 2 - Secondary Treatment	n/a	$ 500,000	Incl. in Project 2.2M													
8			**SUPPORT FACILITIES**																
n/a	n/a	n/a	Tidal Flood Protection - Stage 1	n/a	$ -	Incl. in Project 1.1													
n/a	n/a	n/a	Tidal Flood Protection - Stage 2	n/a	$ 2,600,000	Incl. in Project 2.1M													
n/a	n/a	Yes	Borregas Avenue Parking Lot	Not Included	$ 300,000	Included in Sim. RW													
8.1	1	No - Timing	New Access to Bay Trails	General	$ 400,000	$ 400,000	4	$ 429,000	$ 600,000	Performance/Econ.	9/17/2016	2016	18	9	0	6	24	2	2018
8.2	1	Yes	Household Hazardous Waste Demolition/ Solid Waste Removal	General	$ 300,000	$ 300,000	3	$ 320,000	$ 500,000	Performance/Econ.	7/1/2016	2016	12	9	0	12	24	2	2018
8.3	2	No - Timing	Administration and Lab Building	General	$ 16,300,000	$ 16,600,000	6	$ 18,510,000	$ 26,300,000	R&R	9/12/2017	2017	18	15	0	18	36	3	2020
8.4	2	No - Timing	Maintenance Building	General	$ 4,600,000	$ 4,600,000	6	$ 5,206,000	$ 7,400,000	R&R	9/12/2017	2017	18	9	18	12	48	4	2021
9			**SUPPORT UTILITIES**																
n/a	n/a	n/a	Site Security Improvements - Stage 1	n/a	$ 600,000	Incl. in Project 1.1													
n/a	n/a	n/a	Site Security Improvements - Stage 2	n/a	$ 300,000	Incl. in Project 2.1M													
9.1	2	Yes	Recycle Water Improvements (New Recycled Water PS)	General	$ 2,300,000	$ 2,300,000	12	$ 2,931,000	$ 4,200,000	R&R	7/1/2025	2025	12	9	0	12	24	2	2027
9.2	2	Yes	Community Improvements	General	$ 400,000	$ 400,000	12	$ 510,000	$ 700,000	Policy	7/1/2025	2025	12	9	0	12	24	2	2027
9.3	2	Yes	Landfill Gas Flare and Booster System Upgrades	General	$ 200,000	$ 200,000	12	$ 255,000	$ 400,000	R&R	7/1/2025	2025	12	9	0	12	24	2	2027
9.4	2	Yes	Miscellaneous Civil Site/Support Utility Improvements	General	$ 400,000	$ 400,000	12	$ 510,000	$ 700,000	R&R	7/1/2025	2025	12	9	0	12	24	2	2027

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	Individual Element Const. Cost (Unescalated)	Total Package Const. Cost (Unescalated)	Years to Midpoint of Const.	Total Package Const. Cost (Escalated) 2%	Total Package Project Cost (Escalated) 2%	Project Driver	Project Start Date	Fiscal Year Project Start	Planning/ Design (months)	Permitting/ CEQA (months)	Gap (months)	Construction (months)	Project Duration (months)	Project Duration (years)	Fiscal Year On-Line
10			**DEMOLITION**																
n/a	n/a	n/a	Demolition of Primary Sedimentation Tanks	n/a	$ 2,800,000	Incl. in Project 2.2M													
n/a	n/a	n/a	Demolition of Primary Control Building	n/a	$ 2,200,000	Incl. in Project 2.2M													
n/a	n/a	n/a	Demolition of Auxiliary Pump Station	n/a	$ 600,000	Incl. in Project 1.1													
n/a	n/a	n/a	Demolition Chlorine Building	n/a	$ -	Included in Sim. RW													
n/a	n/a	n/a	Demolition Chemical Storage Area	n/a	$ 600,000	Incl. in Project 1.1													
n/a	n/a	n/a	Demolition Dechlorination Building	n/a	$ 200,000	Incl. in Project 1.1													
n/a	n/a	n/a	Demolition of Administration Building	n/a	$ 300,000	Incl. in Project 8.3													
n/a	n/a	n/a	Demolition of Laboratory Building	n/a	$ 300,000	Incl. in Project 3.4													
n/a	n/a	n/a	Demolition DAFT	n/a	$ 1,500,000	Incl. in Project 3.8													
n/a	n/a	n/a	Demolition Float Pump Station	n/a	$ 1,000,000	Incl. in Project 3.8													
n/a	n/a	No	Demolition Fixed Growth Reactor (FGR) Pump Station	n/a	$ 1,200,000	Incl. in Project 3.8													
n/a	n/a	No	Demolition Fixed Growth Reactors (FGRs)	n/a	$ 3,100,000	Incl. in Project 3.8													
n/a	n/a	No	Demolition Dual Media Filters (DMFs)	n/a	$ 3,000,000	Incl. in Project 3.6													
11			**OPERATIONS AND MAINTENANCE**																
11.1	n/a	n/a	Capital Replacement (1% of All New Construction)	MBR	Annual allowance			$ 8,288,732	$ 11,770,000	R&R									
			ANNUAL TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included															
			CUMULATIVE TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included		$ 13,280,000		$ 13,582,000	$ 19,300,000										
			ANNUAL TOTAL - GENERAL IMPROVEMENTS	General															
			CUMULATIVE TOTAL - GENERAL IMPROVEMENTS	General		$ 252,530,000		$ 315,218,000	$ 421,000,000										
			ANNUAL TOTAL - MBR IMPROVEMENTS	MBR															
			CUMULATIVE TOTAL - MBR IMPROVEMENTS	MBR		$ 349,980,000		$ 423,409,732	$ 553,770,000										
			ANNUAL TOTAL - MBR IMPLEMENTATION																
			CUMULATIVE TOTAL - MBR IMPLEMENTATION			**$ 602,510,000**		**$ 738,627,732**	**$ 974,770,000**										

Notes:
* Includes project with the City of Sunnyvale and Santa Clara Valley Water District. To be jointly funded.

Legend
Value to input
Value same as Split Flow (set equal to a Split Flow input value)
Value calculated
Project element included in another CIP project
Project already funded and underway (not included in total CIP cashflow)

Annual Rate of Escalation	
ENR Construction Cost Index for Unescalated Costs (San Francisco, June 2015)	11,155
Primary Treatment Facility	2.0%
* See Primary Treatment Facility cost details (HW-PST Detail)	*

Program Factor*	Factor	Element Const. Cost (unescalated)
All CIP Projects unless noted otherwise	42.0%	
Primary Treatment Facility	19.6%	$ 104,500,000
Base Elements (Headworks, Primary Sedimentationk Tanks, etc.)	19.5%	$ 99,700,000
Additional Elements Package 2	42.0%	$ 600,000
Additional Elements Package 3	19.5%	$ 4,200,000
Secondary Treatment Improvements Stage 1 - All Elements	26.0%	$ 182,600,000
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%	$ 171,700,000
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%	$ 10,900,000
Secondary Treatment Improvements Stage 2 - All Elements	25.0%	$ 10,700,000
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%	$ 10,700,000
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%	$ -
Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse	25.0%	$ 47,700,000

* See Basis of Program Factor for Additional Information

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	Phase 1 2013-2019 Total Package Project Cost (Escalated) 2%	Phase 2 2020-2024 Total Package Project Cost (Escalated) 2%	Phase 3 2025-2029 Total Package Project Cost (Escalated) 2%	Phase 4 2030-2036 Total Package Project Cost (Escalated) 2%	Phase 5 2037-2042 Total Package Project Cost (Escalated) 2%	FY 14/15 6/14 - 7/15 2014 2014	FY 15/16 6/15 - 7/16 2015 2015	FY 16/17 6/16 - 7/17 2016 2016	FY 17/18 6/17 - 7/18 2017 2017	FY 18/19 6/18 - 7/19 2018 2018	FY 19/20 6/19 - 7/20 2019 2019	FY 20/21 6/20 - 7/21 2020 2020	FY 21/22 6/21 - 7/22 2021 2021
1			**PRIMARY TREATMENT**														
1.1	1	Yes	Primary Treatment Facility	General	$ 133,100,000	$ -	$ -	$ -	$ -	$ 2,538,000	$ 23,715,271	$ 25,246,963	$ 45,444,533	$ 30,296,355	$ 5,858,879	$ -	$ -
1.2	1	Yes	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds	General	$ 2,800,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 840,000	$ 1,960,000	$ -	$ -	$ -	$ -
1.3	1	Yes	Rehabilitation Influent Pipelines to WPCP	General	$ 1,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 450,000	$ 1,050,000	$ -	$ -	$ -	$ -
2			**SECONDARY TREATMENT**														
2.1M	1	No - Scope	Existing Plant Rehabilitation - MBR	MBR	$ 21,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 840,000	$ 1,260,000	$ 8,400,000	$ 10,500,000	$ -	$ -
n/a	n/a	n/a	Recirculation Pump Station Electrical Improvements	n/a													
n/a	n/a	n/a	Fixed Growth Reactor (FGR) Upgrades - MBR	n/a													
n/a	n/a	n/a	Air Flotation Tank (AFT) Upgrades - MBR	n/a													
2.2M	2	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 1 *	MBR	$ -	$ 263,000,000	$ -	$ -	$ -	$ -	$ -	$ 2,630,000	$ 5,260,000	$ 18,410,000	$ 26,300,000	$ 39,450,000	$ 65,750,000
2.3M	5	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 2	MBR	$ -	$ -	$ -	$ -	$ 20,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.4	2	No - Timing	Primary Effluent Diurnal Equalization and Emergency Storage	MBR	$ -	$ 109,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,360,000	$ 6,540,000	$ 38,150,000
2.5	2	No - Timing	Active Retirement of Ponds	MBR	$ -	$ 8,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.7	5	Yes	Chemical Dosing (P-Removal)	MBR	$ -	$ -	$ -	$ -	$ 2,200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3			**TERTIARY TREATMENT**														
n/a	2	n/a	Dual Media Filter (DMF) Rehabilitation - MBR	MBR													
3.3	5	Yes	Denitrification Filters	General	$ -	$ -	$ -	$ -	$ 63,600,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	n/a	Yes	Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion	Not Included	n/a	n/a	n/a	n/a	n/a	$ 840,000	$ 3,780,000	$ 3,780,000	$ -	$ -	$ -	$ -	$ -
n/a	1	n/a	Chlorine Contact Tank (CCT) Rehabilitation	General													
n/a	2	n/a	Effluent Monitoring Stations	General													
3.4	4	Yes	Chloramine Disinfection	General	$ -	$ -	$ -	$ 4,100,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.5	5	Yes	UV Disinfection	General	$ -	$ -	$ -	$ -	$ 20,800,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.6	5	Yes	Ozone Disinfection	General	$ -	$ -	$ -	$ -	$ 45,800,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.8	3	No - Scope/Timing	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse *	MBR	$ -	$ -	$ 84,300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4			**SOLIDS FACILITIES**														
n/a	n/a	Yes	Digester No. 1 and 2 Upgrades	Not Included	n/a	n/a	n/a	n/a	n/a	$ 2,400,000	$ 5,600,000	$ -	$ -	$ -	$ -	$ -	$ -
4.1	2	Yes	Digester Supernatant PS and Drainage Piping Upgrades	General	$ -	$ 1,200,000	$ -	$ -	$ -	$ -	$ -	$ 360,000	$ 840,000	$ -	$ -	$ -	$ -
4.2	2	No - Timing	Thickening and Dewatering Facility - Stage 1	General	$ -	$ 49,900,000	$ -	$ -	$ -				$ 1,497,000	$ 1,497,000	$ 1,996,000		
4.3	4	Yes	Thickening and Dewatering Facility - Stage 2	General	$ -	$ -	$ -	$ 14,300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	n/a	n/a	Digester Sludge Storage Tank	n/a													
n/a	n/a	n/a	Digester Sludge Feed System	n/a													
4.4	4	No - Timing	Digester No. 5	MBR	$ -	$ -	$ -	$ 10,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.5	4	No - Scope	FOG/Food Waste Facility	MBR	$ -	$ -	$ -	$ 2,100,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.6	5	Yes	Phosphorus Recovery Facility	General	$ -	$ -	$ -	$ -	$ 10,900,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.7	4	Yes	Biosolids Post-Processing	General	$ -	$ -	$ -	$ 32,200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5			**COMBINED HEAT AND POWER**														
n/a	n/a	Yes	Cogeneration Gas Treatment	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ 870,000	$ 2,030,000	$ -	$ -	$ -	$ -	$ -
5.1	3	No - Timing	Cogeneration Upgrade	MBR	$ -	$ -	$ 21,200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
6			**ELECTRICAL**														
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 1 - Primary Treatment Facility	n/a													
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 2 - Secondary Treatment	n/a													
7			**PROCESS CONTROL AND AUTOMATION (SCADA)**														
n/a	n/a	n/a	SCADA System Improvements - Stage 1 - Headworks and Primary Treatment	n/a													
n/a	n/a	n/a	SCADA System Improvements - Stage 2 - Secondary Treatment	n/a													
8			**SUPPORT FACILITIES**														
n/a	n/a	n/a	Tidal Flood Protection - Stage 1	n/a													
n/a	n/a	n/a	Tidal Flood Protection - Stage 2	n/a													
n/a	n/a	Yes	Borregas Avenue Parking Lot	Not Included													
8.1	1	No - Timing	New Access to Bay Trails	General	$ 600,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 180,000	$ 420,000	$ -	$ -	$ -	$ -
8.2	1	Yes	Household Hazardous Waste Demolition/ Solid Waste Removal	General	$ 500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ 350,000	$ -	$ -	$ -	$ -
8.3	2	No - Timing	Administration and Lab Building	General	$ -	$ 26,300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,630,000	$ 11,835,000	$ 11,835,000	$ -	$ -
8.4	2	No - Timing	Maintenance Building	General	$ -	$ 7,400,000	$ -	$ -	$ -		$ -			$ 370,000	$ 370,000		$ 6,660,000
9			**SUPPORT UTILITIES**														
n/a	n/a	n/a	Site Security Improvements - Stage 1	n/a													
n/a	n/a	n/a	Site Security Improvements - Stage 2	n/a													
9.1	2	Yes	Recycle Water Improvements (New Recycled Water PS)	General	$ -	$ 4,200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9.2	2	Yes	Community Improvements	General	$ -	$ 700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9.3	2	Yes	Landfill Gas Flare and Booster System Upgrades	General	$ -	$ 400,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9.4	2	Yes	Miscellaneous Civil Site/Support Utility Improvements	General	$ -	$ 700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	Phase 1 2013-2019 Total Package Project Cost (Escalated) 2%	Phase 2 2020-2024 Total Package Project Cost (Escalated) 2%	Phase 3 2025-2029 Total Package Project Cost (Escalated) 2%	Phase 4 2030-2036 Total Package Project Cost (Escalated) 2%	Phase 5 2037-2042 Total Package Project Cost (Escalated) 2%	FY 14/15 6/14 - 7/15 2014 2014	FY 15/16 6/15 - 7/16 2015 2015	FY 16/17 6/16 - 7/17 2016 2016	FY 17/18 6/17 - 7/18 2017 2017	FY 18/19 6/18 - 7/19 2018 2018	FY 19/20 6/19 - 7/20 2019 2019	FY 20/21 6/20 - 7/21 2020 2020	FY 21/22 6/21 - 7/22 2021 2021
10			**DEMOLITION**														
n/a	n/a	n/a	Demolition of Primary Sedimentation Tanks	n/a													
n/a	n/a	n/a	Demolition of Primary Control Building	n/a													
n/a	n/a	n/a	Demolition of Auxiliary Pump Station	n/a													
n/a	n/a	n/a	Demolition Chlorine Building	n/a													
n/a	n/a	n/a	Demolition Chemical Storage Area	n/a													
n/a	n/a	n/a	Demolition Dechlorination Building	n/a													
n/a	n/a	n/a	Demolition of Administration Building	n/a													
n/a	n/a	n/a	Demolition of Laboratory Building	n/a													
n/a	n/a	n/a	Demolition DAFT	n/a													
n/a	n/a	n/a	Demolition Float Pump Station	n/a													
n/a	n/a	No	Demolition Fixed Growth Reactor (FGR) Pump Station	n/a													
n/a	n/a	No	Demolition Fixed Growth Reactors (FGRs)	n/a													
n/a	n/a	No	Demolition Dual Media Filters (DMFs)	n/a													
11			**OPERATIONS AND MAINTENANCE**														
11.1	n/a	n/a	Capital Replacement (1% of All New Construction)	MBR	$ 1,510,000	$ 1,670,000	$ 1,840,000	$ 2,900,000	$ 3,850,000	$ -	$ 290,000	$ 300,000	$ 300,000	$ 310,000	$ 310,000	$ 320,000	$ 330,000
			ANNUAL TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included						$ 3,240,000	$ 10,250,000	$ 5,810,000	$ -	$ -	$ -	$ -	$ -
			CUMULATIVE TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included	$ -	$ -	$ -	$ -	$ -	$ 3,240,000	$ 13,490,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000
			ANNUAL TOTAL - GENERAL IMPROVEMENTS	General						$ 2,538,000	$ 23,715,271	$ 27,226,963	$ 54,191,533	$ 43,998,355	$ 20,059,879	$ -	$ 6,660,000
			CUMULATIVE TOTAL - GENERAL IMPROVEMENTS	General	$ 138,500,000	$ 90,800,000	$ -	$ 50,600,000	$ 141,100,000	$ 2,538,000	$ 26,253,271	$ 53,480,234	$ 107,671,766	$ 151,670,121	$ 171,730,000	$ 171,730,000	$ 178,390,000
			ANNUAL TOTAL - MBR IMPROVEMENTS	MBR						$ -	$ 290,000	$ 3,770,000	$ 6,820,000	$ 27,120,000	$ 41,470,000	$ 46,310,000	$ 104,230,000
			CUMULATIVE TOTAL - MBR IMPROVEMENTS	MBR	$ 22,510,000	$ 382,370,000	$ 107,340,000	$ 15,500,000	$ 26,050,000	$ -	$ 290,000	$ 4,060,000	$ 10,880,000	$ 38,000,000	$ 79,470,000	$ 125,780,000	$ 230,010,000
			ANNUAL TOTAL - MBR IMPLEMENTATION							$ 2,538,000	$ 24,005,271	$ 30,996,963	$ 61,011,533	$ 71,118,355	$ 61,529,879	$ 46,310,000	$ 110,890,000
			CUMULATIVE TOTAL - MBR IMPLEMENTATION		**$ 161,010,000**	**$ 473,170,000**	**$ 107,340,000**	**$ 66,100,000**	**$ 167,150,000**	$ 2,538,000	$ 26,543,271	$ 57,540,234	$ 118,551,766	$ 189,670,121	$ 251,200,000	$ 297,510,000	$ 408,400,000

Notes:
* Includes project with the City of Sunnyvale and Santa Clara Valley Water District. To be jointly funded.

Legend
Value to input
Value same as Split Flow (set equal to a Split Flow input value)
Value calculated
Project element included in another CIP project
Project already funded and underway (not included in total CIP cashflow)

Annual Rate of Escalation	
ENR Construction Cost Index for Unescalated Costs (San Francisco, June 2015)	11,155
Primary Treatment Facility	2.0%
* See Primary Treatment Facility cost details (HW-PST Detail)	*

Program Factor*	Factor
All CIP Projects unless noted otherwise	42.0%
Primary Treatment Facility	19.6%
Base Elements (Headworks, Primary Sedimentationk Tanks, etc.)	19.5%
Additional Elements Package 2	42.0%
Additional Elements Package 3	19.5%
Secondary Treatment Improvements Stage 1 - All Elements	26.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Secondary Treatment Improvements Stage 2 - All Elements	25.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse	25.0%

* See Basis of Program Factor for Additional Information

Final

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	FY 22/23 6/22 - 7/23 2022 2022	FY 23/24 6/23 - 7/24 2023 2023	FY 24/25 6/24 - 7/25 2024 2024	FY 25/26 6/25 - 7/26 2025 2025	FY 26/27 6/26 - 7/27 2026 2026	FY 27/28 6/27 - 7/28 2027 2027	FY 28/29 6/28 - 7/29 2028 2028	FY 29/30 6/29 - 7/30 2029 2029	FY 30/31 6/30 - 7/31 2030 2030	FY 31/32 6/31 - 7/32 2031 2031	FY 32/33 6/32 - 7/33 2032 2032
1			**PRIMARY TREATMENT**												
1.1	1	Yes	Primary Treatment Facility	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.2	1	Yes	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.3	1	Yes	Rehabilitation Influent Pipelines to WPCP	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2			**SECONDARY TREATMENT**												
2.1M	1	No - Scope	Existing Plant Rehabilitation - MBR	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	n/a	n/a	Recirculation Pump Station Electrical Improvements	n/a											
n/a	n/a	n/a	Fixed Growth Reactor (FGR) Upgrades - MBR	n/a											
n/a	n/a	n/a	Air Flotation Tank (AFT) Upgrades - MBR	n/a											
2.2M	2	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 1 *	MBR	$ 65,750,000	$ 39,450,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.3M	5	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 2	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.4	2	No - Timing	Primary Effluent Diurnal Equalization and Emergency Storage	MBR	$ 38,150,000	$ 21,800,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.5	2	No - Timing	Active Retirement of Ponds	MBR	$ -	$ -	$ -	$ 870,000	$ 3,915,000	$ 3,915,000	$ -	$ -	$ -	$ -	$ -
2.7	5	Yes	Chemical Dosing (P-Removal)	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3			**TERTIARY TREATMENT**												
n/a	2	n/a	Dual Media Filter (DMF) Rehabilitation - MBR	MBR											
3.3	5	Yes	Denitrification Filters	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	n/a	Yes	Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	1	n/a	Chlorine Contact Tank (CCT) Rehabilitation	General											
n/a	2	n/a	Effluent Monitoring Stations	General											
3.4	4	Yes	Chloramine Disinfection	General	$ -	$ -	$ 1,230,000	$ 2,870,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.5	5	Yes	UV Disinfection	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.6	5	Yes	Ozone Disinfection	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.8	3	No - Scope/Timing	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse *	MBR	$ 3,372,000	$ 5,058,000	$ 33,720,000	$ 42,150,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4			**SOLIDS FACILITIES**												
n/a	n/a	Yes	Digester No. 1 and 2 Upgrades	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.1	2	Yes	Digester Supernatant PS and Drainage Piping Upgrades	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.2	2	No - Timing	Thickening and Dewatering Facility - Stage 1	General	$ 22,455,000	$ 22,455,000									
4.3	4	Yes	Thickening and Dewatering Facility - Stage 2	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
n/a	n/a	n/a	Digester Sludge Storage Tank	n/a											
n/a	n/a	n/a	Digester Sludge Feed System	n/a											
4.4	4	No - Timing	Digester No. 5	MBR	$ -	$ -	$ 420,000	$ 630,000	$ 4,200,000	$ 5,250,000	$ -	$ -	$ -	$ -	$ -
4.5	4	No - Scope	FOG/Food Waste Facility	MBR	$ -	$ 210,000	$ 945,000	$ 945,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.6	5	Yes	Phosphorus Recovery Facility	General	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,270,000	$ 7,630,000	$ -	$ -	$ -
4.7	4	Yes	Biosolids Post-Processing	General	$ -	$ -	$ -	$ -	$ -	$ 1,288,000	$ 1,932,000	$ 12,880,000	$ 16,100,000	$ -	$ -
5			**COMBINED HEAT AND POWER**												
n/a	n/a	Yes	Cogeneration Gas Treatment	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5.1	3	No - Timing	Cogeneration Upgrade	MBR	$ 848,000	$ 1,272,000	$ 8,480,000	$ 10,600,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
6			**ELECTRICAL**												
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 1 - Primary Treatment Facility	n/a											
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 2 - Secondary Treatment	n/a											
7			**PROCESS CONTROL AND AUTOMATION (SCADA)**												
n/a	n/a	n/a	SCADA System Improvements - Stage 1 - Headworks and Primary Treatment	n/a											
n/a	n/a	n/a	SCADA System Improvements - Stage 2 - Secondary Treatment	n/a											
8			**SUPPORT FACILITIES**												
n/a	n/a	n/a	Tidal Flood Protection - Stage 1	n/a											
n/a	n/a	n/a	Tidal Flood Protection - Stage 2	n/a											
n/a	n/a	Yes	Borregas Avenue Parking Lot	Not Included											
8.1	1	No - Timing	New Access to Bay Trails	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8.2	1	Yes	Household Hazardous Waste Demolition/ Solid Waste Removal	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8.3	2	No - Timing	Administration and Lab Building	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8.4	2	No - Timing	Maintenance Building	General											
9			**SUPPORT UTILITIES**												
n/a	n/a	n/a	Site Security Improvements - Stage 1	n/a											
n/a	n/a	n/a	Site Security Improvements - Stage 2	n/a											
9.1	2	Yes	Recycle Water Improvements (New Recycled Water PS)	General	$ -	$ -	$ -	$ 1,260,000	$ 2,940,000	$ -	$ -	$ -	$ -	$ -	$ -
9.2	2	Yes	Community Improvements	General	$ -	$ -	$ -	$ 210,000	$ 490,000	$ -	$ -	$ -	$ -	$ -	$ -
9.3	2	Yes	Landfill Gas Flare and Booster System Upgrades	General	$ -	$ -	$ -	$ 120,000	$ 280,000	$ -	$ -	$ -	$ -	$ -	$ -
9.4	2	Yes	Miscellaneous Civil Site/Support Utility Improvements	General	$ -	$ -	$ -	$ 210,000	$ 490,000	$ -	$ -	$ -	$ -	$ -	$ -

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	FY 22/23 6/22 - 7/23 2022 2022	FY 23/24 6/23 - 7/24 2023 2023	FY 24/25 6/24 - 7/25 2024 2024	FY 25/26 6/25 - 7/26 2025 2025	FY 26/27 6/26 - 7/27 2026 2026	FY 27/28 6/27 - 7/28 2027 2027	FY 28/29 6/28 - 7/29 2028 2028	FY 29/30 6/29 - 7/30 2029 2029	FY 30/31 6/30 - 7/31 2030 2030	FY 31/32 6/31 - 7/32 2031 2031	FY 32/33 6/32 - 7/33 2032 2032
10			**DEMOLITION**												
n/a	n/a	n/a	Demolition of Primary Sedimentation Tanks	n/a											
n/a	n/a	n/a	Demolition of Primary Control Building	n/a											
n/a	n/a	n/a	Demolition of Auxiliary Pump Station	n/a											
n/a	n/a	n/a	Demolition Chlorine Building	n/a											
n/a	n/a	n/a	Demolition Chemical Storage Area	n/a											
n/a	n/a	n/a	Demolition Dechlorination Building	n/a											
n/a	n/a	n/a	Demolition of Administration Building	n/a											
n/a	n/a	n/a	Demolition of Laboratory Building	n/a											
n/a	n/a	n/a	Demolition DAFT	n/a											
n/a	n/a	n/a	Demolition Float Pump Station	n/a											
n/a	n/a	No	Demolition Fixed Growth Reactor (FGR) Pump Station	n/a											
n/a	n/a	No	Demolition Fixed Growth Reactors (FGRs)	n/a											
n/a	n/a	No	Demolition Dual Media Filters (DMFs)	n/a											
11			**OPERATIONS AND MAINTENANCE**												
11.1	n/a	n/a	Capital Replacement (1% of All New Construction)	MBR	$ 330,000	$ 340,000	$ 350,000	$ 350,000	$ 360,000	$ 370,000	$ 380,000	$ 380,000	$ 390,000	$ 400,000	$ 410,000
			ANNUAL TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			CUMULATIVE TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000
			ANNUAL TOTAL - GENERAL IMPROVEMENTS	General	$ 22,455,000	$ 22,455,000	$ 1,230,000	$ 4,670,000	$ 4,200,000	$ 1,288,000	$ 5,202,000	$ 20,510,000	$ 16,100,000	$ -	$ -
			CUMULATIVE TOTAL - GENERAL IMPROVEMENTS	General	$ 200,845,000	$ 223,300,000	$ 224,530,000	$ 229,200,000	$ 233,400,000	$ 234,688,000	$ 239,890,000	$ 260,400,000	$ 276,500,000	$ 276,500,000	$ 276,500,000
			ANNUAL TOTAL - MBR IMPROVEMENTS	MBR	$ 108,450,000	$ 68,130,000	$ 43,915,000	$ 55,545,000	$ 8,475,000	$ 9,535,000	$ 380,000	$ 380,000	$ 390,000	$ 400,000	$ 410,000
			CUMULATIVE TOTAL - MBR IMPROVEMENTS	MBR	$ 338,460,000	$ 406,590,000	$ 450,505,000	$ 506,050,000	$ 514,525,000	$ 524,060,000	$ 524,440,000	$ 524,820,000	$ 525,210,000	$ 525,610,000	$ 526,020,000
			ANNUAL TOTAL - MBR IMPLEMENTATION		$ 130,905,000	$ 90,585,000	$ 45,145,000	$ 60,215,000	$ 12,675,000	$ 10,823,000	$ 5,582,000	$ 20,890,000	$ 16,490,000	$ 400,000	$ 410,000
			CUMULATIVE TOTAL - MBR IMPLEMENTATION		$ 539,305,000	$ 629,890,000	$ 675,035,000	$ 735,250,000	$ 747,925,000	$ 758,748,000	$ 764,330,000	$ 785,220,000	$ 801,710,000	$ 802,110,000	$ 802,520,000

Notes:
* Includes project with the City of Sunnyvale and Santa Clara Valley Water District. To be jointly funded.

Legend
Value to input
Value same as Split Flow (set equal to a Split Flow input value)
Value calculated
Project element included in another CIP project
Project already funded and underway (not included in total CIP cashflow)

Annual Rate of Escalation	
ENR Construction Cost Index for Unescalated Costs (San Francisco, June 2015)	11,155
Primary Treatment Facility	2.0%
* See Primary Treatment Facility cost details (HW-PST Detail)	*

Program Factor*	Factor
All CIP Projects unless noted otherwise	42.0%
Primary Treatment Facility	19.6%
Base Elements (Headworks, Primary Sedimentationk Tanks, etc.)	19.5%
Additional Elements Package 2	42.0%
Additional Elements Package 3	19.5%
Secondary Treatment Improvements Stage 1 - All Elements	26.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Secondary Treatment Improvements Stage 2 - All Elements	25.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse	25.0%

* See Basis of Program Factor for Additional Information

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	FY 33/34 6/33 - 7/34 2033 2033	FY 34/35 6/34 - 7/35 2034 2034	FY 35/36 6/35 - 7/36 2035 2035	FY 36/37 6/36 - 7/37 2036 2036	FY 37/38 6/37 - 7/38 2037 2037	FY 38/39 6/38 - 7/39 2038 2038	FY 39/40 6/39 - 7/40 2039 2039	FY 40/41 6/40 - 7/41 2040 2040	FY 41/42 6/41 - 7/42 2041 2041	FY 42/43 6/42 - 7/43 2042 2042	FY 43/44 6/43 - 7/44 2043 2043	FY 44/45 6/44 - 7/45 2044 2044	Total
1			**PRIMARY TREATMENT**														
1.1	1	Yes	Primary Treatment Facility	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	133,100,000
1.2	1	Yes	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2,800,000
1.3	1	Yes	Rehabilitation Influent Pipelines to WPCP	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1,500,000
2			**SECONDARY TREATMENT**														
2.1M	1	No - Scope	Existing Plant Rehabilitation - MBR	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	21,000,000
n/a	n/a	n/a	Recirculation Pump Station Electrical Improvements	n/a													
n/a	n/a	n/a	Fixed Growth Reactor (FGR) Upgrades - MBR	n/a													
n/a	n/a	n/a	Air Flotation Tank (AFT) Upgrades - MBR	n/a													
2.2M	2	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 1 *	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	263,000,000
2.3M	5	No - Scope/Timing	Secondary Treatment Improvements - MBR Stage 2	MBR	$ 6,000,000	$ 14,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	20,000,000
2.4	2	No - Timing	Primary Effluent Diurnal Equalization and Emergency Storage	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	109,000,000
2.5	2	No - Timing	Active Retirement of Ponds	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	8,700,000
2.7	5	Yes	Chemical Dosing (P-Removal)	MBR	$ -	$ 660,000	$ 1,540,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2,200,000
3			**TERTIARY TREATMENT**														
n/a	2	n/a	Dual Media Filter (DMF) Rehabilitation - MBR	MBR													
3.3	5	Yes	Denitrification Filters	General	$ -	$ -	$ 2,544,000	$ 3,816,000	$ 25,440,000	$ 31,800,000	$ -	$ -	$ -	$ -	$ -	$ -	63,600,000
n/a	n/a	Yes	Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	8,400,000
n/a	1	n/a	Chlorine Contact Tank (CCT) Rehabilitation	General													
n/a	2	n/a	Effluent Monitoring Stations	General													
3.4	4	Yes	Chloramine Disinfection	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	4,100,000
3.5	5	Yes	UV Disinfection	General	$ 832,000	$ 1,248,000	$ 8,320,000	$ 10,400,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	20,800,000
3.6	5	Yes	Ozone Disinfection	General	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,580,000	$ 20,610,000	$ 20,610,000	$ -	$ -	$ -	45,800,000
3.8	3	No - Scope/Timing	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse *	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	84,300,000
4			**SOLIDS FACILITIES**														
n/a	n/a	Yes	Digester No. 1 and 2 Upgrades	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	8,000,000
4.1	2	Yes	Digester Supernatant PS and Drainage Piping Upgrades	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1,200,000
4.2	2	No - Timing	Thickening and Dewatering Facility - Stage 1	General												$	49,900,000
4.3	4	Yes	Thickening and Dewatering Facility - Stage 2	General	$ 4,290,000	$ 10,010,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	14,300,000
n/a	n/a	n/a	Digester Sludge Storage Tank	n/a													
n/a	n/a	n/a	Digester Sludge Feed System	n/a													
4.4	4	No - Timing	Digester No. 5	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	10,500,000
4.5	4	No - Scope	FOG/Food Waste Facility	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2,100,000
4.6	5	Yes	Phosphorus Recovery Facility	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	10,900,000
4.7	4	Yes	Biosolids Post-Processing	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	32,200,000
5			**COMBINED HEAT AND POWER**														
n/a	n/a	Yes	Cogeneration Gas Treatment	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2,900,000
5.1	3	No - Timing	Cogeneration Upgrade	MBR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	21,200,000
6			**ELECTRICAL**														
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 1 - Primary Treatment Facility	n/a													
n/a	n/a	n/a	12 kV Electrical Distribution System - Stage 2 - Secondary Treatment	n/a													
7			**PROCESS CONTROL AND AUTOMATION (SCADA)**														
n/a	n/a	n/a	SCADA System Improvements - Stage 1 - Headworks and Primary Treatment	n/a													
n/a	n/a	n/a	SCADA System Improvements - Stage 2 - Secondary Treatment	n/a													
8			**SUPPORT FACILITIES**														
n/a	n/a	n/a	Tidal Flood Protection - Stage 1	n/a													
n/a	n/a	n/a	Tidal Flood Protection - Stage 2	n/a													
n/a	n/a	Yes	Borregas Avenue Parking Lot	Not Included													
8.1	1	No - Timing	New Access to Bay Trails	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	600,000
8.2	1	Yes	Household Hazardous Waste Demolition/ Solid Waste Removal	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	500,000
8.3	2	No - Timing	Administration and Lab Building	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	26,300,000
8.4	2	No - Timing	Maintenance Building	General												$	7,400,000
9			**SUPPORT UTILITIES**														
n/a	n/a	n/a	Site Security Improvements - Stage 1	n/a													
n/a	n/a	n/a	Site Security Improvements - Stage 2	n/a													
9.1	2	Yes	Recycle Water Improvements (New Recycled Water PS)	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	4,200,000
9.2	2	Yes	Community Improvements	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	700,000
9.3	2	Yes	Landfill Gas Flare and Booster System Upgrades	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	400,000
9.4	2	Yes	Miscellaneous Civil Site/Support Utility Improvements	General	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	700,000

Master Plan CIP Summary - Membrane Bioreactor (MBR)
WPCP Master Plan
City of Sunnyvale

Project ID	Phase	Same as CAS	Project Title (Descriptive)	Category General MBR Not Included	FY 33/34 6/33 - 7/34 2033 2033	FY 34/35 6/34 - 7/35 2034 2034	FY 35/36 6/35 - 7/36 2035 2035	FY 36/37 6/36 - 7/37 2036 2036	FY 37/38 6/37 - 7/38 2037 2037	FY 38/39 6/38 - 7/39 2038 2038	FY 39/40 6/39 - 7/40 2039 2039	FY 40/41 6/40 - 7/41 2040 2040	FY 41/42 6/41 - 7/42 2041 2041	FY 42/43 6/42 - 7/43 2042 2042	FY 43/44 6/43 - 7/44 2043 2043	FY 44/45 6/44 - 7/45 2044 2044	Total
10			**DEMOLITION**														
n/a	n/a	n/a	Demolition of Primary Sedimentation Tanks	n/a													
n/a	n/a	n/a	Demolition of Primary Control Building	n/a													
n/a	n/a	n/a	Demolition of Auxiliary Pump Station	n/a													
n/a	n/a	n/a	Demolition Chlorine Building	n/a													
n/a	n/a	n/a	Demolition Chemical Storage Area	n/a													
n/a	n/a	n/a	Demolition Dechlorination Building	n/a													
n/a	n/a	n/a	Demolition of Administration Building	n/a													
n/a	n/a	n/a	Demolition of Laboratory Building	n/a													
n/a	n/a	n/a	Demolition DAFT	n/a													
n/a	n/a	n/a	Demolition Float Pump Station	n/a													
n/a	n/a	No	Demolition Fixed Growth Reactor (FGR) Pump Station	n/a													
n/a	n/a	No	Demolition Fixed Growth Reactors (FGRs)	n/a													
n/a	n/a	No	Demolition Dual Media Filters (DMFs)	n/a													
11			**OPERATIONS AND MAINTENANCE**														
11.1	n/a	n/a	Capital Replacement (1% of All New Construction)	MBR	$ 410,000	$ 420,000	$ 430,000	$ 440,000	$ 450,000	$ 460,000	$ 470,000	$ 480,000	$ 490,000	$ 490,000	$ 500,000	$ 510,000	$ 11,770,000
			ANNUAL TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 19,300,000
			CUMULATIVE TOTAL - CURRENT IMPROVEMENTS (Not Included)	Not Included	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000	$ 19,300,000
			ANNUAL TOTAL - GENERAL IMPROVEMENTS	General	$ 5,122,000	$ 11,258,000	$ 10,864,000	$ 14,216,000	$ 25,440,000	$ 31,800,000	$ 4,580,000	$ 20,610,000	$ 20,610,000	$ -	$ -	$ -	$ 421,000,000
			CUMULATIVE TOTAL - GENERAL IMPROVEMENTS	General	$ 281,622,000	$ 292,880,000	$ 303,744,000	$ 317,960,000	$ 343,400,000	$ 375,200,000	$ 379,780,000	$ 400,390,000	$ 421,000,000	$ 421,000,000	$ 421,000,000	$ 421,000,000	$ 421,000,000
			ANNUAL TOTAL - MBR IMPROVEMENTS	MBR	$ 6,410,000	$ 15,080,000	$ 1,970,000	$ 440,000	$ 450,000	$ 460,000	$ 470,000	$ 480,000	$ 490,000	$ 490,000	$ 500,000	$ 510,000	$ 553,770,000
			CUMULATIVE TOTAL - MBR IMPROVEMENTS	MBR	$ 532,430,000	$ 547,510,000	$ 549,480,000	$ 549,920,000	$ 550,370,000	$ 550,830,000	$ 551,300,000	$ 551,780,000	$ 552,270,000	$ 552,760,000	$ 553,260,000	$ 553,770,000	$ 553,770,000
			ANNUAL TOTAL - MBR IMPLEMENTATION		$ 11,532,000	$ 26,338,000	$ 12,834,000	$ 14,656,000	$ 25,890,000	$ 32,260,000	$ 5,050,000	$ 21,090,000	$ 21,100,000	$ 490,000	$ 500,000	$ 510,000	$ 974,770,000
			CUMULATIVE TOTAL - MBR IMPLEMENTATION		$ 814,052,000	$ 840,390,000	$ 853,224,000	$ 867,880,000	$ 893,770,000	$ 926,030,000	$ 931,080,000	$ 952,170,000	$ 973,270,000	$ 973,760,000	$ 974,260,000	$ 974,770,000	$ 974,770,000

Notes:
* Includes project with the City of Sunnyvale and Santa Clara Valley Water District. To be jointly funded.

Legend
Value to input
Value same as Split Flow (set equal to a Split Flow input value)
Value calculated
Project element included in another CIP project
Project already funded and underway (not included in total CIP cashflow)

Annual Rate of Escalation	
ENR Construction Cost Index for Unescalated Costs (San Francisco, June 2015)	11,155
Primary Treatment Facility	2.0%
* See Primary Treatment Facility cost details (HW-PST Detail)	*

Program Factor*	Factor
All CIP Projects unless noted otherwise	42.0%
Primary Treatment Facility	19.6%
Base Elements (Headworks, Primary Sedimentationk Tanks, etc.)	19.5%
Additional Elements Package 2	42.0%
Additional Elements Package 3	19.5%
Secondary Treatment Improvements Stage 1 - All Elements	26.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Secondary Treatment Improvements Stage 2 - All Elements	25.0%
Base Elements (Aeration Basins, Clarifiers, etc.)	25.0%
Additional Elements (12 kV, Primary Control Building Demolition, etc.)	42.0%
Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse	25.0%

* See Basis of Program Factor for Additional Information

Basis of CIP Program Factor
Master Plan
City of Sunnyvale

Item	Master Plan Program Factor [1]	Primary Treatment Facility Program Factor [2]	Secondary Treatment Improvements Stage 1 and 2 Program Cost Factor [3]
Program Cost Factor Applied to Construction Cost			
Engineering design/ESDC fees [4]	15.0%	0.0%	14.0%
Third-party construction management fees	7.0%	7.0%	5.0%
Program management costs	7.0%	0.0%	0.0%
Environmental mitigation	1.5%	1.5%	0.5%
CEQA/permitting	0.5%	0.0%	0.0%
City costs			
City project management costs	1.0%	1.0%	0.5%
City legal and administrative costs and fees	0.0%	0.0%	0.0%
Construction change order allowance (design contingency)	10.0%	10.0%	5.0%
Total Program Cost Factor	**42.0%**	**19.5%**	**25.0%**

Notes:
(1) Program factor applied to all Master Plan CIP projected unless noted otherwise.
(2) Program factor applied to Primary Treatment Facility project because a portion of the project (planning and design) was completed prior to the finalization of the Master Plan.
(3) Program factor applied to Secondary Treatment Improvements - Stage 1 and 2. Developed as part of a joint effort between the City and Santa Clara Valley Water District on the Draft Santa Clara Valley Water District IPR Treatment Options Study Basis of Design Report (July 2014).
(4) Varies accordingly:
Master Plan Program Factor based on 12% design and 3% ESDC.
Primary Treatment Program Factor based on 0% design and 0% ESDC because planning and design already underway prior to finalization of the Master Plan.
Secondary Treatment Improvements Factor based on 11% design and 3% ESDC.

Standard S Curve Distribution of Project Costs

Project Duration (Years)	Percentage of project cost spent in year																				Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2	30%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
3	10%	45%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
4	4%	6%	40%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
5	4%	6%	35%	35%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
6	1%	4%	5%	35%	35%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7	1%	2%	7%	20%	30%	25%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
8	1%	2%	7%	10%	15%	25%	25%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
9	1%	2%	5%	7%	10%	15%	25%	20%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
10	1%	1%	2%	5%	7%	12%	15%	22%	20%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
11	1%	1%	2%	5%	5%	7%	12%	15%	22%	15%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
12	1%	1%	2%	2%	5%	5%	7%	12%	15%	20%	15%	15%	0%	0%	0%	0%	0%	0%	0%	0%	100%
13	1%	1%	2%	2%	3%	5%	5%	7%	11%	14%	20%	15%	14%	0%	0%	0%	0%	0%	0%	0%	100%
14	1%	1%	2%	2%	2%	3%	5%	5%	7%	11%	14%	19%	14%	14%	0%	0%	0%	0%	0%	0%	100%
15	1%	1%	2%	2%	2%	2%	3%	5%	5%	7%	11%	14%	18%	14%	13%	0%	0%	0%	0%	0%	100%

Escalation and S-Curve Detail for Primary Treatment Facility Project

Fiscal Year Cashflow for HW/PSTs 9/25/2014
Primary Treatment Facility Project
City of Sunnyvale

	Escalation Rate	Program Factor	Total Construction Cost Unescalated	Total Construction Cost Escalated	Total Program Cost[1][2] Escalated	Cashflow[1][3] 2014	2015	2016	2017	2018	2019	2020
Base Elements												
Design	0.0%	0.0%	$5,400,000	$ 5,400,000	$5,400,000	$2,538,000	$2,862,000	$0	$0	$0	$0	$0
ESDC	0.0%	0.0%	$2,100,000	$ 2,100,000	$2,100,000	$0	$353,271	$421,963	$759,533	$506,355	$58,879	$0
Construction Package 1	5.0%	19.5%	$16,330,000	$ 17,136,000	$20,500,000	$0	$20,500,000	$0	$0	$0	$0	$0
Construction Package 2	8.6%	19.5%	$75,830,000	$ 82,338,000	$98,400,000	$0	$0	$24,600,000	$44,280,000	$29,520,000	$0	$0
Construction Package 3	16.2%	19.5%	$0		$0	$0	$0	$0	$0	$0	$0	$0
Subtotal			**$99,700,000**	**$107,000,000**	**$126,400,000**	**$2,538,000**	**$23,715,271**	**$25,021,963**	**$45,039,533**	**$30,026,355**	**$58,879**	**$0**
Subtotal Project S-Curve						**2%**	**19%**	**20%**	**36%**	**24%**	**0%**	**0%**
Additional Elements												
Additional Elements Package 2	8.6%	42%	$600,000	$651,480	$900,000	$0	$0	225,000	$405,000	$270,000	$0	$0
Additional Elements Package 3	16.2%	19.5%	$4,200,000	$4,879,231	$5,800,000	$0	$0	$0	$0	$0	$5,800,000	$0
Subtotal			**$4,800,000**	**$5,500,000**	**$6,700,000**	**$0**	**$0**	**$225,000**	**$405,000**	**$270,000**	**$5,800,000**	**$0**
Subtotal Project S-Curve						**0%**	**0%**	**3%**	**6%**	**4%**	**87%**	**0%**
Total			**$104,500,000**	**$ 112,500,000**	**$133,100,000**	**$2,538,000**	**$23,715,271**	**$25,246,963**	**$45,444,533**	**$30,296,355**	**$5,858,879**	**$0**
Total Project S-Curve						**2%**	**18%**	**19%**	**34%**	**23%**	**4%**	**0%**

Note:
(1) All costs are escalated.
(2) Cashflow excludes City and Program Management Consultant (PMC) costs.
(3) Cashflow based on Primary Treatment Facility Project schedule updated on 9/8/14 and total project budget as of 9/25/14.

Custom S-Curve for Fiscal Year Cashflow for HW/PSTs 9/25/2014
Primary Treatment Facility Project
City of Sunnyvale

Project Phase	Start Date	End Date	Start Year	End Year	Duration (Years)	Cashflow[1][3] FYB 2014	FYB 2015	FYB 2016	FYB 2017	FYB 2018	FYB 2019	FYB 2020
						2014	2015	2016	2017	2018	2019	2020
Design	7/1/2015	1/29/2016	2015	2016	1	47%	53%	0%	0%	0%	0%	0%
ESDC	9/9/2015	2/3/2020	2015	2020	5		17%	20%	36%	24%	3%	0%
Construction Package 1	9/9/2015	6/9/2016	2015	2016	1		100%	0%	0%	0%	0%	0%
Construction Package 2	8/1/2016	5/2/2019	2016	2019	3		0%	25%	45%	30%	0%	0%
Construction Package 3	5/3/2019	2/3/2020	2019	2020	1		0%	0%	0%	0%	100%	0%
Construction Add Pack 2	8/1/2016	5/2/2019	2016	2019	3	0%	0%	25%	45%	30%	0%	0%
Construction Add Pack 3	8/1/2016	5/2/2019	2016	2019	3	0%	0%	0%	0%	0%	100%	0%

Note:
(1) All costs are escalated.
(2) Cashflow excludes City and Program Management Consultant (PMC) costs.
(3) Cashflow based on Primary Treatment Facility Project schedule updated on 9/8/14 and total project budget as of 9/25/14.

Custom S-Curve Package 2

Project Phase	2014	2015	2016	2017	2018	2019	2020
Package 2		0%	25%	45%	30%	0%	0%

Custom S-Curve - ESDC

Project Phase	Total Capital Cost	FYB 2014	FYB 2015	FYB 2016	FYB 2017	FYB 2018	FYB 2019	FYB 2020
ESDC - Package 1	$ 360,000	$0	$360,000	$0	$0	$0	$0	$0
ESDC - Package 2	$ 1,720,000	$0	$0	$430,000	$774,000	$516,000	$0	$0
ESDC - Package 3	$ 60,000	$0	$0	$0	$0	$0	$60,000	$0
Total ESDC	**$2,140,000**		**$360,000**	**$430,000**	**$774,000**	**$516,000**	**$60,000**	**$0**
Total ESDC			**16.8%**	**20.1%**	**36.2%**	**24.1%**	**2.8%**	**0.0%**

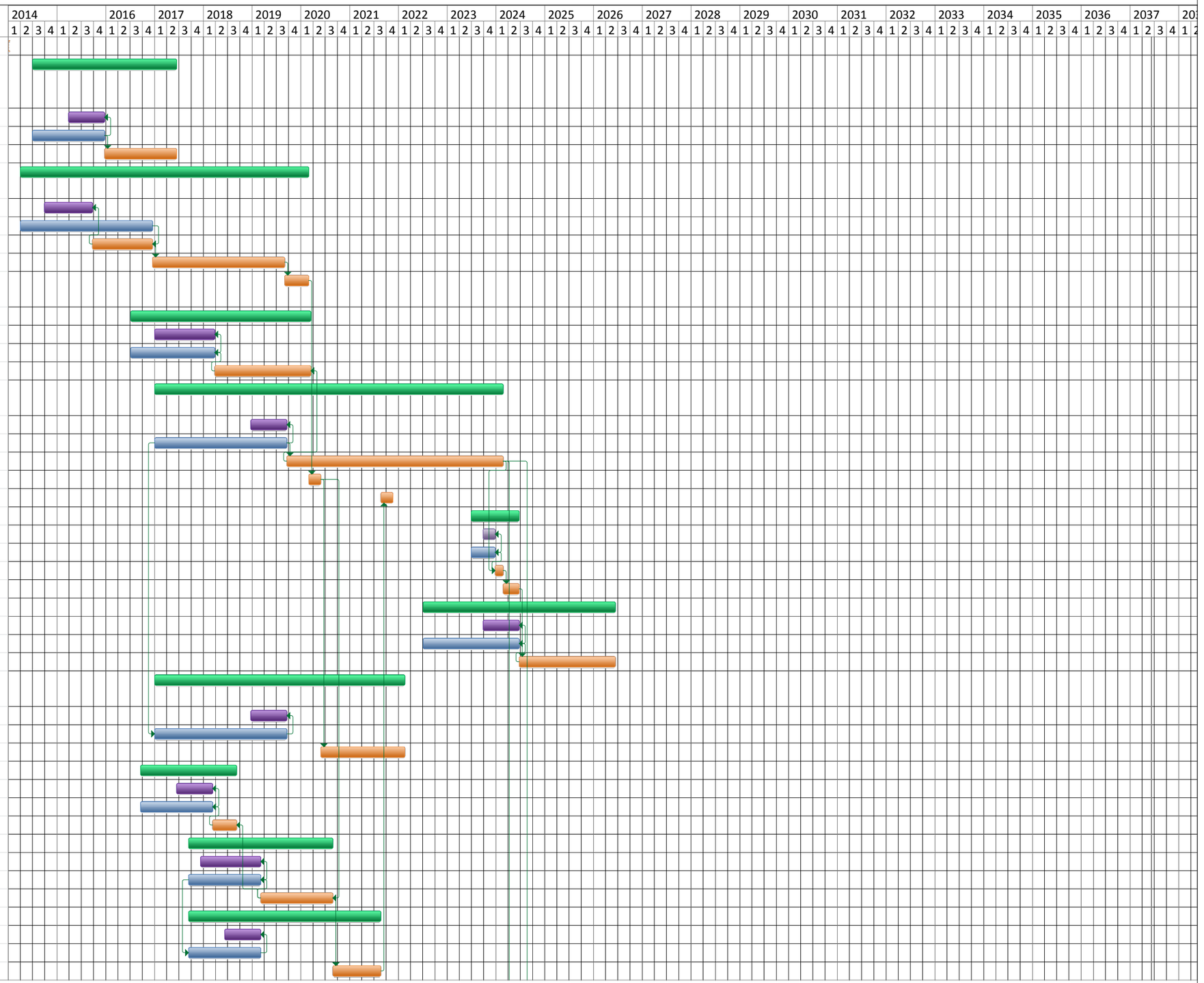
Standard S Curve Distribution of Project Costs

Project Duration (Years)	Percentage of project cost spent in year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2	30%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
3	10%	45%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
4	4%	6%	40%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
5	4%	6%	35%	35%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
6	1%	4%	5%	35%	35%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7	1%	2%	7%	20%	30%	25%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
8	1%	2%	7%	10%	15%	25%	25%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
9	1%	2%	5%	7%	10%	15%	25%	20%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
10	1%	1%	2%	5%	7%	12%	15%	22%	20%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
11	1%	1%	2%	5%	5%	7%	12%	15%	22%	15%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
12	1%	1%	2%	2%	5%	5%	7%	12%	15%	20%	15%	15%	0%	0%	0%	0%	0%	0%	0%	0%	100%
13	1%	1%	2%	2%	3%	5%	5%	7%	11%	14%	20%	15%	14%	0%	0%	0%	0%	0%	0%	0%	100%
14	1%	1%	2%	2%	2%	3%	5%	5%	7%	11%	14%	19%	14%	14%	0%	0%	0%	0%	0%	0%	100%
15	1%	1%	2%	2%	2%	2%	3%	5%	5%	7%	11%	14%	18%	14%	13%	0%	0%	0%	0%	0%	100%

APPENDIX C - CIP SCHEDULE

WPCP Master Plan Implementation Schedule
MBR

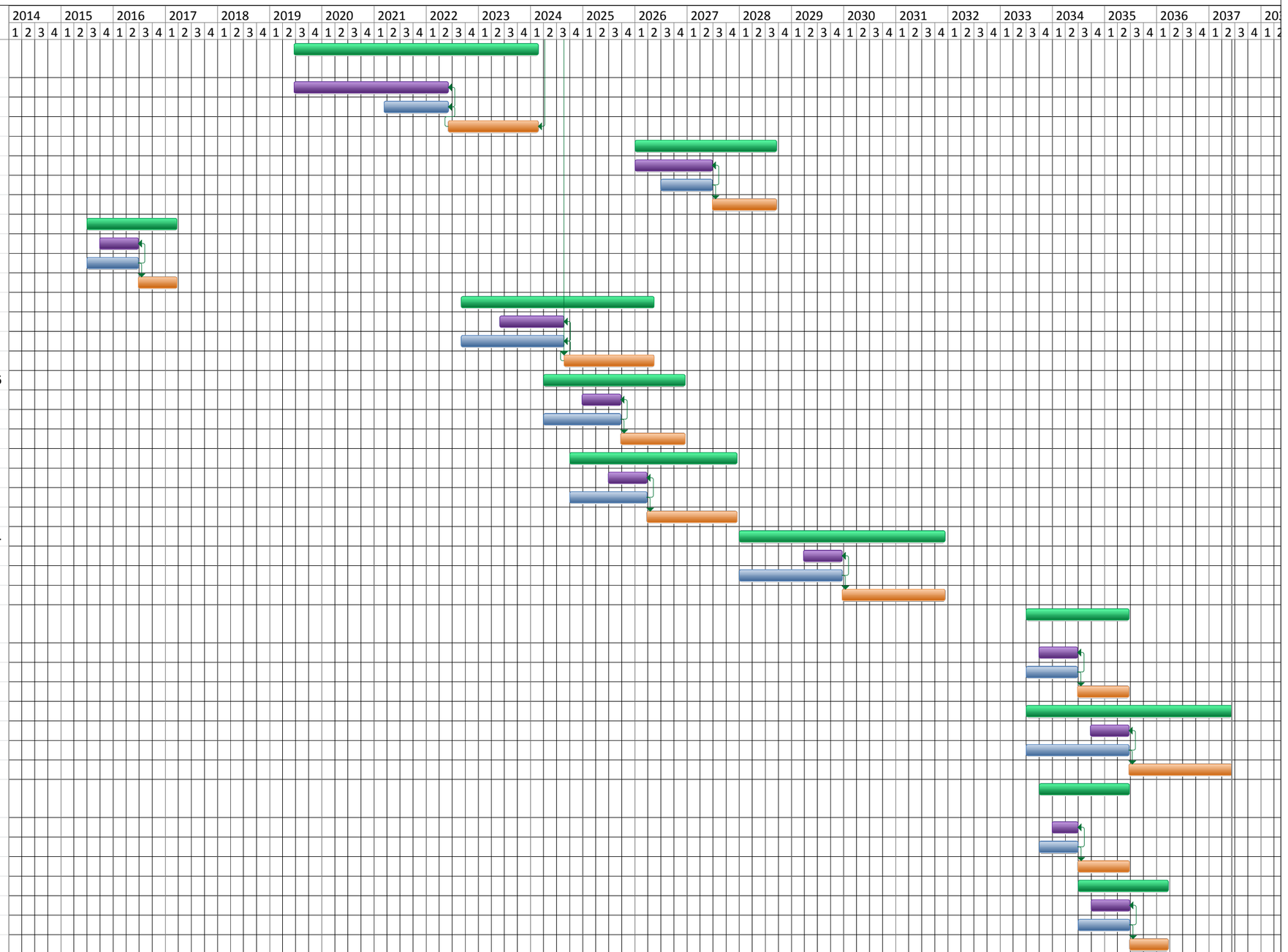
ID	Task Name	Duration	Predecess	Start	Finish
1	CIP Start				
2	**Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion**	**36 mons**		**Tue 7/1/14**	**Wed 6/14/17**
3	Permitting/CEQA	9 mons	4FF	Sat 3/28/15	Tue 12/22/15
4	Design	18 mons		Tue 7/1/14	Tue 12/22/15
5	Construction	18 mons	4	Wed 12/23/15	Wed 6/14/17
6	**Headworks and Primary Treatment Facility**	**72 mons**		**Tue 4/1/14**	**Fri 2/28/20**
7	Permitting/CEQA	12 mons	9SF	Sun 9/28/14	Wed 9/23/15
8	Design	33 mons		Tue 4/1/14	Thu 12/15/16
9	Construction Pkg. 1 - Sitework	15 mons	8FF	Wed 9/23/15	Thu 12/15/16
10	Construction Pkg. 2 - Facilities	33 mons	9	Fri 12/16/16	Sun 9/1/19
11	Construction Pkg. 3 - Demolition PSTs	6 mons	10	Mon 9/2/19	Fri 2/28/20
12	**Existing Plant Rehabilitation**	**45 mons**		**Tue 7/5/16**	**Sun 3/15/20**
13	Permitting/CEQA	15 mons	14FF	Sun 1/1/17	Tue 3/27/18
14	Design	21 mons	15SF	Tue 7/5/16	Tue 3/27/18
15	Construction	24 mons	19SF+6 mo	Tue 3/27/18	Sun 3/15/20
16	**Secondary Treatment Improvements - Stage 1**	**87 mons**		**Sun 1/1/17**	**Fri 2/23/24**
17	Permitting/CEQA	9 mons	18FF	Sat 12/22/18	Tue 9/17/19
18	Design	33 mons		Sun 1/1/17	Tue 9/17/19
19	Construction - All Elements	54 mons	18	Wed 9/18/19	Fri 2/23/24
20	Construction - Utilidor	3 mons	11	Sat 2/29/20	Thu 5/28/20
21	Demolition - PC Building	3 mons	46	Sun 8/22/21	Fri 11/19/21
22	**Demolition - FGRs, AFTs**	**12 mons**		**Thu 6/29/23**	**Sat 6/22/24**
23	Permitting/CEQA	3 mons	24FF	Wed 9/27/23	Tue 12/26/23
24	Design	6 mons	25SF	Thu 6/29/23	Tue 12/26/23
25	Demolition - 2 AFTs	2 mons	19FS-2 mor	Tue 12/26/23	Fri 2/23/24
26	Demolition - 2 AFTs, FGRs	4 mons	25	Sat 2/24/24	Sat 6/22/24
27	**RO/UV Disinfection/AOP for Reuse**	**48 mons**		**Mon 7/4/22**	**Fri 6/12/26**
28	Permitting/CEQA	9 mons	29FF	Wed 9/27/23	Sun 6/23/24
29	Design	24 mons	30SF	Mon 7/4/22	Sun 6/23/24
30	Construction	24 mons	26	Sun 6/23/24	Fri 6/12/26
31	**Thickening and Dewatering Facility - Stage 1**	**62.47 mons**		**Sun 1/1/17**	**Thu 2/17/22**
32	Permitting/CEQA	9 mons	33FF	Sat 12/22/18	Tue 9/17/19
33	Design	33 mons	18SS	Sun 1/1/17	Tue 9/17/19
34	Construction	21 mons	20	Fri 5/29/20	Thu 2/17/22
35	**New Access to Bay Trails**	**24 mons**		**Sat 9/17/16**	**Fri 9/7/18**
36	Permitting/CEQA	9 mons	37FF	Wed 6/14/17	Sun 3/11/18
37	Design	18 mons	38SF	Sat 9/17/16	Sun 3/11/18
38	Construction	6 mons	42SF-6 mor	Sun 3/11/18	Fri 9/7/18
39	**Administration and Lab Building**	**36 mons**		**Tue 9/12/17**	**Wed 8/26/20**
40	Permitting/CEQA	15 mons	41FF	Mon 12/11/17	Wed 3/6/19
41	Design	18 mons	42SF	Tue 9/12/17	Wed 3/6/19
42	Construction	18 mons	20FF+3 mo	Wed 3/6/19	Wed 8/26/20
43	**Maintenance Building**	**48 mons**		**Tue 9/12/17**	**Sat 8/21/21**
44	Permitting/CEQA	9 mons	45FF	Sat 6/9/18	Tue 3/5/19
45	Design	18 mons	41SS	Tue 9/12/17	Tue 3/5/19
46	Construction	12 mons	42	Thu 8/27/20	Sat 8/21/21



Date: Wed 2/24/16 | Overall Project | Permitting/CEQA | Design | Construction

WPCP Master Plan Implementation Schedule
MBR

ID	Task Name	Duration	Predecess	Start	Finish
47	**Primary Effluent Diurnal Equalization and Emergency Storage**	**57 mons**		**Thu 6/20/19**	**Fri 2/23/24**
48	Permitting/CEQA	36 mons	49FF	Thu 6/20/19	Sat 6/4/22
49	Design	15 mons	50SF	Thu 3/11/21	Sat 6/4/22
50	Construction	21 mons	19FF	Sat 6/4/22	Fri 2/23/24
51	**Active Retirement of Ponds**	**33 mons**		**Fri 1/2/26**	**Sun 9/17/28**
52	Permitting/CEQA	18 mons	53FF	Fri 1/2/26	Fri 6/25/27
53	Design	12 mons		Wed 7/1/26	Fri 6/25/27
54	Construction	15 mons	53	Sat 6/26/27	Sun 9/17/28
55	**Cogeneration Gas Treatment**	**21 mons**		**Wed 7/1/15**	**Tue 3/21/17**
56	Permitting/CEQA	9 mons	57FF	Tue 9/29/15	Fri 6/24/16
57	Design	12 mons		Wed 7/1/15	Fri 6/24/16
58	Construction	9 mons	57	Sat 6/25/16	Tue 3/21/17
59	**Cogeneration Upgrade**	**45 mons**		**Fri 9/2/22**	**Wed 5/13/26**
60	Permitting/CEQA	15 mons	61FF	Tue 5/30/23	Thu 8/22/24
61	Design	24 mons	62SF	Fri 9/2/22	Thu 8/22/24
62	Construction	21 mons	19FS+6 mo	Thu 8/22/24	Wed 5/13/26
63	**FOG/Food Waste Facility**	**33 mons**		**Mon 4/1/24**	**Wed 12/16/26**
64	Permitting/CEQA	9 mons	65FF	Fri 12/27/24	Mon 9/22/25
65	Design	18 mons		Mon 4/1/24	Mon 9/22/25
66	Construction	15 mons	65	Tue 9/23/25	Wed 12/16/26
67	**Digester No. 5**	**39 mons**		**Tue 10/1/24**	**Tue 12/14/27**
68	Permitting/CEQA	9 mons	69FF	Sat 6/28/25	Tue 3/24/26
69	Design	18 mons		Tue 10/1/24	Tue 3/24/26
70	Construction	21 mons	69	Wed 3/25/26	Tue 12/14/27
71	**Biosolids Post-Processing**	**48 mons**		**Sat 1/1/28**	**Wed 12/10/31**
72	Permitting/CEQA	9 mons	73FF	Mon 3/26/29	Thu 12/20/29
73	Design	24 mons		Sat 1/1/28	Thu 12/20/29
74	Construction	24 mons	73	Fri 12/21/29	Wed 12/10/31
75	**Secondary Treatment Improvements - Stage 2**	**24 mons**		**Fri 7/1/33**	**Wed 6/20/35**
76	Permitting/CEQA	9 mons	77FF	Thu 9/29/33	Sun 6/25/34
77	Design	12 mons		Fri 7/1/33	Sun 6/25/34
78	Construction	12 mons	77	Mon 6/26/34	Wed 6/20/35
79	**UV Disinfection**	**48 mons**		**Fri 7/1/33**	**Tue 6/9/37**
80	Permitting/CEQA	9 mons	81FF	Sun 9/24/34	Wed 6/20/35
81	Design	24 mons		Fri 7/1/33	Wed 6/20/35
82	Construction	24 mons	81	Thu 6/21/35	Tue 6/9/37
83	**Thickening and Dewatering Facility - Stage 2**	**21 mons**		**Sat 10/1/33**	**Fri 6/22/35**
84	Permitting/CEQA	6 mons	85FF	Fri 12/30/33	Tue 6/27/34
85	Design	9 mons		Sat 10/1/33	Tue 6/27/34
86	Construction	12 mons	85	Wed 6/28/34	Fri 6/22/35
87	**Chemical Dosing (P-Removal)**	**21 mons**		**Sat 7/1/34**	**Fri 3/21/36**
88	Permitting/CEQA	9 mons	89FF	Fri 9/29/34	Mon 6/25/35
89	Design	12 mons		Sat 7/1/34	Mon 6/25/35
90	Construction	9 mons	89	Tue 6/26/35	Fri 3/21/36



Date: Wed 2/24/16 | Overall Project | Permitting/CEQA | Design | Construction

APPENDIX D - CIP PROJECT DESCRIPTIONS AND FIGURES

CIP PROJECT DESCRIPTIONS AND SITE LAYOUT

This section includes a description of each of the CIP projects. It also includes site layout drawings depicting the approximate location of each CIP project.

The CIP projects are organized and numbered by the following process/functional areas:

1. Primary Treatment
2. Secondary Treatment
3. Tertiary Treatment
4. Solids Facilities
5. Combined Heat and Power
6. Electrical
7. Process Control and Automation (SCADA)
8. Support Facilities
9. Support Utilities
10. Demolition
11. Operations and Maintenance

1.0 CIP Project Descriptions

Each project description summarizes the following information about the project:

- Project ID number
- Project name
- Process area primarily impacted by project
- Project driver
- Implementation scenario (whether the project is part of the general CIP implementation or is specific to Split Flow conventional activated sludge [CAS], Full CAS, or MBR CIP implementation scenarios)
- Project justification
- Project description (description of project elements)

- Project implementation considerations (e.g., major stages of the project, linkages to other projects)
- Permits required (not all inclusive, i.e., grading permits, building permits, stormwater permits, etc. are not identified)

2.0 CIP Site Layouts

The CIP project site layouts are shown on Figures D.1 - D.4.

- Figure D.1 shows the site layout of most of the CIP projects.
- Figure D.2 shows the site layout of CIP projects located in the existing oxidation pond area.
- Figure D.3 shows the site layout of the 12 kV Electrical Distribution System and SCADA System Improvement projects.
- Figure D.4 shows the site layout of projects located at the WPCP perimeter (i.e., Tidal Flood Protection and Site Security Improvements) and projects outside the WPCP perimeter (e.g., the New Access to Bay Trails project).

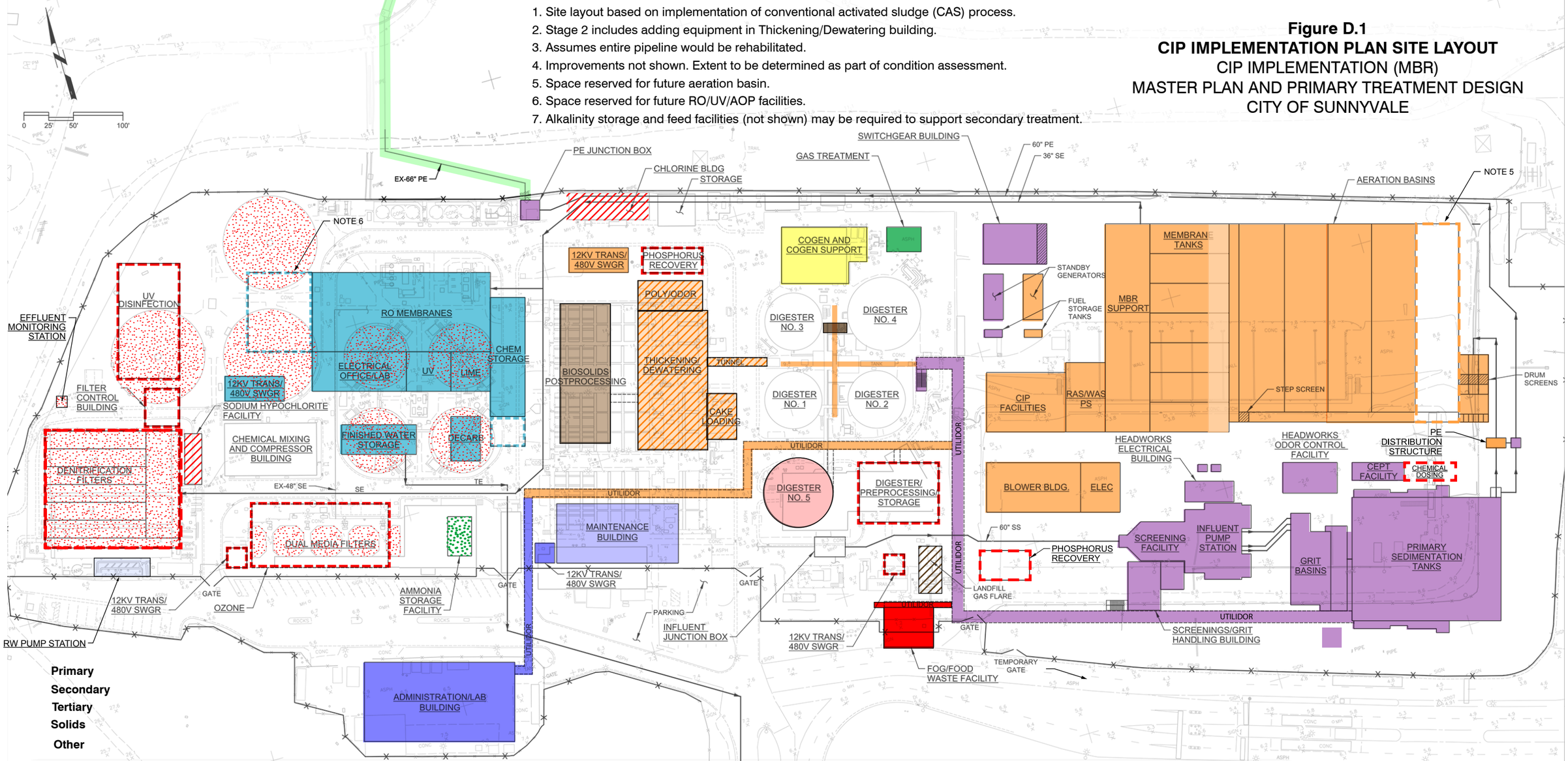
Some CIP projects are not depicted on the site layouts. These projects include:

- Borregas Avenue Parking Lot (project is located along Borregas Avenue, is already underway, and does not impact other CIP projects)
- Household Hazardous Waste Demolition/Solid Waste Removal (facility is to be relocated off the WPCP site; demolition not shown on site layouts for clarity)
- Community Improvements (improvements to occur throughout plant site)
- Miscellaneous Civil Site/Support Utility Improvements (improvements occur throughout the central plant site)
- Demolition projects not shown for clarity

NOTES:

1. Site layout based on implementation of conventional activated sludge (CAS) process.
2. Stage 2 includes adding equipment in Thickening/Dewatering building.
3. Assumes entire pipeline would be rehabilitated.
4. Improvements not shown. Extent to be determined as part of condition assessment.
5. Space reserved for future aeration basin.
6. Space reserved for future RO/UV/AOP facilities.
7. Alkalinity storage and feed facilities (not shown) may be required to support secondary treatment.

Figure D.1
CIP IMPLEMENTATION PLAN SITE LAYOUT
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE



Primary
- Primary Treatment Facility
- Rehabilitation PE Pipeline (Note 3)
- Rehabilitation Influent Pipelines (Note 4)

Secondary
- Existing Plant Rehabilitation
- Secondary Treatment Improv. – Stage 1
- Secondary Treatment Improv. – Stage 2

Tertiary
- Sim. RW/Sodium Hypo. Conversion
- Chloramine Disinfection
- Reverse Osmosis (RO)/ UV Disinfection/ Advanced Oxidation Process (AOP)

Solids
- Digester Supernatant/Drainage Upgrades
- Thickening/Dewatering Facility – Stage 1 and Stage 2 (Note 2)
- Digester No. 5
- FOG/Food Waste Facility
- Biosolids Post-Processing Facility
- Landfill Gas Flare Upgrades

Other
- Cogeneration Gas Treatment
- Cogeneration Upgrade
- Administration/Lab Building
- Maintenance Building
- Recycled Water Improv.

Future Facilities:
- Chemical Dosing (Phosphorus)
- Denitrification Filters
- UV Disinfection
- Ozone Disinfection
- Phosphorus Recovery Facility

PIPE ABBREVIATIONS:

CEPT	Chemically Enhanced Primary Treatment
FOG	Fats, Oils, Grease
ML	Mixed Liquor (Effluent from Aeration Basins)
PE	Primary Effluent
RAS	Return Activated Sludge
SE	Secondary Effluent
T/S	Transformer/Switchgear

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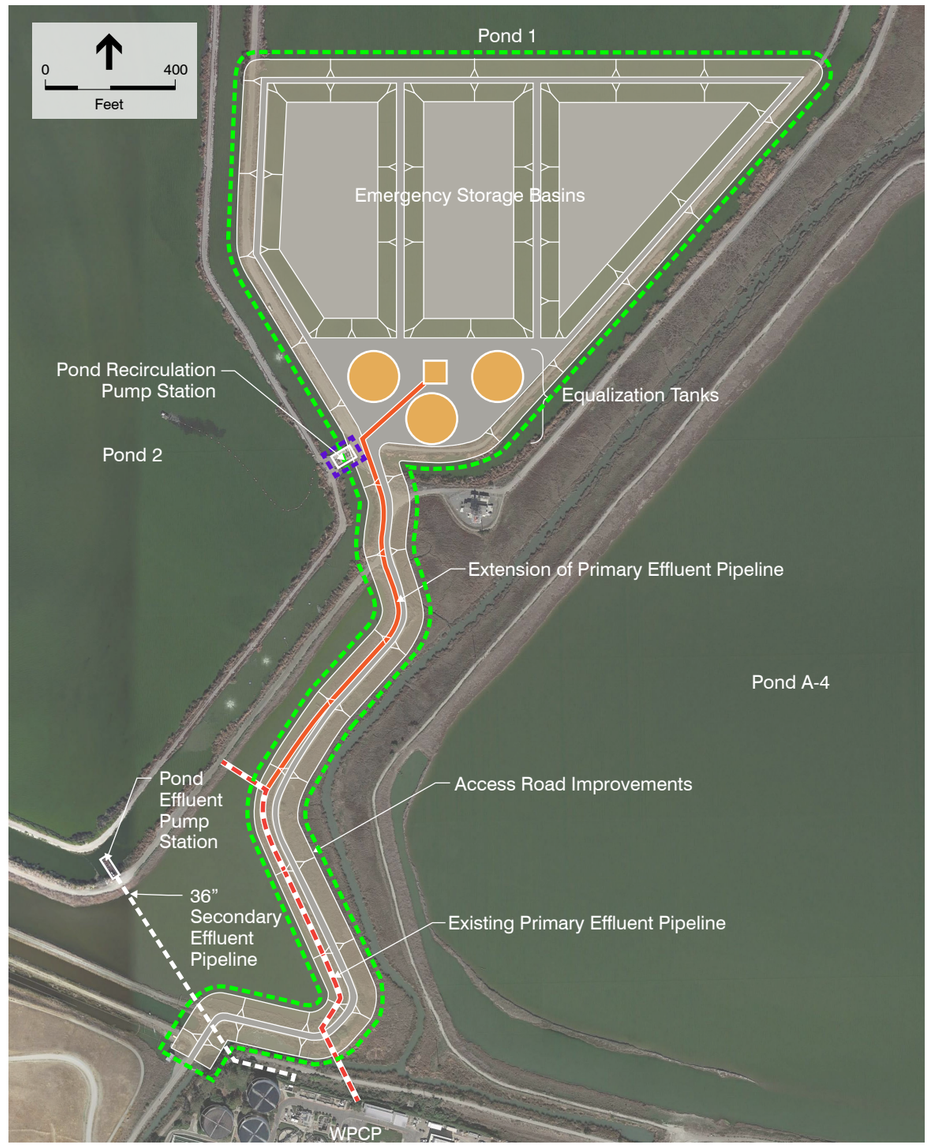
OVERALL SITE LAYOUT



DETAILED SITE LAYOUT

LEGEND
Active Retirement of Ponds (Proposed for Restoration Following Decommissioning)
Rehabilitation PE Pipeline
Existing Plant Rehabilitation
Primary Effluent Diurnal Equalization and Emergency Storage

NOTES:

1. Location and configuration of equalization and emergency storage is tentative and could change.

Figure D.2
CIP POND IMPROVEMENTS SITE LAYOUT
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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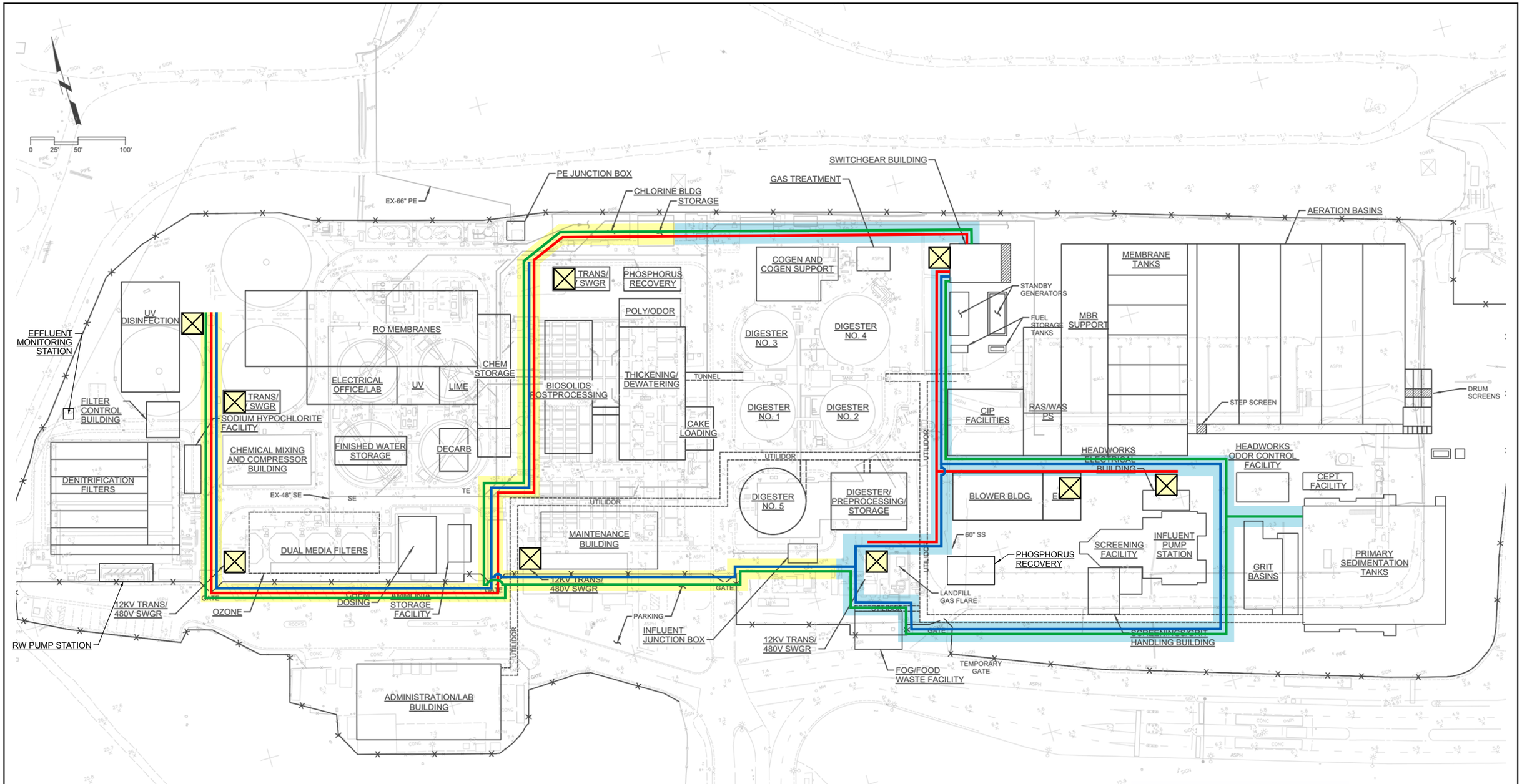

LEGEND

- 12 kV Transformer/480V Switchgear
- 12 kV Radial Loop "A"
- 12 kV Radial Loop "B"
- Fiber Optics Loop

Expansion Stage:

- Stage 1 – Primary Treatment Facility
- Stage 2 – Secondary Treatment Improvements

Figure D.3
ELECTRICAL DISTRIBUTION SYSTEM AND SCADA IMPROVEMENTS SITE LAYOUT
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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Figure D.4
SITE PERIMETER AND OTHER CIP IMPROVEMENTS
CIP IMPLEMENTATION (MBR)
MASTER PLAN AND PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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1.0 - PRIMARY TREATMENT

Project ID Number	1.1
Project Name:	Headworks and Primary Treatment Facility
Process Area:	Primary Treatment
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: A new headworks and primary treatment facility is required to replace the existing headworks and primary treatment facilities, because: (1) The existing primary treatment facilities are structurally deficient, deteriorated, and susceptible to significant failure during a seismic event; (2) the headworks facility includes gas driven influent pumps that will not meet future emissions limits; (3) the headworks facility does not include screening facilities; and (4) the grit removal system does not perform as well as more modern grit removal systems. Implementing screening facilities and a new grit removal system would improve the effectiveness of subsequent treatment processes, as well as reduce long-term maintenance of equipment.

Project Description: This project entails replacing the existing headworks and primary treatment facilities with new facilities. The major project elements include:

- Screening facility
- 39.6 mgd influent pump station (expandable to 58.5 mgd)
- Three multi-tray vortex-type grit basins
- Screenings/grit handling building
- Six primary sedimentation tanks (PSTs)
- Chemically enhanced primary treatment (CEPT) facility
- Odor control facility
- New 60-inch primary effluent pipeline from the new PSTs to a new junction box located at the existing primary effluent pipeline along the north fenceline of the WPCP
- Utilidors
- Standby power and fuel supply
- Exhaust heat recovery system at the existing power generation facility
- Stage 1 site safety and security improvements
- Stage 1 tidal flooding improvements (should be coordinated with site safety and security improvements)

Project Implementation: Currently this project is proposed to be implemented in three construction packages: Package 1 includes site development (grading & preconsolidation along with the replacement of a drainage ditch with a box culvert), Package 2 includes the major structural, mechanical, site civil, electrical and instrumentation facilities and Package 3 includes the decommissioning and demolishing of various existing facilities. Note, Package 3 includes decommissioning of the primary sedimentation tanks (PSTs), which includes removal of mechanical and electrical equipment. The demolition of the PSTs (e.g., removal of the concrete tanks, etc.) is included in the Secondary Treatment Improvements Stage 1 Project.

Permits Required: The following permits will be required:

- Authority to Construct (Bay Area Air Quality Management District)
- Nationwide Permit (Army Corps of Engineers)
- 401 Water Quality Certification (Regional Water Quality Control Board)
- Bay Conservation and Development Commission (BCDC) permit

- California Department of Fish and Wildlife (CDFW) permit.

Special Considerations/Additional Notes: The City will need to initiate a contract for the use of a trailer-mounted dewatering unit prior to demolition of the existing dewatering tiles. This trailer-mounted unit will remain in operation until permanent dewatering facilities are constructed as part of the CAS project.

Project ID Number	1.2
Project Name:	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds
Process Area:	Primary Treatment
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: The primary effluent (PE) pipeline has been in continuous service since the early 1980's and is the main link between the WPCP and the oxidation ponds. A condition assessment in 2007 noted deterioration of the junction structures; however, due to limited access, an inspection of the pipe interior was not possible. A second, more detailed assessment was performed in October 2014 to better determine rehabilitation needs for this pipeline.

Project Description: The major project elements include:

- Rehabilitation (sliplining) of the existing 60" primary effluent pipeline extension from the from Manhole #2 to the oxidation pond recirculation channel
- Miscellaneous repairs of the various manholes/junction structures

Project Implementation: This project could be completed as a standalone project or could be included with the Existing Plant Rehabilitation project or the Headworks and Primary Treatment Facility project.

Permits Required: It is anticipated that following permits would be required:

- Bay Conservation and Development Commission (BCDC)

Special Considerations/Additional Notes: As part of an early study phase for this project, a rehabilitation technique needs to be selected. Based on the selected rehabilitation technique and the location of the access pits associated with that technique, additional resource agency permits may be required.

Project ID Number	1.3
Project Name:	Rehabilitation Influent Pipelines to WPCP
Process Area:	Primary Treatment
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: As part of the Headworks and Primary Treatment Improvements project, raw sewage will be diverted into a new influent junction structure which transitions to a 66-inch pipeline which conveys the influent into the new bar screen facility. The location of the new influent junction structure was selected due to the difficulty in finding a convenient location to intercept the various sewers which feed the WPCP. Certain of these raw sewage plpelines in the immediate vicinity of the WPCP have been in service for over 40 years and their condition is unknown. There is a risk that one or more of these sewers could fail, which would result in raw sewage not being conveyed to the new preliminary treatment facilities.

Project Description: This project would initially involve a condition assessment of the raw sewage pipelines which feed the WPCP. Following this assessment, an evaluation would be made as to how this influent system of pipelines could be consolidated through a program of rehabilitation and/or replacement. Major elements of this project would be defined as part of the detailed evaluation but could include pipeline/manhole rehabilitation (i.e., sliplining) and replacement of pipelines/manholes along with the construction of a diversion structure.

Project Implementation: This project could be implemented as a standalone project or be included as part of the WPCP rehabilitation project.

Permits Required: None

Special Considerations/Additional Notes: A detailed condition assessment would be completed to better define the scope for rehabilitation and/or replacement. This condition assessment could be completed as a standalone effort or be included as the first Stage of the WPCP rehabilitation project.

2.0 - SECONDARY TREATMENT

Project Number:	2.1M
Project Name:	Existing Plant Rehabilitation – MBR or Full CAS
Process Area:	Secondary Treatment
Project Driver:	Condition (R&R)
Implementation Scenario:	MBR or Full CAS

Project Justification: Due to the age of overall facilities at the WPCP, key elements of the existing treatment process need to be rehabilitated or replaced to maintain permit compliance. These include elements of the existing secondary and tertiary treatment process.

Elements of the secondary treatment process (ponds/FGRs/AFTs) need to be rehabilitated to keep them operational until they are fully replaced with conventional activated sludge (CAS) facilities (which are assumed to be operational in 2023±.).

Elements of the tertiary treatment process (chlorine contact tanks) need to be rehabilitated to keep them operational until they are fully replaced with ultraviolet (UV) disinfection facilities (which are assumed to be operational > 2035±).

In addition, because the existing point of compliance is located approximately 10 feet downstream of the bisulfate induction unit, a new compliance point (effluent monitoring station) is being considered. This would provide for better monitoring of the dechlorinated effluent and could result in less bisulfate usage. The City is currently implementing an interim change to the point of compliance (to be implemented as part of the Sodium Hypochlorite Conversion Project).

Project Description: This project entails rehabilitating the existing secondary treatment facilities (ponds/FGRs/AFTs) and tertiary treatment facilities (chlorine contact tanks). The major project elements include:

- Oxidation Pond Facilities
    - Replacement of three existing 4160 kV feeders to the pond recirculation pump station to three separate substations; replacement of three separate substations; replacement of 480 volt electrical distribution from substations.
- Fixed Growth Reactors (FGRs) (assumes upgrades made to all three FGRs)
    - Replacement of top third of media
    - Replacement of protective grid for media
    - Replacement of FGR pumps
- Air Flotation Tanks (AFTs) (assumes upgrades made to all four AFTs)
    - Structural rehabilitation of tank effluent channel, which supports the distributor arm
    - Baffle improvements (increase baffle depth)
- Chlorine Contact Tank Rehabilitation
    - Seismic retrofits to the CCTs (internal separation walls)
    - Coating of concrete structures
    - Repairs to effluent channel downstream of dechlorination point
    - Replacement of effluent flow meter
    - Replacement of all mechanical equipment, including pumps, gates, gate seals, meters, mud valves, and water champ
    - Addition of an effluent monitoring station (the point of compliance may change)
- Stage 2 site safety and security improvements
- Stage 2 tidal flooding improvements (should be coordinated with site safety and security improvements)

Project Implementation: These improvements are assumed to be packaged into one larger WPCP R&R project (as opposed to smaller individual projects). This assumes preparation of a six-month condition assessment report to further define the required improvements.

Permits Required: None

Special Considerations/Additional Notes: A detailed condition assessment evaluation would be completed to better refine the scope for rehabilitation. This condition assessment could be completed as a standalone effort or be included as the first stage of a rehabilitation project.

Project ID Number	2.2M and 2.3M
Project Name:	Secondary Treatment Improvements – MBR Stages 1 and 2
Process Area:	Secondary Treatment
Project Driver:	Policy (Stage 1); Flow and Load (Stage 2)
Implementation Scenario:	MBR

Project Justification: The existing secondary treatment system (ponds/FGRs/ AFTs) cannot meet future, stringent nitrogen standards. Additionally, there is regional demand for high quality reclaimed water. This project would entail full replacement of the existing secondary treatment facilities and tertiary filtration with a process capable of meeting the current and future nitrogen standards along with producing a high quality reclaimed water supply. This reclaimed water supply would be utilized as feedwater for an advanced purification facility (RO/UV/Oxidation).

Project Description: This project entails replacing the existing secondary treatment system and filters with a membrane bioreactor (MBR) and reverse osmosis (RO) facility. The MBR/RO facilities would be implemented in two stages. The Stage 1 facilities would fully replace the existing secondary treatment system. Stage 1 includes demolition of the existing FGRs and AFTs. Stage 2 facilities would be driven by flow and load considerations.

The major project elements, by project Stage, include:

- Stage 1
    - Three fine screens – primary effluent
    - Four aeration basins
    - Blower building and aeration blowers
    - Step screens - mixed liquor (optional)
    - Seven membrane tanks and associated equipment (permeate pumps)
    - Clean-in-place (CIP) facilities
    - Return activated sludge (RAS)/ waste activated sludge (WAS) pump station
    - Primary effluent distribution structure
    - Demolition of existing primary sedimentation tanks
    - Demolition of existing primary control building

- Stage 2
    - Aeration blowers
    - Membrane racks/associated support equipment

Project Implementation: This project would be implemented in two Stages as described above. Due to site constructability limitations, Stage 1 would be implemented following construction of the Headworks and Primary Treatment Facility Project and would include all tankage. Stage 2 would be implemented based on flow and load drivers and would include the installation of membrane racks and related support equipment.

Permits Required: The following permits will be required:

- Authority to Construct.

This project will be implemented with the Primary Effluent Diurnal Equalization and Emergency Storage project, which will require additional permits. Refer to the project description of that project for more information.

Special Considerations/Additional Notes: Active retirement of the ponds is not included in this project.

Project ID Number	2.4
Project Name:	Primary Effluent Diurnal Equalization and Emergency Storage
Process Area:	Secondary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: These facilities would be required when the new secondary treatment facilities are fully implemented and the oxidation ponds are decommissioned.

The primary effluent diurnal equalization facilities are required to:

- Minimize the size of the secondary treatment facilities so they fit on the plant site
- Minimize the cost of the secondary treatment facilities
- Allow more steady influent flow to the secondary treatment process, resulting in more reliable process operations

The emergency storage facilities are required to store process flows during emergency process failures such as major power outages or major process upsets, as well as during major plant maintenance.

Project Description: This project entails constructing equalization tanks and emergency storage basins at the current site of Oxidation Pond #1. The major project elements of include:

- Primary Effluent Diurnal Equalization (EQ) Facilities
    - Removal of sludge/sediment along southern section of Pond #1
    - Access road improvements (raise road above projected sea level rise elevation) from the central plant site to the EQ tanks
    - Earthwork to raise berms and site area to accommodate sea level rise
    - Plant water supply pipeline for washdown uses
    - Three 2.7± million gallon circular concrete EQ tank (e.g., DYK-type)
    - EQ pump station to return flows from the diurnal EQ and emergency EQ basins to the secondary treatment process
    - Extension of primary effluent pipeline from existing primary effluent pipeline (that discharges to the recirculation channel) to the EQ tanks.
- Primary Effluent Emergency Storage
    - Removal of sludge/sediment along southern section of Pond #1
    - 60-MG± (3-days of storage at 2035 average annual flows) earthen storage basin (partitioned into three cells) with basin washdown capabilities (for periodic cleaning)
    - Piping connections to the EQ pump station

The scope (and associated cost) of these facilities may change in the future, if the City decides to locate the diurnal EQ tanks and emergency storage in a different location. Potential alternative locations include the Pond A4 or the Cargill Channel.

Project Implementation: This project would be implemented when the existing secondary treatment system (ponds/FGRs/AFTs) are decommissioned and fully replaced with new secondary treatment facilities (e.g., aeration basins and secondary clarifiers under CAS implementation, or aeration basins and MBRs under MBR implementation). Because of the unknowns associated with the alternatives associated with protection against sea level rise, construction of the access road improvements could be delayed until those protection alternatives are better defined.

Permits Required: Permits required for the construction of the access road and EQ basins are as follows (expected to take up to two years± to obtain):

- Army Corps individual permit
- RWQCB Section 401
- California Dept. of Fish & Wildlife (CDFW) Section 1600
- BCDC
- US Fish & Wildlife Services (USFWS)
- National Marine Fisheries Service (NMFS)

Special Considerations/Additional Notes: If implemented properly, there could be long-term ecological protection and habitat enhancement opportunities if this project were implemented at the alternative sites (Cargill or Pond A4). Extensive pre-work would be required (alternative analysis) to present the overall environmental benefit of the Cargill and Pond A4 options for siting of these facilities. The permitting effort would take approximately 2 years and would include close coordination between the various permitting agencies (with the Army Corps acting as the lead agency). Further background on this can be found in the June 2014 Biological Resources Constraints and Opportunities Report prepared as part of the Master Plan.

Project ID Number	2.5
Project Name:	Active Retirement of Ponds
Process Area:	Secondary Treatment
Project Driver:	Policy
Implementation Scenario:	General

Project Justification: The existing oxidation ponds currently serve as the first step of the existing secondary treatment process (ponds/FGRs/AFTs). When the new secondary treatment facilities are fully implemented, these ponds could be removed from service. Once abandoned for use as treatment, the Army Corps could claim jurisdiction of the ponds. The RWQCB could require approval for removing these ponds from service and could also claim jurisdiction as waters of the State. Active restoration of the ponds could help mitigate issues associated with removing these facilities from use as a treatment process.

Project Description: The major project elements include:

- Construction of planned breaches of the pond levees
- Re-grading and re-vegetation of the ponds

Project Implementation: This project would only be implemented once the new secondary treatment expansion is completed and operational (which would allow for the two oxidation ponds to be removed from service).

Permits Required: Permits required for enhancement activities are as follows (expected to take up to two years± to obtain):

- Army Corps 404 permit
- Rivers and Harbors Act Section 10 Letter of Permission
- RWQCB Section 401
- BCDC administrative permit
- Streambed Alteration Agreement from the California Dept. of Fish & Wildlife

Special Considerations/Additional Notes: Active restoration of the ponds provides potential for wetland mitigation banking opportunities. Approval from agencies that regulate tidal habitats and species would be required (Army Corps, RWQCB, US Fish & Wildlife, California Dept. of Fish & Wildlife and National Marine Fisheries Service). Further background on this can be found in the June 2014 Biological Resources Constraints and Opportunities Report prepared as part of the Master Plan. Final disposition of the ponds once they are no longer used for active treatment will need to consider all potential impacts (i.e., future sea level rise considerations).

Project ID Number	2.7
Project Name:	Chemical Dosing (P-Removal)
Process Area:	Secondary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: The WPCP may need to meet a phosphorous limit of 1 mg/L around 2034±. To meet this limit, chemically enhanced primary clarification (CEPT) facilities, which will be implemented as part of the Primary Treatment Facility project, would need to be utilized continuously and a second stage chemical addition facility would need to be implemented. Once this occur, the WPCP will most likely need a higher dose of methanol to the anoxic zones of the aeration basins to meet the total nitrogen limits. The methanol dosing facility is planned to be implemented as part of the Secondary Treatment Facility project.

Project Description: This project entails implementing a second stage chemical addition facility that would add either ferric chloride or alum at the dual media filters. The major project elements would include:

- Chemical storage tank
- Chemical metering pumps
- Chemical piping at the dual media filters

Project Implementation: None

Permits Required: None

Special Considerations/Additional Notes: 6 months of full-scale field-testing would need to be implemented as the initial Stage of this project to determine design criteria for the facilities.

3.0 - TERTIARY TREATMENT

Project ID Number	n/a
Project Name:	Dual Media Filter (DMF) Rehabilitation – MBR or Full CAS
Process Area:	Tertiary Treatment
Project Driver:	n/a (part of another project)
Implementation Scenario:	MBR of Full CAS

Project Justification: Based on the implementation of membrane bioreactors (MBR), the existing dual media filters (DMFs) will continue to be utilized for bay discharge and production of Title 22 recycled water. Based on the MBR implementation scenario, the DMFs will continue to filter pond effluent until the existing secondary treatment process (ponds/FGRs/AFTs) are fully replaced with the MBR facilities in the 2023 - 2024± time frame.

In 2013, the City upgraded the media and nozzles in DMFs No. 3 and 4. In 2016, the City plans to perform the same upgrades to DMFs No. 1 and 2. In conjunction with those upgrades, the City's plans to perform an overall condition assessment of the DMFs and disinfection systems by the end of 2015 to help determine needed upgrades to the facilities and SCADA for the tertiary systems (the results of which will be utilized as part of the plant-wide condition assessment to be performed under the Existing Plant Rehabilitation project).

Under the MBR implementation scenario, these DMFs will continue to be used over the next 8± years. Therefore is it anticipated that less extensive upgrades would be required.

Project Description: This project entails rehabilitation of the DMFs. It is assumed the upgrades would be made to all four DMFs. The major project elements include:

- Separate chemical feed system upstream of filters
- Potential, selective replacement of filter media with a different type of media that is more compatible with conventional activated sludge treatment and recycle water production
- Replacement of filter underdrains (including nozzles and nozzle support structure)
- Replacement of filter control valves and flow measuring equipment

Project Implementation: This project will be implemented as part of the Existing Plant Rehabilitation Project.

Permits Required: None

Special Considerations/Additional Notes: The results from the 2015 Tertiary System Condition Assessment Evaluation would be incorporated into the results of the condition assessment to be completed as part of the Existing Plant Rehabilitation project. Any additional elements not evaluated as part of the 2015 Tertiary System Condition Assessment Evaluation could be evaluated as part of the condition assessment completed as part of the Existing Plant Rehabilitation project.

Project ID Number	3.3
Project Name:	Denitrification Filters
Process Area:	Tertiary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: The WPCP may need to meet a total nitrogen limit of 3 mg/L in the 2035 to 2045 timeframe. This nitrogen limit cannot be achieved with new secondary treatment facilities alone. Based on current available technology, denitrification filters are a proven, attached-growth process that has been used to achieve the anticipated, stringent nitrogen limits. If required, these denitrification filters would replace the functionality of the existing DMFs, while at the same time providing the required total nitrogen removal.

Project Description: This project entails implementing a denitrification filter facility. The major project elements include:

- Denitrification filters contained in concrete tanks
- Backwash air and backwash water systems
- Methanol chemical storage and feed system

Project Implementation: This project would only be implemented if the WPCP needs to comply with a total nitrogen limit of 3 mg/L.

Permits Required: The following permits will be required:

- Authority to Construct (Bay Area Air Quality Management District).

Special Considerations/Additional Notes: None

Project ID Number	n/a
Project Name:	Simultaneous Production of Recycled Water/Sodium Hypochlorite Conversion
Process Area:	Tertiary Treatment
Project Driver:	Performance
Implementation Scenario:	General

Project Justification:

Modifications to the existing filtration and disinfection facilities (dual media filters/ chlorine contact tanks) are required to replace aging elements of the disinfection process, increase the safety of the disinfection process, and provide simultaneous production of recycled water.

The existing gaseous chlorine disinfection facilities need to be replaced with sodium hypochlorite disinfection facilities because these facilities are reaching the end of their useful life and there are safety concerns associated with gaseous chlorine, which is considered a toxic compressed gas per the Hazardous Materials portion of the Uniform Fire Code.

Improvements to the existing filtration and disinfection facilities are required to facilitate simultaneous production of disinfected, secondary effluent for bay discharge and Title 22 quality recycled water for reuse. The WPCP currently produces disinfected, secondary effluent that is discharged to San Francisco Bay. The WPCP also produces recycled water that is pumped off-site to the San Lucar Recycled Water Storage Tank for reuse. Due to the difference in the treatment and discharge requirements for Bay discharge and recycled water, the WPCP produces recycled water in batch mode by changing the operational parameters to the existing treatment processes for Bay discharge. This method of recycled water production is labor intensive, inefficient, and difficult to control. As a result, the City is proceeding with improvements to existing facilities to allow for simultaneous production of Title 22 quality recycled water.

Project Description: This project entails: (1) replacing the existing gaseous chlorine disinfection system with a sodium hypochlorite disinfection system; and (2) modifying the existing chlorine contact tanks and dual media filters to allow for simultaneous production of disinfected, secondary effluent for Bay discharge and Title 22 recycled water for reuse.

Modifications to the existing tertiary facilities will include the following major project elements:

- Sodium Hypochlorite Conversion
    - Sodium hypochlorite storage tanks, metering pumps, induction units and
    - Chemical feed piping to convey 12.5 percent hypochlorite solution to the existing chlorine contact tanks (CCTs), filter backwash water and tertiary filter influent box.
    - Demolition of existing gaseous chlorine facilities including the chemical scrubber and the building
- Modifications for Simultaneous Production of Recycled Water
    - Segregating one air floatation tank (AFT), one dual media filter (DMF) and two chlorine contact tanks (CCTs) with ability to treat wastewater for Bay discharge
    - New pumps installed at the fixed growth reactors distribution structures to pump flow required for recycled water production to AFT No. 2
    - New pumps installed at AFT No. 2 to pump flow required for recycled water production to DMF No. 4

    - Piping/valving modifications to allow filtered water from DMF No.4 to be isolated and sent to CCT No. 1 influent box, which will be isolated from rest of the CCTs influent channel.
    - Hypochlorite will be added to CCT No. 1 inflow through a w induction unit. CCT No. 2 will be used as a storage tank in addition to the existing off-site storage tank.
    - The downstream system from recycled water disinfection will remain same.
- 21± parking stalls along Borregas Avenue

Project Implementation: None

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	3.4
Project Name:	Chloramine Disinfection
Process Area:	Tertiary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: If a full new secondary treatment process becomes operational in 2023± (either Full CAS or MBR), trihalomethane (THM) formation may increase. The WPCP may need to comply with THM limits and the effluent concentration may exceed the regulated limits. The existing chlorine disinfection process would need to be converted to an alternate disinfection process. Chloramine disinfection could be implemented to reduce THM formation.

If split-flow operation is implemented, there would not be a need for chloramine disinfection because the effluent would contain sufficient ammonia for disinfection.

Project Description: This project entails converting the existing chlorine disinfection system to a chloramine disinfection system. Both chlorine and ammonia would be added at the existing chlorine contact tanks (CCTs) to form chloramines that would provide disinfection within the CCTs. A sodium hypochlorite system (which would be implemented as a separate project prior to the implementation of this project) would be used to dose chlorine to the CCTs. A new aqueous ammonia storage and feed facility would be implemented to dose ammonia to the CCTs. The major project elements include:

- Pilot testing chloramine disinfection
- An aqueous ammonia storage and feed system
- Ammonia piping from the aqueous ammonia storage and feed system to the existing CCTs
- Ammonia induction system located at the CCTs
- Modifications to the sodium hypochlorite induction system located at the CCTs

Project Implementation: For planning purposes, it was assumed THM regulations may be included in the permit cycle following the implementation of the new secondary treatment process, around 2023±. It is assumed the existing chlorine disinfection process would need to be modified by 2029± to comply with the anticipated THM regulations.

Permits Required: None

Special Considerations/Additional Notes: If pilot testing indicates that THM limits cannot be achieved with chloramine disinfection, then the existing disinfection system would need to be replaced with a UV disinfection system. For planning purposes, it was assumed that chloramines disinfection would be implemented as a first Stage project.

If chloramine disinfection is feasible and is implemented, the chloramines disinfection facility would need to be replaced with a UV disinfection facility if: (1) THM limits become more stringent; or (2) if over time the ammonia addition required for chloramine disinfection becomes an operational issue (i.e., the ability to meet effluent ammonia limits becomes difficult).

The ammonia storage and feed facilities would be located where the existing Filter Control Building is located. If CAS treatment is implemented at the plant, the Filter Control Building will be demolished and replaced with a smaller Filter Control Building as part of the Filter Control Building Project. The Filter Control Building Project will occur prior to the Chloramine Disinfection Project and will provide site space for the ammonia storage and feed facilities. If

MBR treatment is implemented at the plant, then the Filter Control Building would need to be demolished as part of the Chloramine Disinfection Project to provide site space for the ammonia storage and feed system.

Project ID Number	3.5
Project Name:	UV Disinfection
Process Area:	Tertiary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: If a full new secondary treatment process becomes operational in 2023±, trihalomethane (THM) formation may increase. An increase in THM formation may introduce THM limits in the permit cycle after the new secondary treatment process is operational. To meet the THM limits, the existing disinfection process may need to be converted to an alternate disinfection process, such as chloramine or UV disinfection.

If chloramine disinfection is implemented, N-nitrosodimethylamine (NDMA) formation may increase. NDMA is not currently regulated, but an increase in NDMA formation may introduce effluent NDMA limits in the permit cycle after ammonia addition is implemented. Should NDMA become a regulatory driver, ammonia addition (chloramine disinfection) would need to be discontinued and UV disinfection would need to be implemented.

If split-flow operation is implemented, there would not be a need for chloramine disinfection because the effluent would contain sufficient ammonia for disinfection. In this case, it is likely that UV disinfection would be implemented when the split-flow operation is discontinued and replaced with a full new secondary treatment process operation.

Project Description: This project entails replacing the existing chlorine disinfection system with a UV disinfection system. The major project elements include:

- Pilot testing UV disinfection equipment
- Open-channel UV disinfection system comprised of low-pressure, high-output UV lamps installed in concrete channels
- Flow split structure to distribute flow to the UV channels
- Weirs structure to regulate water surface elevation through the UV channels
- Flow metering for UV dose control
- Canopy to cover the UV disinfection facility
- Demolition of the fixed growth reactors (FGRs) and FGR pump station could be included as part of this project or as a separate demolition project

Project Implementation: For planning purposes, it was assumed THM regulations may be included in the permit cycle following the implementation of the new secondary treatment process, around 2023±. It is assumed the existing chlorine disinfection process would need to be replaced with an alternate disinfection process by 2037± to comply with the anticipated THM regulations (assumes chloramines disinfection would be implemented as a first Stage project in 2029±).

Because of the proposed site location for the UV facilities, this project could not be implemented until the FGRs and AFTs are removed from service and demolished.

Permits Required: None

Special Considerations/Additional Notes: For financial planning purposes, it was assumed demolition of the FGRs and FGR pump station would be completed as part of a separate demolition project.

Project ID Number	3.6
Project Name:	Ozone Disinfection
Process Area:	Tertiary Treatment
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: The State Water Resources Control Board may implement regulatory guidelines and/or limits for contaminants of emerging concern (CECs). If the SWRCB decides to initiate a statewide CEC monitoring process, it would be at least three permit cycles (2029±) before guidelines for CEC regulation are established and included in discharge permits. To meet CEC limits, an ozone disinfection process would need to be implemented to operate in conjunction with a sodium hypochlorite disinfection process or a UV disinfection process.

Project Description: This project entails implementing an ozone disinfection system that would be operated in conjunction with a sodium hypochlorite disinfection process or a UV disinfection process (whichever is the current disinfection process when this project is implemented). The major project elements include:

- Pilot testing ozone technology
- Pipeline contactor
- Liquid oxygen system
- Ozone generation facility
- Ozone pump station
- Demolition of the existing dual media filters (DMFs)

Project Implementation: For planning purposes, it was assumed it would be at least four permit cycles (2033±) before guidelines for CEC regulation are established and included in discharge permits. It is assumed an ozone disinfection process would need to be implemented in 10 years after limits are included in discharge permits (2043±).

Permits Required: None

Project ID Number	3.8
Project Name:	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse
Process Area:	Tertiary Treatment
Project Driver:	Policy
Implementation Scenario:	MBR

Project Justification: There is regional demand for high quality reclaimed water as an alternative source for potable water supply. The Santa Clara Valley Water District has completed a long range master planning effort which identifies reclaimed water as one component of the District's future potable water supply. In joint partnership with the City of Sunnyvale, the treated effluent from the WPCP MBR facilities has been identified as one viable source for that reclaimed water supply.

Project Description: This project entails the construction of an advanced treatment system at the WPCP site. This advanced treatment facility would be designed to produce a source water supply consistent with Indirect Potable Reuse, utilizing reverse osmosis (RO), ultraviolent (UV) disinfection, and chemical oxidation process facilities. The initial stage of these facilities would be designed to produce 10 mgd of product water (expandable to 15 mgd). The major project elements include:

- Demolition of existing air flotation tanks (AFTs) and AFT pump station
- Demolition of existing fixed growth reactors (FGRs) and FGR pump station
- Four RO feed pumps/Wetwell
- Four cartridge filters
- Four 2.5 mgd RO trains
- Four interstage booster pumps
- Two low pressure/high output UV reactors
- Two packed tower aerators (decarbonators)
- Finished water storage/pump station (three pumps)
- RO clean-in-place (CIP) facilities
    - Two CIP solution tanks (with heater/mixer)
    - CIP feed pump
- Four utility water pumps
- Bulk storage chemical storage
    - Two hypochlorite tanks
    - One aqua ammonia tank
    - Two sulfuric acid tanks
    - One scale inhibitor tank
- Lime System
    - One lime silo
    - Two slurry tanks

Project Implementation: Due to the location on the WPCP site, construction of this project would follow startup of the MBR facilities (the FGRs and AFTs must remain in operation to maintain permit compliance).

Permits Required: The following permits will be required:

- Authority to Construct.

Special Considerations/Additional Notes: Active retirement of the ponds is not included in this project.

4.0 - SOLIDS FACILITIES

Project ID Number	n/a
Project Name:	Digester No. 1 and 2 Upgrades
Process Area:	Solids Facilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: Key components of the existing Digesters No. 1 and 2 will reach the end of their useful life during the master planning period. Upgrades are required to keep them operational beyond the master planning period. Minor improvements to Digester No. 3 are also required.

Project Description: This project entails rehabilitation of existing Digesters No. 1 and 2 and minor improvements to Digester No. 3. The major project elements include:

- Demolition of existing mechanical (non-structural) equipment at Digesters No. 1 and 2
    - Two floating digester covers and associated concrete ballasts, guiderails, manholes, sampling wells, etc.
    - Sludge recirculation pumps and heating water pumps
    - Digester gas mixing system
    - Gas collection system
    - Digester motor control center (MCC)
    - Ancillary equipment such as piping and valves
- Digester No. 1 and 2 Rehabilitation
    - Structural modifications
    - Fixed steel covers with external supports
    - Mixing system
    - Heating system
    - Gas system
    - Electrical and instrumentation and control improvements
- Digester No. 3 Improvements
    - Placement of non-slip surface to the existing cover

Project Implementation: Given the age of Digesters No. 1 and 2, the City considers rehabilitating these digesters a high priority and began this project prior to the completion of the Master Plan.

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	4.1
Project Name:	Digester Supernatant PS and Drainage Piping Upgrades
Process Area:	Solids Facilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: Due to the age of the overall facilities as well as proposed process upgrades at the WPCP, key elements of the digester supernatant pump station and drainage piping need to be rehabilitated or replaced to maintain reliable operation.

Project Description: This project entails rehabilitating selected components of the existing support utility systems. The major project elements include:

- Repair of concrete within supernatant pump station
- Replacement of digester supernatant pumps
- Repair of portions of drainage piping from digesters to supernatant pump station

Project Implementation: These improvements are assumed to take place around the same time as the Thickening and Dewatering Stage 1 project.

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	4.2 and 4.3
Project Name:	Thickening and Dewatering Facility – Stages 1 and 2
Process Area:	Solids Facilities
Project Driver:	Policy (Stage 1); Flow and Load (Stage 2)
Implementation Scenario:	General

Project Justification: An initial stage of thickening and dewatering facilities would be required for solids treatment when the initial stage of new secondary treatment facilities is implemented. A second stage of thickening and dewatering facilities would be required for solids treatment when the second stage of new secondary treatment facilities is implemented.

Due to the proposed process upgrades at the WPCP, key elements of solids treatment facilities (digesters and digester support facilities) need to be upgraded to maintain reliable operation. The digester support facilities would need to be upgraded to include a new digester sludge storage tank and new separate PS and WAS sludge feed systems.

- In order to provide operational flexibility for the dewatering facilities, upstream storage of digested sludge is typically provided to store digested sludge prior to dewatering. Because the WPCP has limited digester storage volume, a separate storage tank is proposed.
- The existing treatment process produces primary sludge (PS) which is fed to the digesters by the primary sludge feed system. Once the new secondary treatment facilities are operational, the treatment process will produce both primary sludge and waste activated sludge (WAS). Both types of sludge will need to be stabilized through anaerobic digestion. Given the challenges associated with digesting WAS, separate WAS and PS feed systems would need to be implemented so O&M staff could control and monitor the WAS and PS feed to the digesters. The existing PS feed system would need to be abandoned because it would not provide the necessary level of control and monitoring.

Due to the overall age of the solids treatment facilities (digesters and digester support facilities), key elements of the existing facilities need to be rehabilitated or replaced to maintain permit compliance.

Project Description: This project entails implementing a facility to thicken secondary sludge (produced by the new secondary treatment facilities) and to dewater digested biosolids produced by the anaerobic digestion process. The facility will be implemented in two Stages. Stage 1 includes implementing thickening and dewatering facilities required to support the first phase of new secondary treatment improvements. Stage 2 includes implementing additional thickening and dewatering facilities to support the required expansion of the new secondary treatment improvements. In addition to the new thickening and dewatering facilities, this project also include rehabilitating aging elements of the existing digester support facilities and upgrading the existing digester support facilities to include a digester sludge storage tank and separate PS and WAS sludge feed systems.

The major project elements, by project Stage, include:

- Stage 1
    - Pilot testing thickening and dewatering equipment
    - Building to house the equipment (with bridge crane)
    - Two thickening units (i.e., rotary drum thickeners)

    - Thickened waste activated sludge (TWAS) pumps
    - Thickening polymer storage and feed system
    - Digester sludge feed piping upgrades
    - Digester sludge storage tank
    - Three dewatering units (i.e., screw presses)
    - Cake pumps
    - Dewatering polymer storage and feed system
    - Provisions to remove equipment from the building (e.g., bridge crane)
    - Cake storage hopper and truck loading facility
    - Odor control system comprised of biotrickling scrubber
- Stage 2
    - One thickening unit (i.e., rotary drum thickener) and associated TWAS pump, polymer system, and support utilities
    - One dewatering unit (i.e., screw press) and associated cake pump, polymer system, and support utilities
- Rehabilitation of digester support facilities
    - Replace supernatant pumps
    - Replace piping underneath digesters
- Digester sludge storage tank
    - 1-MG digester sludge storage tank
    - Tank mixing system (similar to the existing digester mixing pumps)
    - Digester sludge pump station
    - Yard piping (to be routed in a utilidor system)
        - Piping from the anaerobic digesters to the digester sludge storage tank
        - Piping from the digester sludge storage tank to the dewatering facility
- Separate PS and WAS feed systems
    - Existing PS feed system
        - Piping modifications to allow for the installation of automated control valves and flow metering to automatically control sludge feed to each digester
    - WAS Feed System
        - Piping from WAS thickening facilities to each anaerobic digester
        - Automated control valves and flow metering to automatically control sludge feed to each digester

Project Implementation: The WPCP will be utilizing contract dewatering until these permanent facilities are operational. Therefore it has been assumed that these facilities, which would be included as part of the Secondary Treatment Improvements Stage 1 project, would be identified as a potential early completion element. This would eliminate the need to operate the contract dewatering until the Secondary Treatment facilities are operational. The location for the proposed thickening & dewatering facilities is the site of the existing Primary Control Building. Either this working space needs to be replaced with temporary facilities or the dewatering facilities must be delayed until the new Maintenance & Warehouse Building is completed.

Permits Required: See Secondary Treatment Improvements Stage 1 and 2

Special Considerations/Additional Notes: This project has been developed so that either screw presses or centrifuges could be installed for dewatering (i.e., accommodation for space requirements for screw presses and power requirements for centrifuges).

Project ID Number	4.4
Project Name:	Digester No. 5
Process Area:	Solids Facilities
Project Driver:	Flow and Load
Implementation Scenario:	General

Project Justification: Based on projections for solids loadings, it is anticipated that additional digester volume would be required (equivalent to the volume of existing Digester No. 4).

Project Description: This project entails constructing a new anaerobic digester, Digester No. 5. The major project elements include:

- One anaerobic digester (equivalent in size to Digester No. 4; about 1.0 MG)
- 50± LF of utilidor to connect the digester to the utilidor system
- Digester mixing system
    - Digester mixing pump
- Digester heating system
    - Heat exchanger
    - Digester sludge circulating pump
    - Digester hot water circulating pump
    - Raw sludge hot water pump
- Digester sludge pumping system
    - Digester supernatant pump
- Influent sludge grinder

Project Implementation: This project would be implemented earlier under MBR (or Full CAS) implementation, than it would be under Split Flow implementation. Under MBR (or Full CAS) implementation, the Secondary Treatment Improvements - Stage 1 would generate more waste activated sludge (WAS) and require utilization of more digester capacity.

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	4.5
Project Name:	FOG/Food Waste Facility
Process Area:	Solids Facilities
Project Driver:	Economic
Implementation Scenario:	General

Project Justification: Digesting fats, oils, and grease (FOG) and food wastes, in addition to the biosolids produced at the WPCP, can increase digester gas production. Given the City uses digester gas to produce electricity, additional gas production would provide additional benefit to the City. Digesting FOG and food waste is anticipated to be economically beneficial only if excess digester capacity is used.

Project Description: This project entails implementing a FOG and food waste facility that would store and feed FOG and food waste to the digesters. This project is based on using the excess digester capacity, as opposed to constructing additional digester capacity to accommodate FOG and food waste processing. This project is also based on accepting and digesting emulsified (liquid) food wastes (as opposed to whole food wastes) to minimize capital and operational costs and minimize footprint.

The major project elements include:

- FOG and food waste market analysis (assumes three months to further refine design criteria before beginning design)
- FOG and food waste receiving program development
- 3,000 gallon per day FOG storage and feed facility (based on FOG projections included in the Rehabilitation of Anaerobic Digesters No. 1 and 2 and Improvements to No. 3, Kennedy Jenks, 2012)
    - Storage tank
    - Grinder pumps
    - Feed pumps
- 3,000 gallon per day emulsified food waste storage and feed facility
    - Storage tank
    - Grinder pumps
    - Feed pumps

Project Implementation: It is recommended the City gain experience with digesting primary and WAS sludge before accepting and digesting FOG and/or food waste. As a result, it is assumed this project would be implemented after Stage 1 of the Secondary Treatment Improvements project. However, this project could be implemented at any time the City deems it financially beneficial.

Permits Required: None.

Special Considerations/Additional Notes: A FOG and food waste market analysis would be need to be completed at the onset of this project to confirm digesting FOG and food waste is economically beneficial.

Project ID Number:	4.6
Project Name:	Phosphorus Recovery Facility
Process Area:	Solids Facilities
Project Driver:	Performance/Economic
Implementation Scenario:	General

Project Justification: The Master Plan anticipated that by the year 2035, the City will be required to meet at total phosphorus limit of 1 mg/L. This limit could be met with either a chemical phosphorus removal or biological phosphorus removal approach. If the City decides to meet the phosphorus limit through a biological approach, phosphorus will accumulate within the cells of the phosphorus accumulating organisms contained within the waste activated sludge (WAS). When the WAS is exposed to the anaerobic conditions of the anaerobic digester, the cells could release their stored phosphorus. That phosphorus can then combine with magnesium and ammonium to form magnesium-ammonium-phosphate (or struvite). This struvite can attach to the walls of the anaerobic digester, pipe walls, valves or pumps, yielding maintenance problems for the City. Additionally, the released phosphorus that does not form struvite will be returned to the head of the plant and will need to be removed through the secondary process again. One way to combat this maintenance problem and to reduce the phosphorus content of the dewatering return is to build a struvite recovery facility to harvest the struvite from the dewatering return stream. The struvite recovered from the struvite recovery facility can then be sold as fertilizer.

Project Description: This project entails the construction of a struvite recovery facility. This facility would be designed to produce a marketable fertilizer. The major project elements include:

- Struvite recovery facility building including
    - Struvite harvesting reactors and associated mechanical systems
    - Product storage area
    - Dryer
    - Dewatering screen
    - Conveyor
    - Classifying screen
    - Storage silo
    - Bagging system
- Centrate storage/equalization
- Chemical feed system

Project Implementation: This project would be implemented when phosphorous removal is implemented at the WPCP.

Permits Required: The following permits will be required:

- Authority to Construct.

Special Considerations/Additional Notes: A market analysis for recovered struvite should be performed to determine if this project is economically feasible.

Project ID Number	4.7
Project Name:	Biosolids Post-Processing
Process Area:	Solids Facilities
Project Driver:	Regulatory
Implementation Scenario:	General

Project Justification: The cost and availability of biosolids disposal alternatives could dictate the necessity for the City to direct a portion of the dewatered cake to a thermal drying facility. This would reduce the volume of solids that would ultimately need to be taken offsite and would open up options for disposal or beneficial use of the solids.

Project Description: The major project elements include:

- Biosolids dryer or equivalent technology fueled with a mixture of gases including landfill gas, digester gas, and natural gas.
- Support equipment for dryer (wet cake storage, cake feed pump, product cooling conveyor, product screening conveyor, off gas handling system, thermal fluid heating system, instrumentation/controls)
- Odor control
- Loading conveyor & trailer loader system
- Bridge crane
- 5000± sq. ft. building to house equipment
- 50± LF of utilidor to connect to Thickening & Dewatering Building

Project Implementation: This project would be implemented only after the Thickening & Dewatering Building is operational.

Permits Required: The following permits will be required:

- Permit to Operate and Authority to Construct (Bay Area Air Quality Management District).

Special Considerations/Additional Notes: If biosolids post-processing is implemented, at least one or two of the dewatering screw presses would need to be replaced with dewatering centrifuges to achieve drier cake solids (minimum 22 percent solids) to make thermal drying cost-effective.

5.0 - COMBINED HEAT AND POWER

Project ID Number	n/a
Project Name:	Cogeneration Gas Treatment
Process Area:	Combined Heat and Power
Project Driver:	Economic
Implementation Scenario:	General

Project Justification: The existing gas treatment system is antiquated and needs to be replaced. A new gas cleaning system is required to serve the existing PGF facility as well as the future PGF facilities (that will be constructed in 2020-2025±, depending on the condition of the existing engines). Gas treatment is required because the biogas fed to the existing and future PGF facilities is contaminated with hydrogen sulfide and siloxanes. Hydrogen sulfide can damage the engines because sulfurous and sulfuric acid can be produced in the combustion process and undesirable sulfur dioxide can be produced in the PGF exhaust. Siloxanes in the biogas from the WPCP can produce harmful silica deposits on the interior of the engines. As a result, both the hydrogen sulfide and siloxanes need to be removed.

Project Description: This project entails demolition of the existing gas cleaning system and construction of new hydrogen sulfide and siloxane treatment systems on a concrete slab, adjacent to the existing PGF building. Desulfurization could be achieved with an iron sponge, biological treatment, or with specialty treatment media (e.g., sulfatreat). Siloxane treatment could be achieved by chilling the biogas, removing moisture, and then treating with activated carbon. The major project elements include:

- Siloxane removal equipment
- H2S removal equipment
- Equipment concrete slab
- Related piping and supports
- Electrical instrumentation and controls

Project Implementation: This work will be done under a separate contract and not part of Stage 2 improvements. If this project is not implemented as a standalone project, then these proposed improvements would be incorporated as part of the cogeneration upgrades.

Permits Required: The following permits will be required:

- Permit to Operate and Authority to Construct (Bay Area Air Quality Management District).

Special Considerations/Additional Notes: None

Project ID Number	5.1
Project Name:	Cogeneration Upgrade
Process Area:	Combined Heat and Power
Project Driver:	Economic
Implementation Scenario:	General

Project Justification: Even with proposed gas treatment improvements, it is anticipated that the existing cogeneration facilities will need to be replaced in-kind by 2025± to take advantage of new technologies. New engine technology is more efficient and requires less maintenance. The existing cogeneration facilities would be refurbished in the same location.

Project Description: This project entails replacing existing facilities while maintaining operation of at least one cogeneration unit at all times. The project includes installing new power generation engines in the existing PGF building and replacing all related controls and heat recovery equipment with the exception of the exhaust heat recovery units, which will be installed as part of the Primary Treatment Facility Project. This project also includes installing gas cleaning equipment that would be installed outside, to the east of the PGF building (assuming gas treatment is not installed earlier).

The major project elements include:

- Demolition of existing generators heat exchangers and exhaust facilities
- Reuse of the existing PGF building
- Miscellaneous structural and architectural modifications to existing PGF building
- Two new engine generators with a capacity of approximately 800 kW each
- Waste heat recovery facilities from jackets (typically provided in engine vendor package)
- Heat exchangers (typically provided in engine vendor package)
- Pumps for heat loops (typically provided in engine vendor package)
- Related replacement of piping for lube oil and ancillary facilities as needed
- Upgrades to electrical equipment as needed to meet current codes or replace equipment that causes maintenance or safety issues
- Electrical, instrumentation and control equipment for new facilities.
- Civil and site work

Project Implementation: The PGF facility would be upgraded by modifying the existing facility rather than building a new cogeneration facility. Construction would be staged to allow the operation of one unit at all times.

Permits Required: The following permits will be required:

- Permit to Operate and Authority to Construct (Bay Area Air Quality Management District).

Special Considerations/Additional Notes: The PGF external architecture would be modified to match the existing architecture.

6.0 - ELECTRICAL

Project ID Number	n/a
Project Name:	12 kV Electrical Distribution System
Process Area:	Electrical
Project Driver:	n/a (part of another project)
Implementation Scenario:	General

Project Justification: Due to the age and overall condition of the existing 4160 volt (V) electrical distribution system, it needs to be replaced with a 12 kilovolt (kV) electrical distribution system.

Project Description: This project entails implementing a 12 kilovolt (kV) electrical distribution system to distribute power to the existing and future WPCP facilities. The 12 kV distribution system would be implemented in Stages and would gradually replace the existing 4160 V electrical distribution system.

The 12.4 kV distribution system would be a radial system. A radial system provides two feeds to each substation via an independent path. Each feed and transformer would be sized to accommodate the entire substation load. In the event of an equipment failure, (cable or transformer), the substation could be operated in a "single-ended" manner maintaining complete plant operations.

The major project elements of each Stage of implementation include:

- 12 kV cable, conduit, and ductbanks with provisions for fiber optics cable
- 12 kV-480V transformers
- Manholes provided at the limits of the 12 kV ductbanks to facilitate extending the 12-kV ductbanks in future Stages.
- Demolition of 4160 V distribution system on an as-needed basis as it conflicts with future projects

Project Implementation:

This project will be implemented in the following Stages:

- Stage 1 – Headworks and Primary Treatment Facility
    - Includes 12 kV distribution to headworks, primary treatment, and cogeneration facilities.
- Stage 2 – Secondary Treatment Improvements - Stage 1
    - Includes 12 kV distribution to all other facilities at the WPCP

Stage 1 would be implemented with the Headworks and Primary Treatment Facility project. Stage 2 would be implemented with the Secondary Treatment Improvements project.

Permits Required: None

Special Considerations/Additional Notes: None

7.0 - PROCESS CONTROL AND AUTOMATION

Project ID Number	n/a
Project Name:	SCADA System Improvements
Process Area:	Process Control and Automation (SCADA)
Project Driver:	n/a (part of another project)
Implementation Scenario:	General

Project Justification: The WPCP currently has a semi-automated control system comprised of antiquated equipment, disparate manufacturers and no unified interface for plant staff to monitor or control the various processes. An Automated Control System (ACS) master plan has been developed which provides the foundation for a unified plant-wide automation control system that leverages state-of-the-art technology. Implementing the proposed system would allow WPCP plant staff the ability to manage process facilities in a highly efficient manner.

Project Description: This project entails implementing automation system improvements for automation and control of the existing and future WPCP facilities. The new automation system would gradually replace the existing automation system.

The new automation system would be a four level network, comprised of the following levels:

- Field Network. The field network would be comprised of discrete and analog devices connected either directly to input/output (I/O) cards or through a fieldbus to a programmable logic controller (PLC).
- Control Network. The control network would be comprised of PLCs that collect data from the field network devices and provide communication between the various control devices.
- Process Control System (PCS) Network. The PCS network would link the PLCs with the personal computer (PC)-based Human Machine Interface (HMI) systems. Plant staff would use the PCS to control the plant processes.
- Business Network. The Business Network would extend the plant process controls to ancillary systems to either optimize operations or provide information on performance of the process facilities. This network would house systems like the Computerized Maintenance Manager Systems (CMMS) and Laboratory Information Management Systems (LIMS).

The major project elements of each Stage of implementation include:

- Instrumentation
    - Digital bus instrumentation
- Communications Backbone
    - 72 strand single-mode fiber optics cable, installed in a loop configuration
    - Ductbank
    - Communications cabinets
- Hardware/software/programming
    - Smart motor control centers
    - PLC cabinets
    - Remote I/O cabinets
    - PLC programming
    - HMI programming
- Infrastructure (all elements to be implemented in Stage 1)
    - Servers

- Workstations/tablets
- Wireless network nodes
- Communications cabinets
- SCADA software/licensing
- Configuration

Project Implementation:

This project will be implemented in the following Stages:

- Stage 1 – Headworks and Primary Treatment Facility
  - Establishes SCADA backbone and initial fiber optics distribution for the headworks, primary treatment, and cogeneration facilities.
- Stage 2 – Secondary Treatment Improvements - Stage 1
  - Includes fiber optics distribution and SCADA upgrades to all other facilities at the WPCP

Stage 1 would be implemented with the Headworks and Primary Treatment Facility project. Stage 2 would be implemented with the Secondary Treatment Improvements project.

Permits Required: None

Special Considerations/Additional Notes: None

8.0 - SUPPORT FACILITIES

Project ID Number	1.1 and 2.1 (1.1 and 2.1M for MBR implementation)
Project Name:	Tidal Flood Protection – Stages 1 and 2
Process Area:	Support Facilities
Project Driver:	n/a (part of another project)
Implementation Scenario:	General

Project Justification: Santa Clara County's shoreline is at risk from coastal flooding due to extreme storm events combined with high tides. Based on the location of the WPCP, as well as the local topography, the plant site would be subject to inundation from a 100-year tidal flooding event. Per Santa Clara County flood control ordinance requirements, tidal flooding protection is required to elevation 13.00 (plant datum elevation 113.00).

Project Description: The major project elements include:

- Construction of a sheet pile flood wall, approximately 4,000± linear feet in length, around the entire perimeter of the WPCP site.
    - In Stage 1, about 2,400± linear feet of the flood wall will be constructed to encompass the western half of the main plant site.
    - In Stage 2, about 1,500± linear feet of the flood wall will be constructed to encompass the remaining eastern half of the main plant site.
- Construction of a retractable flood barrier at each entrance to the WPCP. Retractable flood barriers will be installed in both Stages of this project.

Project Implementation: This project would be implemented in two stages. Stage 1 would be completed at part of the Headworks/PST project. Stage 2 would be completed as part of the Existing Plant Rehabilitation project.

Permits Required: It is anticipated that following permits would be required:

- Bay Conservation and Development Commission (BCDC)
- Regional Water Quality Control Board (RWQCB).

Special Considerations/Additional Notes: None

Project ID Number	8.1
Project Name:	New Access to Bay Trails
Process Area:	Support Facilities
Project Driver:	Performance
Implementation Scenario:	General

Project Justification: Because of the proposed improvements to the WPCP, it is necessary to re-locate the public access point from Carl Road to Caribbean Drive. This would provide for a safer access for the public and allow the City to utilize the Carl Road space more readily for temporary and permanent WPCP improvements.

Project Description: This project entails re-routing of public access to a location where the West Flood channel crosses Caribbean Drive. There is currently an access point at this location, which would be enhanced by the following improvements:

- Approximately 950 feet of one lane of Caribbean Drive, to the east and west of the proposed bay trail access location, would be converted to parking in combination with sidewalk improvement for access.
- Grading and landscaping improvements would be provided along the new parking areas and new access location

Project Implementation: These improvements could not begin until completion of the SCVWD's East/West channel improvements project. In addition, the new Administration and Maintenance Buildings cannot proceed until this New Access to Bay Trails project is implemented.

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	8.2
Project Name:	Household Hazardous Waste Demolition/ Solid Waste Removal
Process Area:	Solids Facilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: The household hazardous waste facility needs to be relocated to provide site space for the new Administration and Lab Building. The facility will be located off the WPCP site.

Project Description: This project entails relocating the household hazardous waste facility to an offsite location. The major project elements include:

- Relocation of the household hazardous waste facility

Project Implementation: These improvements are assumed to take place early in the master planning period, before the Administration Building project starts.

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	8.3
Project Name:	Administration and Lab Building
Process Area:	Support Facilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: A support building programming evaluation was completed which evaluated the space use and needs for the following functional areas: (1) administration; (2) operations and control; (3) maintenance; (4) laboratory; (5) compliance inspection and (6) general staff support. Key findings and recommendations from that effort included the following:

- Most functional areas have adequate space for current staff levels. Notable functional area deficiencies include:
  - Laboratory
  - Accessible meeting and training space
  - Maintenance Shop and storage
  - Offices and workstations for future staff
- The existing occupied spaces are located in multiple locations including existing buildings, temporary trailers, repurposed structures, and underutilized space in process buildings. Efficiency of space use, communication and circulation between functional groups is compromised by the decentralized facilities.
- Storage of some materials, parts and equipment are remote from primary functional locations. Access to storage is inefficient and inventory more difficult to maintain.
- Recommend consolidation of Administration, Outreach, Laboratory, Compliance Inspection and Operations/Control functions in single building to increase efficiencies, accommodate future staff, maximize shared use space and minimize building space requirements.
- Recommend consolidation of Maintenance Shop, Storage and Maintenance staff facilities with Warehouse for efficiency and inventory control.

Project Description: This project entails implementing a new Administration Building that would house administration, outreach, operations, laboratory, and compliance inspection functions. The new Administration Building would replace the functionality of the existing Administration Building, Laboratory/Control Building, and Compliance Inspection Building. As a result, these buildings would be demolished.

The major project elements include:

- Site preparation (includes removal of landfill material at the building site)
- 21,600 SF two-story building
- Landscaping
- 68± parking stalls
- Demolition of existing Administration Building

Project Implementation: The project cannot proceed until public access to the Bay Trail system is relocated from Carl Road to Caribbean Drive. In addition, due to support utility considerations, the new Administration Building must be coordinated with an early milestone completion for the CAS facilities (i.e, secondary clarifiers, RAS/WAS pump station, utilidor). It is

assumed that this project and the Maintenance Building project would be designed under one set of contract documents and constructed as one project.

Permits Required: The following permits will be required:

- Santa Clara County Health Department CalRecycle Local Enforcement Agency.

Special Considerations/Additional Notes: Tidal flooding protection is being provided for the main plant site at the WPCP. The proposed location for the Administration Building is outside of the proposed flood protection perimeter and therefore special provisions would need to be provided for this structure.

The City intends construct this building to meet LEED Silver standards, but not pursue the formal application process for certification.

Due to the location of the building, the Landfill Closure Plan will need to be reopened so that landfill material can be removed from the site. Refer to the Hazardous Materials TM for boring information in this area.

Project ID Number	8.4
Project Name:	Maintenance Building
Process Area:	Support Facilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: A support building programming evaluation was completed which evaluated the space use and needs for the following functional areas: (1) administration; (2) operations and control; (3) maintenance; (4) laboratory; (5) compliance inspection and (6) general staff support. Key findings and recommendations from that effort included the following:

- Most functional areas have adequate space for current staff levels. Notable functional area deficiencies include:
  - Laboratory
  - Accessible meeting and training space
  - Maintenance Shop and storage
  - Offices and workstations for future staff
- The existing occupied spaces are located in multiple locations including existing buildings, temporary trailers, repurposed structures, and underutilized space in process buildings. Efficiency of space use, communication and circulation between functional groups is compromised by the decentralized facilities.
- Storage of some materials, parts and equipment are remote from primary functional locations. Access to storage is inefficient and inventory more difficult to maintain.
- Recommend consolidation of Administration, Outreach, Laboratory, Compliance Inspection and Operations/Control functions in single building to increase efficiencies, accommodate future staff, maximize shared use space and minimize building space requirements.
- Recommend consolidation of Maintenance Shop, Storage and Maintenance staff facilities with Warehouse for efficiency and inventory control.

Project Description: This project entails implementing a new Maintenance Building that would include a maintenance shop, staff space, warehouse and storage areas. The Maintenance Building would have exterior yard space for storage and vehicle access. The new Maintenance Building would replace the functionality of the existing Maintenance Shop, Maintenance Storage Yard, Instrumentation Shop, and Primary Control Building. As a result, these buildings would be demolished as part of this project.

The major project elements include:

- 8,200 SF one-story building
- Landscaping
- Yard space for storage and vehicle access

Project Implementation: The project cannot proceed until public access to the Bay Trail system is relocated from Carl Road to Caribbean Drive. In addition, because the proposed location for the new maintenance building uses the space currently occupied by the existing Administration Building, the new Administration Building must be completed and staff relocated before demolition and construction of new facilities can begin. It is assumed that this project and

the Administration Building project would be designed under one set of contract documents and constructed as one project.

Permits Required: None

Special Considerations/Additional Notes: The City intends construct this building to meet LEED Silver standards, but not pursue the formal application process for certification.

Project ID Number	n/a
Project Name:	Sea Level Rise Protection
Process Area:	Support Facilities
Project Driver:	Regulatory and Policy
Implementation Scenario:	General

Project Justification: Santa Clara County's shoreline is at risk from coastal flooding due to extreme storm events combined with high tides and in the future as sea levels rise. The South San Francisco Bay Shoreline Study (SSFBSS), which is congressionally funded through the Army Corps, is evaluating the feasibility of options for managing flood risk along the South Bay shoreline as well as undertaking ecosystem restoration and expanding public access. Using a combination of flood levees and natural wetlands, the goal is to provide natural infrastructure to provide sea level rise flood protection and restore Bay habitats. This would allow the flood protection approach to evolve as more information on sea level rise impacts is developed. A feasibility study being managed by the Santa Clara County Valley Water District (SCVWD) will be completed in late 2016. This feasibility study will better define potential long-term alternatives for the South Bay shoreline.

Project Description: In order to evaluate the cost/benefit for each proposed alternative for shoreline levee flood protection, the SSFBSS has identified ten (10) Economic Impact Areas (EIA) along the South San Francisco Bay Shoreline from San Francisquito Creek to Guadalupe River. Three of those EIAs, Nos. 7, 8 and 9, are within the City of Sunnyvale. A preliminary routing for a future shoreline flood levee has been developed and would be evaluated as part of the SCVWD feasibility study.

Project Implementation: Based on discussions with the SCVWD, it is anticipated that due to the costs and the desire to coordinate these efforts with other goals (i.e., South Bay Salt Pond Restoration Project's desire to restore 15,000 acres of former salt ponds to wetlands), implementation for these projects would be outside of the current Master Plan planning period (> 2050).

Permits Required: It is anticipated that following permits would be required:

- Army Corps of Engineers
- Bay Conservation and Development Commission
- California Department of Fish and Wildlife
- Regional Water Quality Control Board.

Special Considerations/Additional Notes: It is anticipated that once the existing oxidation ponds are no longer part of the treatment process train at the WPCP, the ponds could become part of the long-term alternatives being evaluated as part of the SSFBSS and South Bay Salt Pond Restoration Project.

9.0 - SUPPORT UTILITIES

Project ID Number	1.1 and 2.1 (1.1 and 2.1M for MBR implementation)
Project Name:	Site Security Improvements – Stages 1 and 2
Process Area:	Support Utilities
Project Driver:	n/a (part of another project)
Implementation Scenario:	General

Project Justification: These improvements are required to maintain overall plant safety and security.

Project Description: The major project elements include:

- Construction of perimeter fence and closed circuit video camera system
    - In Stage 1, about 2,400± linear feet of the fence would be constructed to encompass the western half of the main plant site.
    - In Stage 2, about 1,500± linear feet of the flood wall would be constructed to encompass the remaining eastern half of the main plant site.
    - Includes: intrusion detention alarms, electronic access control systems, lighting requirements, system communication requirements

Project Implementation: This project would be implemented in two stages. Stage 1 would be completed at part of the Headworks/PST project. Stage 2 would be completed as part of the Existing Plant Rehabilitation project.

These improvements will be closely coordinate with the tidal flood wall improvements.

Permits Required: It is anticipated that following permits would be required:

- Bay Conservation and Development Commission (BCDC)
- Regional Water Quality Control Board (RWQCB).

Special Considerations/Additional Notes: None

Project ID Number	9.1
Project Name:	Recycle Water Improvements (New Recycled Water Pump Station)
Process Area:	Support Utilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: Due to the age of the recycled water pump station facilities, the facilities would need to be rehabilitated or replaced to maintain reliable operation.

Project Description: This project entails rehabilitating selected components of the existing recycled water pump station. The major support utility systems include:

- Replacement of recycled water pumps
- Replacement of miscellaneous mechanical equipment (e.g., valves) and piping

Project Implementation: These improvements should be implemented when a majority of the recycled water pump station facilities near the end of their useful life.

Permits Required: None

Special Considerations/Additional Notes: The condition assessment, proposed to be completed as part of the Existing Plant Rehabilitation Project, would include an assessment of the recycled water pump station (even though rehabilitation/replacement of these facilities would likely be completed as a standalone project). Depending upon the timing of these improvements, the recycled water pump station section of that condition assessment may need to be updated.

Project ID Number	9.2
Project Name:	Community Improvements
Process Area:	Support Utilities
Project Driver:	Policy
Implementation Scenario:	General

Project Justification: City ordinance dictates that a certain percentage of capital improvements projects need to include community enhancements.

Project Description: This project entails community and environmental enhancements. These enhancements could include:

- Educational features in the Public Outreach Meeting Space of the new Administration Building
- Public parking, sidewalks, signage, and road markings to facilitate plant tours
- Americans with Disabilities Act (ADA) related improvements for public tours
- Kiosks at the entrance of the oxidation ponds

Project Implementation: None

Permits Required: None

Special Considerations/Additional Notes: None

Project ID Number	9.3
Project Name:	Landfill Gas Flare and Booster System Upgrade
Process Area:	Support Utilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: Due to the age of the landfill gas flare and booster system, the facilities would need to be rehabilitated or replaced to maintain reliable operation.

Project Description: This project entails rehabilitating selected components of the existing landfill gas flare and booster system. The major support utility systems include:

- Replacement of landfill gas flare
- Replacement of miscellaneous mechanical equipment (e.g., valves) and piping

Project Implementation: These improvements should be implemented when a majority of the landfill gas flare and booster system facilities near the end of their useful life.

Permits Required: None

Special Considerations/Additional Notes: The condition assessment, proposed to be completed as part of the Existing Plant Rehabilitation Project, would include an assessment of the recycled water pump station (even though rehabilitation/replacement of these facilities would likely be completed as a standalone project). Depending upon the timing of these improvements, the recycled water pump station section of that condition assessment may need to be updated.

Project ID Number	9.4
Project Name:	Miscellaneous Civil Site/Support Utility Improvements
Process Area:	Support Utilities
Project Driver:	Condition (R&R)
Implementation Scenario:	General

Project Justification: Due to the age of the overall facilities as well as proposed process upgrades at the WPCP, key elements of the support utilities need to be rehabilitated or replaced to maintain reliable operation. These include the potable water, utility water, hot water, utility air, digester gas, landfill gas, natural gas, tank drain, sanitary drain, storm drain, and recycled water systems.

Project Description: This project entails rehabilitating selected components of the existing support utility systems. The major support utility systems include:

- Potable water, utility water, hot water, utility air
- Digester gas, landfill gas, natural gas
- Tank drains, sanitary drains, storm drains
- Recycled water

Project Implementation: These improvements are assumed to be packaged into one larger WPCP R&R project (as opposed to smaller individual projects).

Permits Required: None

Special Considerations/Additional Notes: The condition assessment, proposed to be completed as part of the Existing Plant Rehabilitation Project, would include an assessment of the support utility systems (even though rehabilitation/replacement of these facilities would likely be completed as a standalone project). Depending upon the timing of these improvements, the support utility systems section of that condition assessment may need to be updated.

APPENDIX E - FISCAL CASH FLOW SCENARIOS

Master Plan CIP Fiscal Scenarios - Membrane Bioreactors (MBRs)
Total Program Costs (Escalated)

FINAL
5/16/2016

CIP Phase	Project Title (Descriptive)	Scenario 1 - Total CIP (Includes all potential projects)									Scenario 2				Scenario 3				Comments
		% of Project Incld.	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phases 1 - 3	Phases 4 - 5	Total (Ph. 1 - 5)	% of Project Incld.	Phases 1 - 3	Phases 4 - 5	Total (Ph. 1 - 5)	% of Project Incld.	Phases 1 - 3	Phases 4 - 5	Total (Ph. 1 - 5)	
	PRIMARY TREATMENT																		
1	Primary Treatment Facility	100%	$ 133,100,000	$ -	$ -	$ -	$ -	$ 133,100,000	$ -	$ 133,100,000	100%	$ 133,100,000	$ -	$ 133,100,000	100%	$ 133,100,000	$ -	$ 133,100,000	
1	Rehabilitation Primary Effluent Pipeline from Central Plant to Ponds	100%	$ 2,800,000	$ -	$ -	$ -	$ -	$ 2,800,000	$ -	$ 2,800,000	100%	$ 2,800,000	$ -	$ 2,800,000	100%	$ 2,800,000	$ -	$ 2,800,000	
1	Rehabilitation Influent Pipelines to WPCP	100%	$ 1,500,000	$ -	$ -	$ -	$ -	$ 1,500,000	$ -	$ 1,500,000	100%	$ 1,500,000	$ -	$ 1,500,000	100%	$ 1,500,000	$ -	$ 1,500,000	
	SECONDARY TREATMENT																		
1	Existing Plant Rehabilitation - MBR	100%	$ 21,000,000	$ -	$ -	$ -	$ -	$ 21,000,000	$ -	$ 21,000,000	100%	$ 21,000,000	$ -	$ 21,000,000	100%	$ 21,000,000	$ -	$ 21,000,000	
2	Secondary Treatment Improvements - MBR Stage 1 *	100%	$ -	$ 263,000,000	$ -	$ -	$ -	$ 263,000,000	$ -	$ 263,000,000	100%	$ 263,000,000	$ -	$ 263,000,000	100%	$ 263,000,000	$ -	$ 263,000,000	
5	Secondary Treatment Improvements - MBR Stage 2	100%	$ -	$ -	$ -	$ -	$ 20,000,000	$ -	$ 20,000,000	$ 20,000,000	100%	$ -	$ 20,000,000	$ 20,000,000	0%	$ -	$ -	$ -	Scenario 3 based on flows and loads not increasing enough to require Stage 2 facilities.
2	Primary Effluent Diurnal Equalization and Emergency Storage	100%	$ -	$ 109,000,000	$ -	$ -	$ -	$ 109,000,000	$ -	$ 109,000,000	100%	$ 109,000,000	$ -	$ 109,000,000	84%	$ 91,600,000	$ -	$ 91,600,000	Scenario 3 based on building 1 day of emergency storage instead of 3.
2	Active Retirement of Ponds	100%	$ -	$ 8,700,000	$ -	$ -	$ -	$ 8,700,000	$ -	$ 8,700,000	100%	$ 8,700,000	$ -	$ 8,700,000	0%	$ -	$ -	$ -	
5	Chemical Dosing (P-Removal)	100%	$ -	$ -	$ -	$ -	$ 2,200,000	$ -	$ 2,200,000	$ 2,200,000	0%	$ -	$ -	$ -	0%	$ -	$ -	$ -	
	TERTIARY TREATMENT																		
5	Denitrification Filters	100%	$ -	$ -	$ -	$ -	$ 63,600,000	$ -	$ 63,600,000	$ 63,600,000	0%	$ -	$ -	$ -	0%	$ -	$ -	$ -	
4	Chloramine Disinfection	100%	$ -	$ -	$ -	$ 4,100,000	$ -	$ -	$ 4,100,000	$ 4,100,000	100%	$ -	$ 4,100,000	$ 4,100,000	100%	$ -	$ 4,100,000	$ 4,100,000	
5	UV Disinfection	100%	$ -	$ -	$ -	$ -	$ 20,800,000	$ -	$ 20,800,000	$ 20,800,000	100%	$ -	$ 20,800,000	$ 20,800,000	100%	$ -	$ 20,800,000	$ 20,800,000	
5	Ozone Disinfection	100%	$ -	$ -	$ -	$ -	$ 45,800,000	$ -	$ 45,800,000	$ 45,800,000	0%	$ -	$ -	$ -	0%	$ -	$ -	$ -	
3	Reverse Osmosis (RO), UV Disinfection, Advanced Oxidation Process (AOP) for Reuse *	100%	$ -	$ -	$ 84,300,000	$ -	$ -	$ 84,300,000	$ -	$ 84,300,000	100%	$ 84,300,000	$ -	$ 84,300,000	100%	$ 84,300,000	$ -	$ 84,300,000	
	SOLIDS FACILITIES																		
2	Digester Supernatant PS and Drainage Piping Upgrades	100%	$ -	$ 1,200,000	$ -	$ -	$ -	$ 1,200,000	$ -	$ 1,200,000	100%	$ 1,200,000	$ -	$ 1,200,000	100%	$ 1,200,000	$ -	$ 1,200,000	
2	Thickening and Dewatering Facility - Stage 1	100%	$ -	$ 49,900,000	$ -	$ -	$ -	$ 49,900,000	$ -	$ 49,900,000	100%	$ 49,900,000	$ -	$ 49,900,000	100%	$ 49,900,000	$ -	$ 49,900,000	
4	Thickening and Dewatering Facility - Stage 2	100%	$ -	$ -	$ -	$ 14,300,000	$ -	$ -	$ 14,300,000	$ 14,300,000	100%	$ -	$ 14,300,000	$ 14,300,000	100%	$ -	$ 14,300,000	$ 14,300,000	
4	Digester No. 5	100%	$ -	$ -	$ -	$ 10,500,000	$ -	$ -	$ 10,500,000	$ 10,500,000	100%	$ -	$ 10,500,000	$ 10,500,000	100%	$ -	$ 10,500,000	$ 10,500,000	
4	FOG/Food Waste Facility	100%	$ -	$ -	$ -	$ 2,100,000	$ -	$ -	$ 2,100,000	$ 2,100,000	100%	$ -	$ 2,100,000	$ 2,100,000	100%	$ -	$ 2,100,000	$ 2,100,000	Potential reduction in Phase 1 -3 Program.
5	Phosphorus Recovery Facility	100%	$ -	$ -	$ -	$ -	$ 10,900,000	$ -	$ 10,900,000	$ 10,900,000	0%	$ -	$ -	$ -	0%	$ -	$ -	$ -	
4	Biosolids Post-Processing	100%	$ -	$ -	$ -	$ 32,200,000	$ -	$ -	$ 32,200,000	$ 32,200,000	100%	$ -	$ 32,200,000	$ 32,200,000	0%	$ -	$ -	$ -	
	COMBINED HEAT AND POWER																		
3	Cogeneration Upgrade	100%	$ -	$ -	$ 21,200,000	$ -	$ -	$ 21,200,000	$ -	$ 21,200,000	100%	$ 21,200,000	$ -	$ 21,200,000	100%	$ 21,200,000	$ -	$ 21,200,000	
	SUPPORT FACILITIES																		
1	New Access to Bay Trails	100%	$ 600,000	$ -	$ -	$ -	$ -	$ 600,000	$ -	$ 600,000	100%	$ 600,000	$ -	$ 600,000	100%	$ 600,000	$ -	$ 600,000	
1	Household Hazardous Waste Demolition/ Solid Waste Removal	100%	$ 500,000	$ -	$ -	$ -	$ -	$ 500,000	$ -	$ 500,000	100%	$ 500,000	$ -	$ 500,000	100%	$ 500,000	$ -	$ 500,000	
2	Administration and Lab Building	100%	$ -	$ 26,300,000	$ -	$ -	$ -	$ 26,300,000	$ -	$ 26,300,000	100%	$ 26,300,000	$ -	$ 26,300,000	100%	$ 26,300,000	$ -	$ 26,300,000	
2	Maintenance Building	100%	$ -	$ 7,400,000	$ -	$ -	$ -	$ 7,400,000	$ -	$ 7,400,000	100%	$ 7,400,000	$ -	$ 7,400,000	100%	$ 7,400,000	$ -	$ 7,400,000	
	SUPPORT UTILITIES																		
2	Recycle Water Improvements (New Recycled Water PS)	100%	$ -	$ 4,200,000	$ -	$ -	$ -	$ 4,200,000	$ -	$ 4,200,000	100%	$ 4,200,000	$ -	$ 4,200,000	100%	$ 4,200,000	$ -	$ 4,200,000	
2	Community Improvements	100%	$ -	$ 700,000	$ -	$ -	$ -	$ 700,000	$ -	$ 700,000	100%	$ 700,000	$ -	$ 700,000	100%	$ 700,000	$ -	$ 700,000	
2	Landfill Gas Flare and Booster System Upgrades	100%	$ -	$ 400,000	$ -	$ -	$ -	$ 400,000	$ -	$ 400,000	100%	$ 400,000	$ -	$ 400,000	100%	$ 400,000	$ -	$ 400,000	
2	Miscellaneous Civil Site/Support Utility Improvements	100%	$ -	$ 700,000	$ -	$ -	$ -	$ 700,000	$ -	$ 700,000	100%	$ 700,000	$ -	$ 700,000	100%	$ 700,000	$ -	$ 700,000	
	DEMOLITION																		
	OPERATIONS AND MAINTENANCE																		
	Capital Replacement (1% of All New Construction)	100%	$ 1,510,000	$ 1,670,000	$ 1,840,000	$ 2,900,000	$ 3,850,000	$ 5,020,000	$ 6,750,000	$ 11,770,000	100%	$ 5,020,000	$ 6,750,000	$ 11,770,000	100%	$ 5,020,000	$ 6,750,000	$ 11,770,000	
	Total		**$ 161,010,000**	**$ 473,170,000**	**$ 107,340,000**	**$ 66,100,000**	**$ 167,150,000**	**$ 741,520,000**	**$ 233,250,000**	**$ 974,770,000**		**$ 741,520,000**	**$ 110,750,000**	**$ 852,270,000**		**$ 715,420,000**	**$ 58,550,000**	**$ 773,970,000**	

Notes:
* Includes project with the City of Sunnyvale and Santa Clara Valley Water District. To be jointly funded.

APPENDIX F - CIP MODEL USER INFORMATION

User Information for WPCP Master Plan CIP Model (Excel Spreadsheet)
Master Plan
City of Sunnyvale

Input Tabs	Column	Input/ Calculated	Description of Key Inputs or Calculated Values
Program Factor Input			
	B	Input	Program cost factors for all Master Plan CIP projects, unless noted otherwise.
	C	Input	Program cost factors for Primary Treatment Facility
	D	Input	Program cost factors for Secondary Treatment Improvements Stage 1 and 2
Capital Replacement-Input			
	C	Input	Percentage of annual expenditure for capital replacement
HW-PST Detail			
	E	Input	Total construction cost for each phase of the project
	F	Input	Total cost of each phase of engineering services during construction (ESDC)
	G - M	Input	Custom s-curve to be used for each phase of the project
CAS CIP-Input			
MBR CIP-Input			
	A	Input	Project ID, a numerical assignment to facilitate cross reference with individual project descriptions.
	B	Input	Project phase (1 - 5), based on approximate time the project will take place.
	C	Input	Description of whether the project is the same as CAS. Enter one of the following: - On the CAS tab, enter "n/a" for all projects - On MBR tab, enter "No - Scope" if only the scope is different - On MBR tab, enter "No - Scope/Timing" if the scope and timing are different - On MBR tab, enter "No - Timing" if only the timing is different
	D	Input	Project title
	E	Input	Project category. Enter one of the following: - Enter "General" if the project is the same under Split Flow CAS, Full CAS, and MBR implementation - Enter "Split Flow" if the project applies to Split Flow implementation only - Enter "Full CAS" if the project applies to Full CAS implementation only. - Enter "MBR" if the project applies to MBR implementation only - Enter "Not Included" if the project is already underway and funded through previous CIP planning efforts
	F	Input	Construction cost of each project element (i.e., each line item on this tab).
	G	Input	Sum of all project elements included in the total project package. (Manually sum project elements included in the project package).
	H	Calculated	Years to midpoint of construction
	I	Calculated	Total escalated construction cost
	J	Calculated	Total escalated project cost
	K	Input	Project driver. Enter one of the following: - R&R - Regulatory - Flow and Load - Performance/Econ. - Policy
	L	Input	Project start date
	M	Calculated	Project start year
	N	Input	Duration of project planning/design phase (in months)
	O	Input	Duration of project permitting/CEQA phase (in months)
	P	Input	Duration of gaps in project schedule (if any) (in months)
	Q	Input	Duration of project construction phase (in months)
	R	Calculated	Total project duration (in months)
	S	Calculated	Total project duration (in years)
	T	Calculated	Fiscal year project is online (i.e. complete)

	U - Y	Calculated	Project cost for each phase of the master plan.
	Z - BE	Calculated	Fiscal year cash flow of project
CAS Fiscal Scenarios			
MBR Fiscal Scenarios			
	A	Calculated	Project phase (1 - 5), based on approximate time the project will take place.
	B	Calculated	Project title
	C	Fixed	Percentage of project included in Fiscal Planning Scenario 1. Fixed at 100% because this scenario includes all CIP projects.
	D - K	Calculated	Project cost for each phase of the master plan, under Fiscal Planning Scenario 1.
	L	Input	Percentage of project included in Fiscal Planning Scenario 2.
	M - O	Calculated	Project cost for each phase of the master plan, under Fiscal Planning Scenario 2.
	P	Input	Percentage of project included in Fiscal Planning Scenario 3.
	Q - S	Calculated	Project cost for each phase of the master plan, under Fiscal Planning Scenario 3.
	T	Input	Comments describing specific inputs. Enter as needed.
S-Curve - Standard	All	Fixed	Standard project cost breakdown by year depending on the duration of the project.

Output Tabs	**CAS Tab Name**	**MBR Tab Name**	**Description of Tab Contents**
CAS Output Tabs			
CAS Output Tabs			
	CAS TM Fig 1	MBR TM Fig 1	Figure showing the breakdown of the total CIP program cost by project driver. Figure is based on implementing Fiscal Planning Scenario 2.
	CAS TM Fig 2	MBR TM Fig 2	Figure showing the annual CIP program costs. Figure is based on implementing Fiscal Planning Scenario 1 (all CIP projects).
	CAS-Fig-Fiscal Scenarios	MBR-Fig-Fiscal Scenarios	Figure comparing the annual CIP program costs of each of the Fiscal Planning Scenarios.
	CAS FY Cash-Scn 1	MBR FY Cash-Scn 1	Table summarizing the annual program costs for Fiscal Planning Scenario 1.
	CAS FY Cash-Scn 2	MBR FY Cash-Scn 2	Table summarizing the annual program costs for Fiscal Planning Scenario 2.
	CAS FY Cash-Scn 3	MBR FY Cash-Scn 3	Table summarizing the annual program costs for Fiscal Planning Scenario 3.

APPENDIX G - PROGRAM O&M COSTS

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase		**Phase 0**				**Phase 1**				**Phase 2**		
Year	**6/14 - 7/15**	**6/15 - 7/16**	**6/16 - 7/17**	**6/17 - 7/18**	**6/18 - 7/19**	**6/19 - 7/20**	**6/20 - 7/21**	**6/21 - 7/22**	**6/22 - 7/23**	**6/23 - 7/24**	**6/24 - 7/25**	**6/25 - 7/26**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Average Annual Flow												
Flow, mgd	15.2	15.2	15.5	15.7	16.0	16.2	16.5	16.8	17.0	17.3	17.5	17.8
Recycled Water, mgd		1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Bay Discharge, mgd		13.5	13.8	14.0	14.3	14.5	14.8	15.1	15.3	15.6	15.8	16.1
Labor Costs												
UNESCALATED Total Annual Labor Cost, $	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000
ESCALATED Total Annual Labor Cost, $	$ 9,100,000	$ 9,100,000	$ 9,400,000	$ 9,700,000	$ 9,900,000	$ 10,200,000	$ 10,500,000	$ 10,900,000	$ 11,200,000	$ 11,500,000	$ 11,900,000	$ 12,200,000
	Note: same value each year											
Power Costs												
Average Power Demand, kW						1,520	1,545	1,569	1,593	1,618	6,006	6,095
Average Power Production, kW						1,000	1,000	1,000	1,000	1,000	1,000	1,000
Net Power Demand (Usage), kW						520	545	569	593	618	5,006	5,095
Average Annual Power Demand, kWh						4,557,446	4,770,656	4,983,867	5,197,077	5,410,287	43,850,878	44,630,743
Average Cost of Power, $/kWh						$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20
UNESCALATED Annual Power Cost, $	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 900,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,100,000	$ 8,800,000	$ 8,900,000
ESCALATED Annual Power Cost, $	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 1,100,000	$ 1,300,000	$ 1,300,000	$ 1,400,000	$ 1,600,000	$ 13,700,000	$ 14,500,000
Chemical Costs												
Polymer - CEPT												
Dose, mg/L		0	0	0	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Usage, pounds per day		0	0	0	0	28	28	28	29	29	30	30
Activation, %		30	30	30	30	30	30	30	30	30	30	30
Density, SG		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Months of Operation per Year		0	0	0	0	2	2	2	2	2	2	2
Usage, gallons per year		0	0	0	0	668	668	668	692	692	717	717
Usage, pounds per year		0	0	0	0	1703	1703	1703	1764	1764	1825	1825
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ 1,908	$ 1,908	$ 1,908	$ 1,976	$ 1,976	$ 2,044	$ 2,044
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ 2,147	$ 2,212	$ 2,278	$ 2,430	$ 2,503	$ 2,667	$ 2,747
Polymer - AFT												
Dose, mg/L		5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	0	0	0
Usage, pounds per day		698	710	722	734	745	757	769	781	0	0	0
Activation, %		27	27	27	27	27	27	27	27	27	27	27
Density, SG		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year		110930	112830	114740	116650	118400	120300	122210	124120	0	0	0
Usage, pounds per year		254770	259150	263530	267910	271925	276305	280685	285065	0	0	0
UNESCALATED Annual Cost, $	$ 285,342	$ 290,248	$ 295,154	$ 300,059	$ 304,556	$ 309,462	$ 314,367	$ 319,273	$ -	$ -	$ -	
ESCALATED Annual Cost, $	$ 285,342	$ 298,955	$ 313,128	$ 327,883	$ 342,780	$ 358,751	$ 375,371	$ 392,665	$ -	$ -	$ -	
Polymer - DMF												
Dose, mg/L		1	1	1	1	1	1	1	1	0	0	0
Usage, pounds per day		127	129	132	134	136	138	140	142	0	0	0
Activation, %		27	27	27	27	27	27	27	27	27	27	27
Density, SG		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year		20190	20500	20980	21300	21620	21940	22250	22570	0	0	0
Usage, pounds per year		46355	47085	48180	48910	49640	50370	51100	51830	0	0	0
UNESCALATED Annual Cost, $	$ 51,918	$ 52,735	$ 53,962	$ 54,779	$ 55,597	$ 56,414	$ 57,232	$ 58,050	$ -	$ -	$ -	
ESCALATED Annual Cost, $	$ 51,918	$ 54,317	$ 57,248	$ 59,859	$ 62,575	$ 65,400	$ 68,338	$ 71,394	$ -	$ -	$ -	
Polymer - Thickening												
Sludge, pounds per day		0	0	0	0	0	0	0	0	14000	14083	14167
Dose, lb/dry ton		15	15	15	15	15	15	15	15	15	15	15
Usage, pounds per day		0	0	0	0	0	0	0	0	105	106	107
Activation, %		30	30	30	30	30	30	30	30	30	30	30
Density, SG		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year		0	0	0	0	0	0	0	0	15020	15170	15310

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			Phase 3							Phase 4		
Year	6/26 - 7/27	6/27 - 7/28	6/28 - 7/29	6/29 - 7/30	6/30 - 7/31	6/31 - 7/32	6/32 - 7/33	6/33 - 7/34	6/34 - 7/35	6/35 - 7/36	6/36 - 7/37	6/37 - 7/38
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Average Annual Flow												
Flow, mgd	18.1	18.3	18.6	18.8	19.1	19.4	19.6	19.9	20.1	20.4	20.4	20.4
Recycled Water, mgd	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	3.6	3.6	3.6
Bay Discharge, mgd	16.4	16.6	16.9	17.1	17.4	17.7	17.9	18.2	18.4	16.8	16.8	16.8
Labor Costs												
UNESCALATED Total Annual Labor Cost, $	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000
ESCALATED Total Annual Labor Cost, $	$ 12,600,000	$ 13,000,000	$ 13,400,000	$ 13,800,000	$ 14,200,000	$ 14,600,000	$ 15,000,000	$ 15,500,000	$ 16,000,000	$ 16,400,000	$ 16,900,000	$ 17,400,000
	3.11											
Power Costs												
Average Power Demand, kW	6,184	6,273	6,362	6,451	6,540	6,629	6,718	6,807	6,896	6,985	6,985	6,985
Average Power Production, kW	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Net Power Demand (Usage), kW	5,184	5,273	5,362	5,451	5,540	5,629	5,718	5,807	5,896	5,985	5,985	5,985
Average Annual Power Demand, kWh	45,410,608	46,190,472	46,970,337	47,750,202	48,530,067	49,309,932	50,089,796	50,869,661	51,649,526	52,429,391	52,429,391	52,429,391
Average Cost of Power, $/kWh	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20
UNESCALATED Annual Power Cost, $	$ 9,100,000	$ 9,200,000	$ 9,400,000	$ 9,600,000	$ 9,700,000	$ 9,900,000	$ 10,000,000	$ 10,200,000	$ 10,300,000	$ 10,500,000	$ 10,500,000	$ 10,500,000
ESCALATED Annual Power Cost, $	$ 15,600,000	$ 16,500,000	$ 17,700,000	$ 19,000,000	$ 20,200,000	$ 21,600,000	$ 22,900,000	$ 24,500,000	$ 26,000,000	$ 27,900,000	$ 29,300,000	$ 30,700,000
Chemical Costs												
Polymer - CEPT												
Dose, mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Usage, pounds per day	31	31	31	32	32	33	33	34	34	35	35	35
Activation, %	30	30	30	30	30	30	30	30	30	30	30	30
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Months of Operation per Year	2	2	2	2	2	2	2	2	2	2	2	2
Usage, gallons per year	740	740	740	763	763	787	787	812	812	835	835	835
Usage, pounds per year	1886	1886	1886	1947	1947	2008	2008	2068	2068	2129	2129	2129
UNESCALATED Annual Cost, $	$ 2,112	$ 2,112	$ 2,112	$ 2,180	$ 2,180	$ 2,248	$ 2,248	$ 2,317	$ 2,317	$ 2,385	$ 2,385	$ 2,385
ESCALATED Annual Cost, $	$ 2,924	$ 3,011	$ 3,102	$ 3,298	$ 3,397	$ 3,608	$ 3,716	$ 3,944	$ 4,062	$ 4,307	$ 4,436	$ 4,569
Polymer - AFT												
Dose, mg/L	0	0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per day	0	0	0	0	0	0	0	0	0	0	0	0
Activation, %	27	27	27	27	27	27	27	27	27	27	27	27
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year	0	0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per year	0	0	0	0	0	0	0	0	0	0	0	0
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer - DMF												
Dose, mg/L	0	0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per day	0	0	0	0	0	0	0	0	0	0	0	0
Activation, %	27	27	27	27	27	27	27	27	27	27	27	27
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year	0	0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per year	0	0	0	0	0	0	0	0	0	0	0	0
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer - Thickening												
Sludge, pounds per day	14250	14333	14417	14500	14583	14667	14750	14833	14917	15000	15000	15000
Dose, lb/dry ton	15	15	15	15	15	15	15	15	15	15	15	15
Usage, pounds per day	107	108	109	109	110	110	111	112	112	113	113	113
Activation, %	30	30	30	30	30	30	30	30	30	30	30	30
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year	15310	15450	15590	15590	15740	15740	15880	16020	16020	16170	16170	16170

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			**Phase 5**					
Year	**6/38 - 7/39**	**6/39 - 7/40**	**6/40 - 7/41**	**6/41 - 7/42**	**6/42 - 7/43**	**6/43 - 7/44**	**6/44 - 7/45**	
	2038	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	
Average Annual Flow								
Flow, mgd	20.4	20.4	20.4	20.4	20.4	20.4	20.4	
Recycled Water, mgd	3.6	3.6	3.6	3.6	3.6	3.6	3.6	
Bay Discharge, mgd	16.8	16.8	16.8	16.8	16.8	16.8	16.8	
Labor Costs								
UNESCALATED Total Annual Labor Cost, $	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	$ 9,100,000	**$ 282,100,000**
ESCALATED Total Annual Labor Cost, $	$ 18,000,000	$ 18,500,000	$ 19,100,000	$ 19,600,000	$ 20,200,000	$ 20,800,000	$ 21,400,000	**$ 442,000,000**
Power Costs								
Average Power Demand, kW	6,985	6,985	7,924	7,924	7,924	7,924	7,924	
Average Power Production, kW	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
Net Power Demand (Usage), kW	5,985	5,985	6,924	6,924	6,924	6,924	6,924	
Average Annual Power Demand, kWh	52,429,391	52,429,391	60,653,049	60,653,049	60,653,049	60,653,049	60,653,049	
Average Cost of Power, $/kWh	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	
UNESCALATED Annual Power Cost, $	$ 10,500,000	$ 10,500,000	$ 12,100,000	$ 12,100,000	$ 12,100,000	$ 12,100,000	$ 12,100,000	**$ 224,600,000**
ESCALATED Annual Power Cost, $	$ 32,300,000	$ 33,900,000	$ 41,000,000	$ 43,000,000	$ 45,200,000	$ 47,400,000	$ 49,800,000	**$ 600,900,000**
Chemical Costs								
Polymer - CEPT								
Dose, mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Usage, pounds per day	35	35	35	35	35	35	35	
Activation, %	30	30	30	30	30	30	30	
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Months of Operation per Year	2	2	2	2	2	2	2	
Usage, gallons per year	835	835	835	835	835	835	835	
Usage, pounds per year	2129	2129	2129	2129	2129	2129	2129	
UNESCALATED Annual Cost, $	$ 2,385	$ 2,385	$ 2,385	$ 2,385	$ 2,385	$ 2,385	$ 2,385	**$ 57,436**
ESCALATED Annual Cost, $	$ 4,706	$ 4,848	$ 4,993	$ 5,143	$ 5,297	$ 5,456	$ 5,620	**$ 97,420**
Polymer - AFT								
Dose, mg/L	0	0	0	0	0	0	0	
Usage, pounds per day	0	0	0	0	0	0	0	
Activation, %	27	27	27	27	27	27	27	
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Usage, gallons per year	0	0	0	0	0	0	0	
Usage, pounds per year	0	0	0	0	0	0	0	
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,418,461**
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,694,877**
Polymer - DMF								
Dose, mg/L	0	0	0	0	0	0	0	
Usage, pounds per day	0	0	0	0	0	0	0	
Activation, %	27	27	27	27	27	27	27	
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Usage, gallons per year	0	0	0	0	0	0	0	
Usage, pounds per year	0	0	0	0	0	0	0	
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 440,686**
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 491,048**
Polymer - Thickening								
Sludge, pounds per day	15000	15000	15000	15000	15000	15000	15000	
Dose, lb/dry ton	15	15	15	15	15	15	15	
Usage, pounds per day	113	113	113	113	113	113	113	
Activation, %	30	30	30	30	30	30	30	
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Usage, gallons per year	16170	16170	16170	16170	16170	16170	16170	

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase		Phase 0				Phase 1				Phase 2		
Year	6/14 - 7/15	6/15 - 7/16	6/16 - 7/17	6/17 - 7/18	6/18 - 7/19	6/19 - 7/20	6/20 - 7/21	6/21 - 7/22	6/22 - 7/23	6/23 - 7/24	6/24 - 7/25	6/25 - 7/26
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Usage, pounds per year		0	0	0	0	0	0	0	0	38325	38690	39055
UNESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 42,924	$ 43,333	$ 43,742
ESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 54,375	$ 56,539	$ 58,785
Polymer - Dewatering												
Sludge, pounds per day		0	0	0	0	0	0	0	0	19600	19742	19883
Dose, lb/dry ton		34	34	34	34	34	34	34	34	34	34	34
Usage, pounds per day		0	0	0	0	0	0	0	0	334	336	339
Activation, %		30	30	30	30	30	30	30	30	30	30	30
Density, SG		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year		0	0	0	0	0	0	0	0	47770	48060	48490
Usage, pounds per year		0	0	0	0	0	0	0	0	121910	122640	123735
UNESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 136,539	$ 137,357	$ 138,583
ESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 172,964	$ 179,219	$ 186,244
Ferric Chloride ($FeCl_3$) - CEPT												
Dose, mg/L		0	0	0	0	20	20	20	20	20	20	20
Usage, pounds per day		0	0	0	0	2709	2753	2796	2839	2883	2926	2970
Solution, %		39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Density, SG		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Months of Operation per Year		0	0	0	0	2	2	2	2	2	2	2
Usage, gallons per year		0	0	0	0	38482	39107	39717	40328	40953	41563	42188
Usage, pounds per year		0	0	0	0	164798	167474	170090	172706	175383	177998	180675
UNESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ 55,798	$ 56,705	$ 57,589	$ 58,476	$ 59,382	$ 60,267	$ 61,173
ESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ 62,802	$ 65,736	$ 68,764	$ 71,918	$ 75,224	$ 78,635	$ 82,212
Ferric Chloride ($FeCl_3$) - Chemical Phosphorous Removal[(1)]												
Dose, mg/L		0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per day		0	0	0	0	0	0	0	0	0	0	0
Solution, %		39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Density, SG		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Months of Operation per Year		0	1	2	3	4	5	6	7	8	9	10
Usage, gallons per year		0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per year		0	0	0	0	0	0	0	0	0	0	0
UNESCALATED Annual Cost, $	$	- $	- $	- $	- $	- $	- $	- $	- $	- $	- $	-
ESCALATED Annual Cost, $	$	- $	- $	- $	- $	- $	- $	- $	- $	- $	- $	-
Methanol - Nitrogen Removal (Required if Chemical Phosphorous Removal is implemented)[(1)]												
Dose, mg/L		0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per day		0	0	0	0	0	0	0	0	0	0	0
Density, SG		0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Usage, gallons per day		0	0	0	0	0	0	0	0	0	0	0
Usage, gallons per year		0	0	0	0	0	0	0	0	0	0	0
Usage, pounds per year		0	0	0	0	0	0	0	0	0	0	0
UNESCALATED Annual Cost, $	$	- $	- $	- $	- $	- $	- $	- $	- $	- $	- $	-
ESCALATED Annual Cost, $	$	- $	- $	- $	- $	- $	- $	- $	- $	- $	- $	-
Sodium Hypochlorite (NaOCl) - Chlorination												
Dose, mg/L Cl2		11	11	11	11	11	11	11	11	11	11	11
Usage, pounds per day Cl2		1395	1419	1443	1467	1490	1514	1538	1562	1586	1610	1633
NaOCl/Cl2 Ratio		1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
NaOCl Concentration, %		12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Density, SG		1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Usage, pounds per day NaOCl		1465	1490	1516	1541	1565	1590	1615	1641	1666	1691	1715
Usage, gallons per year NaOCl		420440	427610	435070	442250	449130	456310	463480	470940	478120	485290	492180
Usage, pounds per year NaOCl		534725	543850	553340	562465	571225	580350	589475	598965	608090	617215	625975
UNESCALATED Annual Cost, $	$	420,440 $	427,610 $	435,070 $	442,250 $	449,130 $	456,310 $	463,480 $	470,940 $	478,120 $	485,290 $	492,180
ESCALATED Annual Cost, $	$	420,440 $	440,438 $	461,566 $	483,259 $	505,500 $	528,988 $	553,419 $	579,197 $	605,668 $	633,193 $	661,449

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			Phase 3							Phase 4		
Year	6/26 - 7/27	6/27 - 7/28	6/28 - 7/29	6/29 - 7/30	6/30 - 7/31	6/31 - 7/32	6/32 - 7/33	6/33 - 7/34	6/34 - 7/35	6/35 - 7/36	6/36 - 7/37	6/37 - 7/38
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Usage, pounds per year	39055	39420	39785	39785	40150	40150	40515	40880	40880	41245	41245	41245
UNESCALATED Annual Cost, $	$ 43,742	$ 44,150	$ 44,559	$ 44,559	$ 44,968	$ 44,968	$ 45,377	$ 45,786	$ 45,786	$ 46,194	$ 46,194	$ 46,194
ESCALATED Annual Cost, $	$ 60,549	$ 62,948	$ 65,437	$ 67,400	$ 70,059	$ 72,160	$ 75,001	$ 77,947	$ 80,285	$ 83,432	$ 85,935	$ 88,513
Polymer - Dewatering												
Sludge, pounds per day	20025	20167	20308	20450	20592	20733	20875	21017	21158	21300	21300	21300
Dose, lb/dry ton	34	34	34	34	34	34	34	34	34	34	34	34
Usage, pounds per day	341	343	346	348	351	353	355	358	360	363	363	363
Activation, %	30	30	30	30	30	30	30	30	30	30	30	30
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Usage, gallons per year	48780	49060	49490	49780	50210	50490	50780	51210	51490	51920	51920	51920
Usage, pounds per year	124465	125195	126290	127020	128115	128845	129575	130670	131400	132495	132495	132495
UNESCALATED Annual Cost, $	$ 139,401	$ 140,218	$ 141,445	$ 142,262	$ 143,489	$ 144,306	$ 145,124	$ 146,350	$ 147,168	$ 148,394	$ 148,394	$ 148,394
ESCALATED Annual Cost, $	$ 192,963	$ 199,918	$ 207,716	$ 215,185	$ 223,551	$ 231,569	$ 239,868	$ 249,152	$ 258,060	$ 268,017	$ 276,057	$ 284,339
Ferric Chloride ($FeCl_3$) - CEPT												
Dose, mg/L	20	20	20	20	20	20	20	20	20	0	0	0
Usage, pounds per day	3013	3056	3100	3143	3186	3230	3273	3316	3360	0	0	0
Solution, %	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Density, SG	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Months of Operation per Year	2	2	2	2	2	2	2	2	2	2	2	2
Usage, gallons per year	42800	43410	44035	44646.66667	45257	45882	46493	47103	47728	0	0	0
Usage, pounds per year	183291	185907	188583	191199	193815	196492	199108	201723	204400	0	0	0
UNESCALATED Annual Cost, $	$ 62,060	$ 62,945	$ 63,851	$ 64,738	$ 65,622	$ 66,528	$ 67,415	$ 68,300	$ 69,206	$ -	$ -	$ -
ESCALATED Annual Cost, $	$ 85,906	$ 89,744	$ 93,767	$ 97,922	$ 102,237	$ 106,759	$ 111,427	$ 116,276	$ 121,353	$ -	$ -	$ -
Ferric Chloride ($FeCl_3$) - Chemical Phosphorous Removal[1]												
Dose, mg/L	0	0	0	0	0	0	0	0	0	54	54	54
Usage, pounds per day	0	0	0	0	0	0	0	0	0	9188	9188	9188
Solution, %	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Density, SG	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Months of Operation per Year	11	12	13	14	15	16	17	18	19	12	12	12
Usage, gallons per year	0	0	0	0	0	0	0	0	0	783,090	783,090	783,090
Usage, pounds per year	0	0	0	0	0	0	0	0	0	3,353,620	3,353,620	3,353,620
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,135,481	$ 1,135,481	$ 1,135,481
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,050,804	$ 2,112,328	$ 2,175,698
Methanol - Nitrogen Removal (Required if Chemical Phosp												
Dose, mg/L	0	0	0	0	0	0	0	0	0	6.64	6.64	6.64
Usage, pounds per day	0	0	0	0	0	0	0	0	0	1130	1130	1130
Density, SG	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Usage, gallons per day	0	0	0	0	0	0	0	0	0	171	171	171
Usage, gallons per year	0	0	0	0	0	0	0	0	0	62,565	62,565	62,565
Usage, pounds per year	0	0	0	0	0	0	0	0	0	412,476	412,476	412,476
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 125,130	$ 125,130	$ 125,130
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 225,999	$ 232,779	$ 239,762
Sodium Hypochlorite (NaOCl) - Chlorination												
Dose, mg/L Cl2	11	11	11	11	11	11	11	11	11	11	11	11
Usage, pounds per day Cl2	1657	1681	1705	1729	1753	1777	1800	1824	1848	1872	1872	1872
NaOCl/Cl2 Ratio	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
NaOCl Concentration, %	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Density, SG	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Usage, pounds per day NaOCl	1740	1766	1791	1816	1841	1866	1890	1916	1941	1966	1966	1966
Usage, gallons per year NaOCl	499360	506820	513990	521170	528340	535520	542400	549870	557040	564210	564210	564210
Usage, pounds per year NaOCl	635100	644590	653715	662840	671965	681090	689850	699340	708465	717590	717590	717590
UNESCALATED Annual Cost, $	$ 499,360	$ 506,820	$ 513,990	$ 521,170	$ 528,340	$ 535,520	$ 542,400	$ 549,870	$ 557,040	$ 564,210	$ 564,210	$ 564,210
ESCALATED Annual Cost, $	$ 691,231	$ 722,604	$ 754,812	$ 788,316	$ 823,137	$ 859,352	$ 896,505	$ 936,117	$ 976,773	$ 1,019,026	$ 1,049,597	$ 1,081,085

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			**Phase 5**					
Year	**6/38 - 7/39**	**6/39 - 7/40**	**6/40 - 7/41**	**6/41 - 7/42**	**6/42 - 7/43**	**6/43 - 7/44**	**6/44 - 7/45**	
	2038	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	
Usage, pounds per year	41245	41245	41245	41245	41245	41245	41245	
UNESCALATED Annual Cost, $	$ 46,194	$ 46,194	$ 46,194	$ 46,194	$ 46,194	$ 46,194	$ 46,194	**$ 995,837**
ESCALATED Annual Cost, $	$ 91,169	$ 93,904	$ 96,721	$ 99,622	$ 102,611	$ 105,689	$ 108,860	**$ 1,757,942**
Polymer - Dewatering								
Sludge, pounds per day	21300	21300	21300	21300	21300	21300	21300	
Dose, lb/dry ton	34	34	34	34	34	34	34	
Usage, pounds per day	363	363	363	363	363	363	363	
Activation, %	30	30	30	30	30	30	30	
Density, SG	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Usage, gallons per year	51920	51920	51920	51920	51920	51920	51920	
Usage, pounds per year	132495	132495	132495	132495	132495	132495	132495	
UNESCALATED Annual Cost, $	$ 148,394	$ 148,394	$ 148,394	$ 148,394	$ 148,394	$ 148,394	$ 148,394	**$ 3,186,187**
ESCALATED Annual Cost, $	$ 292,869	$ 301,655	$ 310,705	$ 320,026	$ 329,627	$ 339,516	$ 349,701	**$ 5,628,922**
Ferric Chloride ($FeCl_3$) - CEPT								
Dose, mg/L	0	0	0	0	0	0	0	
Usage, pounds per day	0	0	0	0	0	0	0	
Solution, %	39.5	39.5	39.5	39.5	39.5	39.5	39.5	
Density, SG	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
Months of Operation per Year	2	2	2	2	2	2	2	
Usage, gallons per year	0	0	0	0	0	0	0	**$ 689,693**
Usage, pounds per year	0	0	0	0	0	0	0	**$ 2,953,641**
UNESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 1,000,055**
ESCALATED Annual Cost, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 1,430,680**
Ferric Chloride ($FeCl_3$) - Chemical Phosphorous Removal[1]								
Dose, mg/L	54	54	54	54	54	54	54	
Usage, pounds per day	9188	9188	9188	9188	9188	9188	9188	
Solution, %	39.5	39.5	39.5	39.5	39.5	39.5	39.5	
Density, SG	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
Months of Operation per Year	12	12	12	12	12	12	12	
Usage, gallons per year	783,090	783,090	783,090	783,090	783,090	783,090	783,090	**7,830,900**
Usage, pounds per year	3,353,620	3,353,620	3,353,620	3,353,620	3,353,620	3,353,620	3,353,620	**33,536,200**
UNESCALATED Annual Cost, $	$ 1,135,481	$ 1,135,481	$ 1,135,481	$ 1,135,481	$ 1,135,481	$ 1,135,481	$ 1,135,481	**$ 11,354,805**
ESCALATED Annual Cost, $	$ 2,240,969	$ 2,308,198	$ 2,377,444	$ 2,448,767	$ 2,522,230	$ 2,597,897	$ 2,675,834	**$ 23,510,171**
Methanol - Nitrogen Removal (Required if Chemical Phosp								
Dose, mg/L	6.64	6.64	6.64	6.64	6.64	6.64	6.64	
Usage, pounds per day	1130	1130	1130	1130	1130	1130	1130	
Density, SG	0.79	0.79	0.79	0.79	0.79	0.79	0.79	
Usage, gallons per day	171	171	171	171	171	171	171	
Usage, gallons per year	62,565	62,565	62,565	62,565	62,565	62,565	62,565	**625,651**
Usage, pounds per year	412,476	412,476	412,476	412,476	412,476	412,476	412,476	**4,124,763**
UNESCALATED Annual Cost, $	$ 125,130	$ 125,130	$ 125,130	$ 125,130	$ 125,130	$ 125,130	$ 125,130	**$ 1,251,302**
ESCALATED Annual Cost, $	$ 246,955	$ 254,364	$ 261,995	$ 269,855	$ 277,950	$ 286,289	$ 294,877	**$ 2,590,825**
Sodium Hypochlorite (NaOCl) - Chlorination								
Dose, mg/L Cl2	11	11	11	11	11	11	11	
Usage, pounds per day Cl2	1872	1872	1872	1872	1872	1872	1872	
NaOCl/Cl2 Ratio	1.05	1.05	1.05	1.05	1.05	1.05	1.05	
NaOCl Concentration, %	12.5	12.5	12.5	12.5	12.5	12.5	12.5	
Density, SG	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Usage, pounds per day NaOCl	1966	1966	1966	1966	1966	1966	1966	**53,722**
Usage, gallons per year NaOCl	564210	564210	564210	564210	564210	564210	564210	**15,417,430**
Usage, pounds per year NaOCl	717590	717590	717590	717590	717590	717590	717590	**19,608,530**
UNESCALATED Annual Cost, $	$ 564,210	$ 564,210	$ 564,210	$ 564,210	$ 564,210	$ 564,210	$ 564,210	**$ 15,417,430**
ESCALATED Annual Cost, $	$ 1,113,517	$ 1,146,923	$ 1,181,330	$ 1,216,770	$ 1,253,273	$ 1,290,872	$ 1,329,598	**$ 25,003,955**

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase		**Phase 0**					**Phase 1**					**Phase 2**		
Year	**6/14 - 7/15**	**6/15 - 7/16**	**6/16 - 7/17**	**6/17 - 7/18**	**6/18 - 7/19**	**6/19 - 7/20**	**6/20 - 7/21**	**6/21 - 7/22**	**6/22 - 7/23**	**6/23 - 7/24**	**6/24 - 7/25**	**6/25 - 7/26**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Sodium Bisulfilte ($NaHSO_3$) - Dechlorination												
Dose, mg/L Cl2		11	11	11	11	11	11	11	11	11	11	11
Consumed, mg/L Cl2		5	5	5	5	5	5	5	5	5	5	5
Residual, mg/L Cl2		6	6	6	6	6	6	6	6	6	6	6
Usage, pounds per day Cl2		676	689	702	715	728	741	754	767	780	793	806
NaHSO3/Cl2 Ratio		1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
NaHSO3 Concentration, %		25	25	25	25	25	25	25	25	25	25	25
Density, SG		1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Usage, pounds per day NaHSO3		987	1006	1025	1044	1063	1082	1101	1120	1139	1158	1177
Usage, gallons per year NaHSO3		141630	144360	147080	149810	152540	155260	157990	160720	163440	166170	168890
Usage, pounds per year NaHSO3		360255	367190	374125	381060	387995	394930	401865	408800	415735	422670	429605
UNESCALATED Annual Cost, $		$ 141,630	$ 144,360	$ 147,080	$ 149,810	$ 152,540	$ 155,260	$ 157,990	$ 160,720	$ 163,440	$ 166,170	$ 168,890
ESCALATED Annual Cost, $		$ 141,630	$ 148,691	$ 156,037	$ 163,701	$ 171,685	$ 179,989	$ 188,648	$ 197,665	$ 207,041	$ 216,814	$ 226,974
Sodium Hypochlorite (NaOCl) - MBR Cleaning												
Concentration, %		10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Density, SG		1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168
Usage, gallons per year NaOCl		0	0	0	0	0	0	0	0	0	16869	16869
UNESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,869	$ 16,869
ESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 22,010	$ 22,670
Citric Acid (C6H8O7) - MBR Cleaning												
Concentration, %		50	50	50	50	50	50	50	50	50	50	50
Density, SG		1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Usage, gallons per year C6H8O7		0	0	0	0	0	0	0	0	0	2272	2272
UNESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,178	$ 18,178
ESCALATED Annual Cost, $		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 23,719	$ 24,430
UNESCALATED Total Annual Chemical Cost[(1)], $	$ 1,100,000	$ 900,000	$ 900,000	$ 900,000	$ 900,000	$ 1,000,000	$ 1,000,000	$ 1,100,000	$ 1,100,000	$ 900,000	$ 900,000	$ 900,000
ESCALATED Total Annual Chemical Cost[(1)], $	$ 1,100,000	$ 900,000	$ 900,000	$ 1,000,000	$ 1,000,000	$ 1,100,000	$ 1,200,000	$ 1,300,000	$ 1,300,000	$ 1,100,000	$ 1,200,000	$ 1,300,000
TOTAL												
UNESCALATED Total O&M Cost		$ 10,300,000	$ 10,300,000	$ 10,300,000	$ 10,300,000	$ 11,000,000	$ 11,100,000	$ 11,200,000	$ 11,200,000	$ 11,100,000	$ 18,800,000	$ 18,900,000
ESCALATED Total O&M Cost		$ 10,300,000	$ 10,600,000	$ 11,000,000	$ 11,200,000	$ 12,400,000	$ 13,000,000	$ 13,500,000	$ 13,900,000	$ 14,200,000	$ 26,800,000	$ 28,000,000

Notes:
(1) It is assumed chemical phosphorous removal will be implemented. As a result, total chemical costs include the cost for ferric and methanol required for chemical phosphorous removal.

LEGEND
Major process change
Inputs

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			**Phase 3**							**Phase 4**		
Year	**6/26 - 7/27**	**6/27 - 7/28**	**6/28 - 7/29**	**6/29 - 7/30**	**6/30 - 7/31**	**6/31 - 7/32**	**6/32 - 7/33**	**6/33 - 7/34**	**6/34 - 7/35**	**6/35 - 7/36**	**6/36 - 7/37**	**6/37 - 7/38**
	2026	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Sodium Bisulfilte ($NaHSO_3$) - Dechlorination												
Dose, mg/L Cl2	11	11	11	11	11	11	11	11	11	11	11	11
Consumed, mg/L Cl2	5	5	5	5	5	5	5	5	5	5	5	5
Residual, mg/L Cl2	6	6	6	6	6	6	6	6	6	6	6	6
Usage, pounds per day Cl2	819	832	845	858	871	884	897	910	923	841	841	841
NaHSO3/Cl2 Ratio	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
NaHSO3 Concentration, %	25	25	25	25	25	25	25	25	25	25	25	25
Density, SG	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Usage, pounds per day NaHSO3	1196	1215	1234	1253	1272	1291	1310	1329	1348	1228	1228	1228
Usage, gallons per year NaHSO3	171620	174350	177070	179800	182530	185250	187980	190710	193430	176210	176210	176210
Usage, pounds per year NaHSO3	436540	443475	450410	457345	464280	471215	478150	485085	492020	448220	448220	448220
UNESCALATED Annual Cost, $	$ 171,620	$ 174,350	$ 177,070	$ 179,800	$ 182,530	$ 185,250	$ 187,980	$ 190,710	$ 193,430	$ 176,210	$ 176,210	$ 176,210
ESCALATED Annual Cost, $	$ 237,562	$ 248,581	$ 260,033	$ 271,964	$ 284,376	$ 297,272	$ 310,702	$ 324,671	$ 339,181	$ 318,255	$ 327,803	$ 337,637
Sodium Hypochlorite (NaOCl) - MBR Cleaning												
Concentration, %	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Density, SG	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168
Usage, gallons per year NaOCl	16869	16869	16869	16869	16869	16869	16869	16869	16869	19680	19680	19680
UNESCALATED Annual Cost, $	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 16,869	$ 19,680	$ 19,680	$ 19,680
ESCALATED Annual Cost, $	$ 23,350	$ 24,051	$ 24,772	$ 25,515	$ 26,281	$ 27,069	$ 27,881	$ 28,718	$ 29,579	$ 35,544	$ 36,611	$ 37,709
Citric Acid ($C_6H_8O_7$) - MBR Cleaning												
Concentration, %	50	50	50	50	50	50	50	50	50	50	50	50
Density, SG	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Usage, gallons per year $C_6H_8O_7$	2272	2272	2272	2272	2272	2272	2272	2272	2272	2651	2651	2651
UNESCALATED Annual Cost, $	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 18,178	$ 21,208	$ 21,208	$ 21,208
ESCALATED Annual Cost, $	$ 25,163	$ 25,918	$ 26,695	$ 27,496	$ 28,321	$ 29,171	$ 30,046	$ 30,947	$ 31,876	$ 38,304	$ 39,453	$ 40,637
UNESCALATED Total Annual Chemical Cost[(1)], $	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 2,200,000	$ 2,200,000	$ 2,200,000
ESCALATED Total Annual Chemical Cost[(1)], $	$ 1,300,000	$ 1,400,000	$ 1,400,000	$ 1,500,000	$ 1,600,000	$ 1,600,000	$ 1,700,000	$ 1,800,000	$ 1,800,000	$ 4,000,000	$ 4,200,000	$ 4,300,000
TOTAL												
UNESCALATED Total O&M Cost	$ 19,200,000	$ 19,300,000	$ 19,500,000	$ 19,700,000	$ 19,800,000	$ 20,000,000	$ 20,100,000	$ 20,300,000	$ 20,400,000	$ 21,800,000	$ 21,800,000	$ 21,800,000
ESCALATED Total O&M Cost	$ 29,500,000	$ 30,900,000	$ 32,500,000	$ 34,300,000	$ 36,000,000	$ 37,800,000	$ 39,600,000	$ 41,800,000	$ 43,800,000	$ 48,300,000	$ 50,400,000	$ 52,400,000

Notes:
(1) It is assumed chemical phosphorous removal will be implemented. As a result, total chemical costs include the cost for ferric and methanol required for chemical phosphorous removal.

LEGEND
Major process change
Inputs

WPCP Master Plan O&M Costs - MBR Implementation
WPCP Master Plan
City of Sunnyvale

Phase			**Phase 5**					
Year	**6/38 - 7/39**	**6/39 - 7/40**	**6/40 - 7/41**	**6/41 - 7/42**	**6/42 - 7/43**	**6/43 - 7/44**	**6/44 - 7/45**	
	2038	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	
Sodium Bisulfilte ($NaHSO_3$) - Dechlorination								
Dose, mg/L Cl2	11	11	11	11	11	11	11	
Consumed, mg/L Cl2	5	5	5	5	5	5	5	
Residual, mg/L Cl2	6	6	6	6	6	6	6	
Usage, pounds per day Cl2	841	841	841	841	841	841	841	
NaHSO3/Cl2 Ratio	1.46	1.46	1.46	1.46	1.46	1.46	1.46	
NaHSO3 Concentration, %	25	25	25	25	25	25	25	
Density, SG	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Usage, pounds per day NaHSO3	1228	1228	1228	1228	1228	1228	1228	**35,630**
Usage, gallons per year NaHSO3	176210	176210	176210	176210	176210	176210	176210	**5,112,730**
Usage, pounds per year NaHSO3	448220	448220	448220	448220	448220	448220	448220	**13,004,950**
UNESCALATED Annual Cost, $	$ 176,210	$ 176,210	$ 176,210	$ 176,210	$ 176,210	$ 176,210	$ 176,210	**$ 5,112,730**
ESCALATED Annual Cost, $	$ 347,766	$ 358,199	$ 368,945	$ 380,013	$ 391,413	$ 403,156	$ 415,250	**$ 8,221,654**
Sodium Hypochlorite (NaOCl) - MBR Cleaning								
Concentration, %	10.3	10.3	10.3	10.3	10.3	10.3	10.3	
Density, SG	1.168	1.168	1.168	1.168	1.168	1.168	1.168	
Usage, gallons per year NaOCl	19680	19680	19680	19680	19680	19680	19680	**382,354**
UNESCALATED Annual Cost, $	$ 19,680	$ 19,680	$ 19,680	$ 19,680	$ 19,680	$ 19,680	$ 19,680	**$ 382,354**
ESCALATED Annual Cost, $	$ 38,840	$ 40,005	$ 41,206	$ 42,442	$ 43,715	$ 45,026	$ 46,377	**$ 689,370**
Citric Acid (C6H8O7) - MBR Cleaning								
Concentration, %	50	50	50	50	50	50	50	
Density, SG	1.24	1.24	1.24	1.24	1.24	1.24	1.24	
Usage, gallons per year C6H8O7	2651	2651	2651	2651	2651	2651	2651	**51,505**
UNESCALATED Annual Cost, $	$ 21,208	$ 21,208	$ 21,208	$ 21,208	$ 21,208	$ 21,208	$ 21,208	**$ 412,041**
ESCALATED Annual Cost, $	$ 41,856	$ 43,111	$ 44,405	$ 45,737	$ 47,109	$ 48,522	$ 49,978	**$ 742,895**
UNESCALATED Total Annual Chemical Cost[(1)], $	$ 2,200,000	$ 2,200,000	$ 2,200,000	$ 2,200,000	$ 2,200,000	$ 2,200,000	$ 2,200,000	**$ 42,600,000**
ESCALATED Total Annual Chemical Cost[(1)], $	$ 4,400,000	$ 4,600,000	$ 4,700,000	$ 4,800,000	$ 5,000,000	$ 5,100,000	$ 5,300,000	**$ 73,900,000**
TOTAL								
UNESCALATED Total O&M Cost	$ 21,800,000	$ 21,800,000	$ 23,400,000	$ 23,400,000	$ 23,400,000	$ 23,400,000	$ 23,400,000	**$ 538,800,000**
ESCALATED Total O&M Cost	$ 54,700,000	$ 57,000,000	$ 64,800,000	$ 67,400,000	$ 70,400,000	$ 73,300,000	$ 76,500,000	**$ 1,106,300,000**

Notes:
(1) It is assumed chemical phosphorous removal will be implemented. As a result, total chemical costs include the cost for ferric and methanol required for chemical phosphorous removal.

LEGEND
Major process change
Inputs

O&M Cost Assumptions - MBR
WPCP Master Plan
City of Sunnyvale

Legend

Highlight yellow - Input from Master Plan TMs
Input
Italicized if same as Split Flow
Black - Calculated

Assumptions

Annual Escalation Rate for Labor and Chemical Costs	*3%*
Annual Escalation Rate for Power Costs	*5%*

Unit Costs

Current Unit Cost for Power, $/kWh	*$ 0.30*	Phase 1
Future Unit Cost for Power, $/kWh	*$ 0.20*	Phase 2
Future Unit Cost for Power, $/kWh	*$ 0.11*	Phase 3
Future Unit Cost for Power, $/kWh	*$ 0.11*	Phase 4 and 5
Polymer, $/lb	*$ 1.12*	
Sodium Bisulfilte ($NaHSO_3$), $/gal	*$ 1.00*	
Ferric Chloride ($FeCl_3$), $/gal	*$ 1.45*	
Sodium Hypochlorite (NaOCl), $/gal	*$ 1.00*	
Citric Acid (C6H8O7), $/gal	$ 8.00	

Source:
Master Plan Basis of Cost TM

Flow and Loads

	(current)							
Year from Flow and Loads TM	2010	2015	2019	2024	2025	2028	2035	> 2035
Average annual flow, mgd	*13.8*	*15.2*	*16.2*	*17.5*	*17.8*	*18.6*	*20.4*	20.4
Maximum month flow, mgd	*17.8*	*19.5*	*20.9*	*22.6*	*22.9*	*23.9*	*26.2*	26.2

Source:
Master Plan Flow and Loads TM

Power Demand

		Phase 0	**Phase 1**	**Phase 2**		**Phase 3**	**Phase 4**	**Phase 5**
								> 2035 (most on in 2040)
Year		Current (2015)	2019	2024		2028	2035	
Duty Power Demand (all duty units in service), hp		1529	2719	10740		11004	11054	14170
Estimated Ratio Average Power Demand/Duty Power Demand, %	75%							
Estimated Average Power Demand, hp		1529	2039	8055		8253	8291	10628
Estimated Average Power Demand (scaled by flow), kW		1140	1520	6006		6153	6181	7924

O&M Cost Assumptions - MBR
WPCP Master Plan
City of Sunnyvale

Power Production, kW		1000	1000
Annual Power Cost, $/year		$ 306,000	
			2.37

Notes:
WPCP is a net energy producer due to Congen Units. Power production averages 1,200 kW. Power demand averages 1,050 - 1,150 kW. (Per Sorrick email 2015-03-26)

Source:
Master Plan Basis of Design - Summary of Equipment Loads
WPCP Level 4 Annual Fiscal Report

Chemical Use

Year	**2014**		
Chemical Cost from WPCP Level 4 Annual Fiscal Report	$ 1,067,873		
Polymer - CEPT			
Dose, mg/L	0.2		
Activation, %	30		
Density, SG	1.02		
Months of Operation per Year	2		
Polymer - Thickening			
Year		2023	2035
Dose, lb/dry ton	15		
Activation, %	30		
Density, SG	1.02		
Sludge, pounds per day		14000	15000
Polymer - DMF			
Year		2023	2035
Dose, mg/L		1	0
Activation, %	27		
Density, SG	1.02		
Polymer - Dewatering		Stage 1	Stage 2
Year		2023	2035
Dose, lb/dry ton	34		
Activation, %	30		
Density, SG	1.02		
Sludge, pounds per day		19600	21300
Polymer - AFT			
Year		2023	2035
Dose, mg/L		5.5	0
Activation, %	27		
Density, SG	1.02		

O&M Cost Assumptions - MBR
WPCP Master Plan
City of Sunnyvale

Sodium Bisulfilte ($NaHSO_3$) - Dechlorination			
Dose, mg/L Cl2	*11*		
Consumed, mg/L Cl2	*5*		
NaHSO3/Cl2 Ratio	*1.46*		
NaHSO3 Concentration, %	*25*		
Density, SG	*1.22*		
Ferric Chloride ($FeCl_3$) - CEPT			
Year		2019	2035
Dose, mg/L		*20*	*20*
Solution, %	*39.5*		
Density, SG	*1.3*		
Months of Operation per Year		*2*	*2*
Ferric Chloride ($FeCl_3$) - Chemical Phosphorous Removal			
Year		2019	2035
Dose, mg/L		*0*	*54*
Solution, %	*39.5*		
Density, SG	*1.3*		
Months of Operation per Year		*0*	*12*
Methanol			
Year		2015	2035
Specific Gravity, g/mL	0.79		
Chemical Usage at maximum month, ppd as COD	2310		
Chemical Usage at maximum month, ppd as methanol	1540		
Flow basis for chemical usage at maximum month, mgd	27.8		
Chemical Usage, mg/L as methanol		0	6.6
Sodium Hypochlorite (NaOCl) - Chlorination			
Dose, mg/L Cl2	*11*		
NaOCl/Cl2 Ratio	*1.05*		
NaOCl Concentration, %	*12.5*		
Density, SG	*1.22*		
Sodium Hypochlorite (NaOCl) - MBR Cleaning			
Year		2023	2035
Dose, mg/L	10.3		
Density, SG	1.168		
Usage, gal/yr	19680		
Number of Membrane Trains		6	7
Citric Acid (C6H8O7) - MBR Cleaning			
Year		2023	2035
Dose, mg/L	50		
Density, SG	1.24		
Usage, gal/yr	2651		
Number of Membrane Trains		6	7

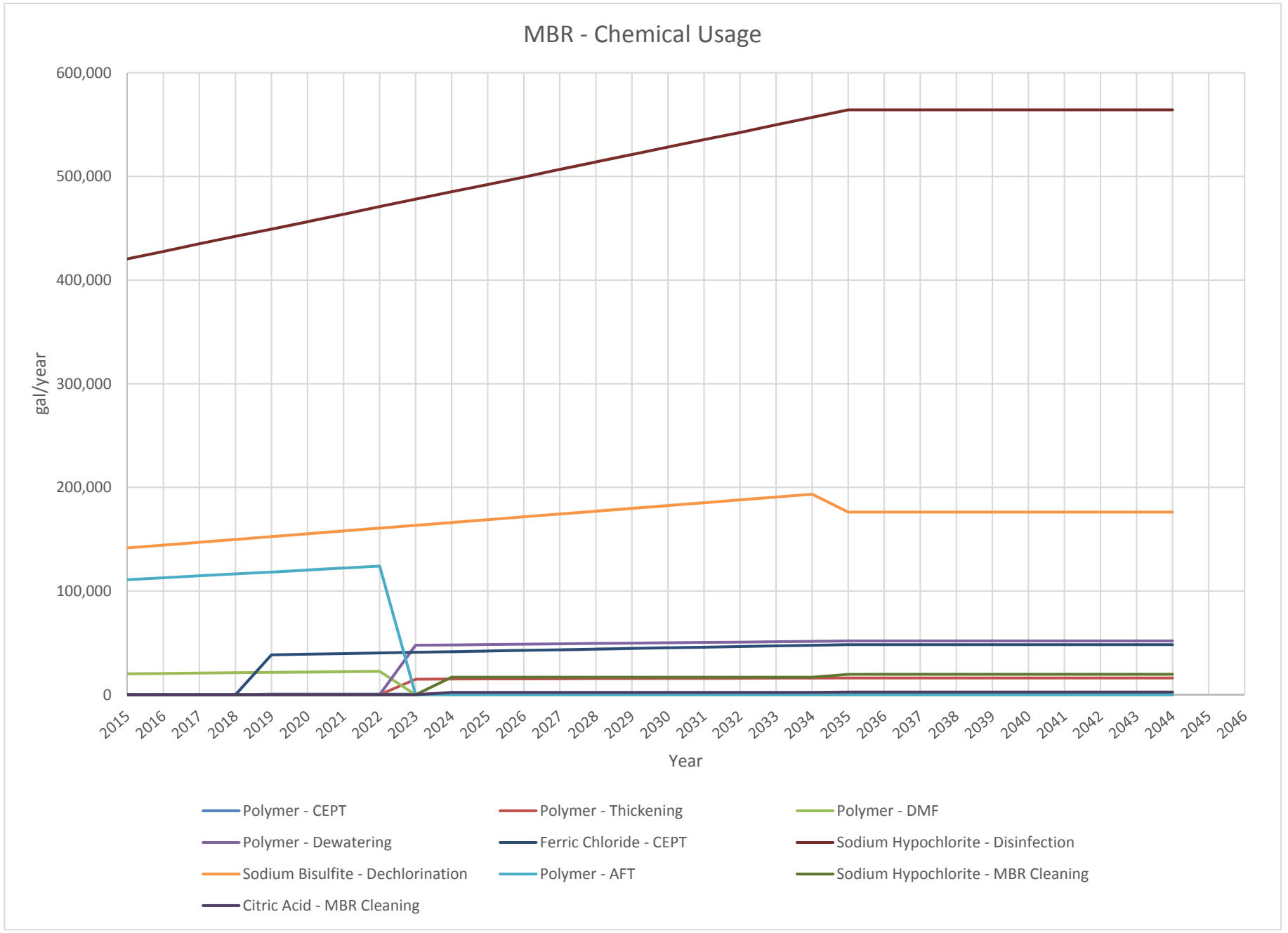
O&M Cost Assumptions - MBR
WPCP Master Plan
City of Sunnyvale

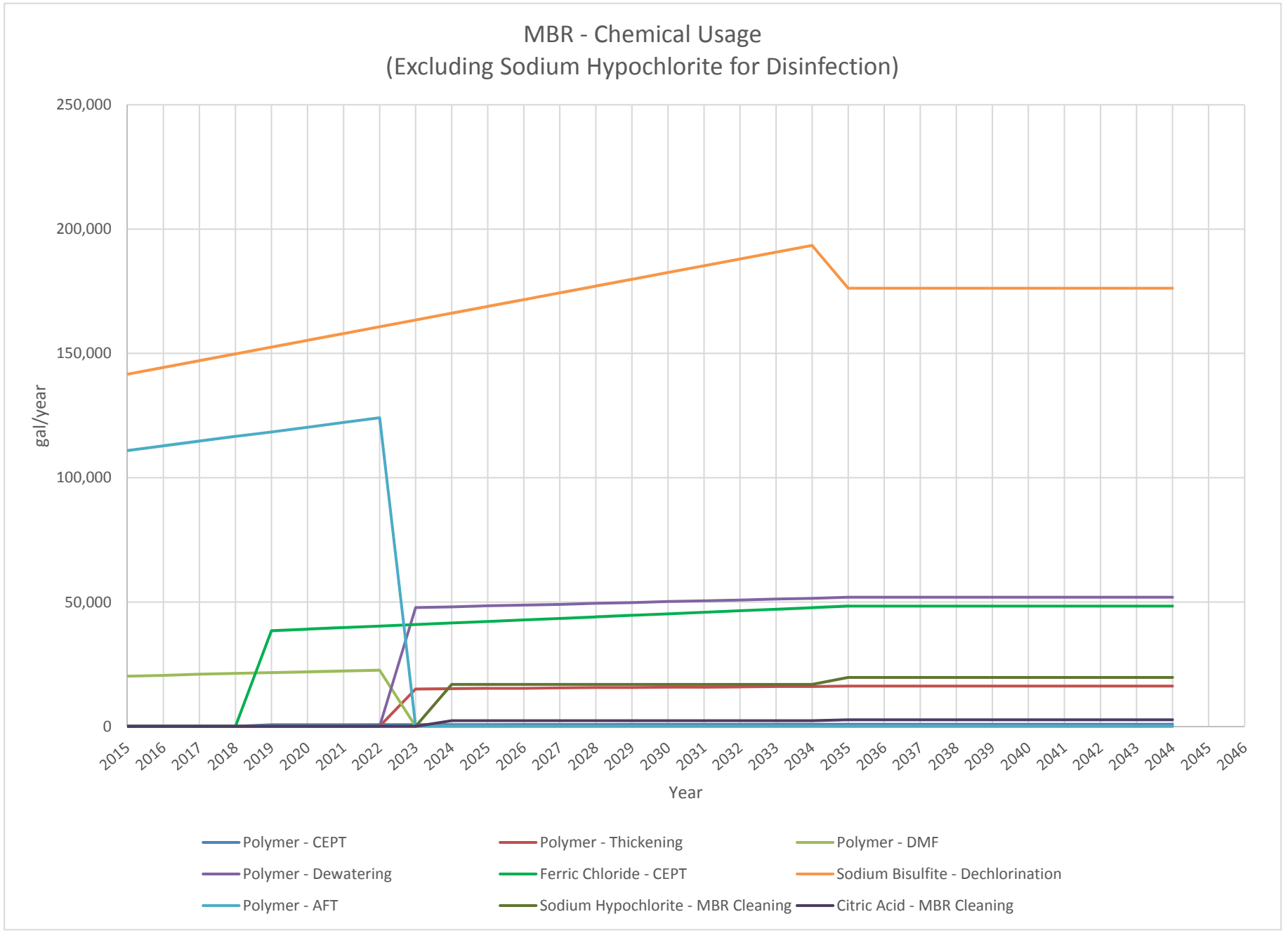
Source:
Master Plan Treatment Alternatives TMs and Site Plan TM
Solids Alternatives Sizing

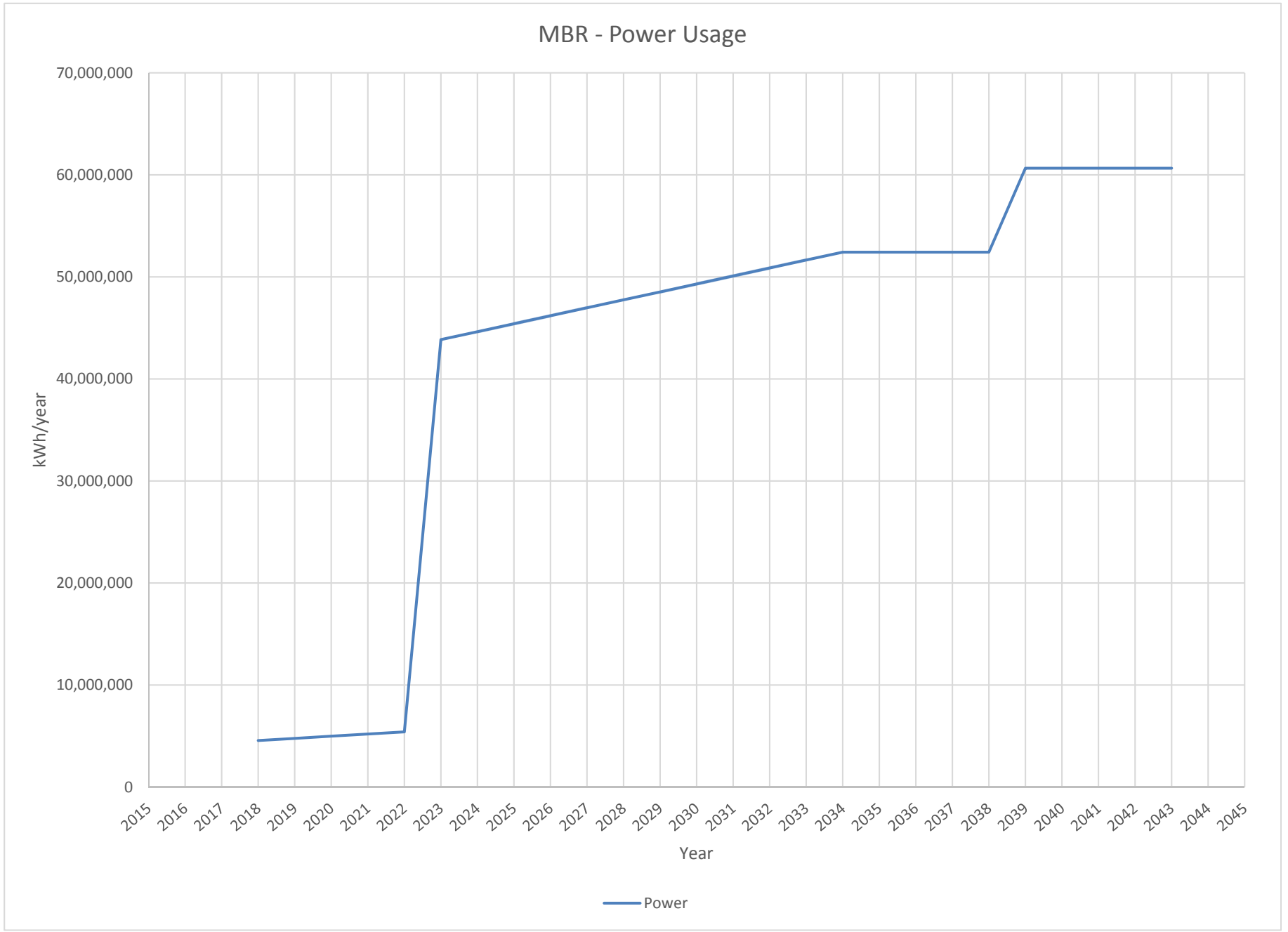
Labor Cost

Year	**2014**
Labor Cost	*$ 9,124,677*

Source:
WPCP Level 4 Annual Fiscal Report


MBR - Chemical Usage
600,000
500,000
400,000
300,000
200,000
100,000
0
gal/year
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
Year
Polymer - CEPT
Polymer - Thickening
Polymer - DMF
Polymer - Dewatering
Ferric Chloride - CEPT
Sodium Hypochlorite - Disinfection
Sodium Bisulfite - Dechlorination
Polymer - AFT
Sodium Hypochlorite - MBR Cleaning
Citric Acid - MBR Cleaning


MBR - Chemical Usage
(Excluding Sodium Hypochlorite for Disinfection)
250,000
200,000
150,000
100,000
50,000
0
gal/year
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
Year
Polymer - CEPT
Polymer - Thickening
Polymer - DMF
Polymer - Dewatering
Ferric Chloride - CEPT
Sodium Bisulfite - Dechlorination
Polymer - AFT
Sodium Hypochlorite - MBR Cleaning
Citric Acid - MBR Cleaning


MBR - Power Usage
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
kWh/year
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
Year
Power