MASTER PLAN

BASIS OF DESIGN

Final

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CITY OF SUNNYVALE

MASTER PLAN
BASIS OF DESIGN

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GLOSSARY

General Abbreviations

3W	Utility Water
AA (F or L)	Average Annual (Flow or Load)
AAF	Average Annual Flow
ABNG	Air Blended Natural Gas
ADA	Americans with Disabilities Act
ADW (F or L)	Average Dry Weather (Flow or Load)
AOP	Advanced Oxidation Process
BAAQMD	Bay Area Air Quality Management District
BAAQMD	Bay Area Air Quality Management District
BACT	Best Available Control Technology
Basin Plan	Water Quality Control Plan for the San Francisco Bay Basin
bhp	brake horsepower
BNR	Biological Nutrient Removal
BOD	Biochemical Oxygen Demand
BODR	Basis of Design Report
BTU	British Thermal Unit
CBC	California Building Code: Part 2, California Building Standards Code, Title 24, California Code of Regulations
CBOD	Carbonaceous Biochemical Oxygen Demand
CCT	Chlorine Contact Tank
CEC	Contaminants of Emerging Concern
CEPT	Chemically Enhanced Primary Treatment.
CF	Cubic Feet
cf	cubic feet
cfd	cubic feet per day
CFM	Cubic Feet per Minute
CHP	Combined Heat and Power
City	City of Sunnyvale Master Pollution Control Plant
cm/s	Centimeters per Second
CMU	Concrete Masonry Unit
CO	Carbon Monoxide
DegC	Degrees Celsius
DegF	Degrees Fahrenheit
DMF	Dual media Filter
FGR	Fixed Growth Reactor
FOG	Fats, Oil and Grease
FOG	Fats, Oils, and Grease
g	gram
gpd/sf	Gallons Per Day per Square Foot
gpm/sf	Gallons per Minute per Square Foot
H2O	water
H2S	Hydrogen Sulfide
Hp	Horsepower

hr	hour
Hypochlorite	Sodium Hypochlorite
in	inch
IPR	Indirect Potable Water Reuse
$KMnO_4$	Potassium Permanganate
kV	kilovolt
kW	kilowatt
kWh	Kilowatt-Hour
lb	Pound
lb	pound
LEED	Leadership in Energy and Environmental Deign
LFG	Landfill Gas
m	minute
MAX	Maximum
MBR	Membrane Bioreactor
mg	milligram
MG	Million Gallons
mg	milligram
MG	Mixed Gas
mg/L	milligrams per Liter
mgd	Million Gallons per Day
min	Minute
mJ/cm^2	Millijoule per Square Centimeter
MM(F or L)	Max Month (Flow or Load)
MMF	Maximum Monthly Flow
MPN	Most Probable Number
NDMA	N-Nitrosodimethylamine
NOx	Mono-nitrogen oxides
NPV	Net Present Value
NTU	Nephlometric Turbidity Unit
O&M	Operations and Maintenance
O&M	Operation and Maintenance
PD (F or L)	Peak Day (Flow or Load)
PG&E	Pacific Gas and Electric Company
PGF	Power Generation Facility
PH (F or L)	Peak Hour (Flow or Load)
PPM	Parts per Million
ppmv	parts per million by volume
PSA	pressure Swing Adsorption
psig	pounds per square in gauge
PSTs	Primary Storage Tanks
RAS	Return Activated Sludge
RW	Recycled Water
RWMP	2013 Recycled Water Master Plan (Hydroscience Engineers/Kennedy Jenks)
RWPS	Recycled Water Pump Station
SCCWRP	Southern California Coastal Water Research Project
scfm	standard cubic feet per minute
SCVWD	Santa Clara Valley Water District

sf	Square-Foot
SFPUC	San Francisco Public Utilities Commission
SIP	2009 Strategic Infrastructure Plan (Brown and Caldwell)
SRT	Solids Retention Time
SWRCB	California State Water Resources Control Board
TDS	Total Dissolved Solids
THM	Trihalomethane
Title 22	California Code of Regulations, Title 22, Division 4, Environmental Health Regulations for Recycled Water
TM	Technical Memorandum
TN	Total Nitrogen
TWAS	Thickened Waste Activated Sludge
UF	Ultrafilter OR Ultrafiltration
USGBC	United States Green Building Council
UV	Ultraviolet
VOC	Volatile Organic Compound
VS	Volatile Solids
VSS	Volatile Suspended Solids
VTSH	Vertical Turbine Solids Handling
WAS	Waste Activated Sludge
WPCP	Sunnyvale Water Pollution Control Plant
WPCP	City of Sunnyvale Water Pollution Control Plant
WWTP	Wastewater Treatment Plant

PURPOSE/CONTENTS

1.1 PURPOSE

The City of Sunnyvale completed a major master planning effort for the City of Sunnyvale Water Pollution Control Plant (WPCP) in 2016. This master planning effort identified a number of proposed improvements to the major process facilities at the WPCP. These proposed plant upgrades were included in a capital improvement program (CIP) implementation plan was developed, which will be updated annually. With assistance from the Program Management Consultant (PMC), the City will utilize the CIP to develop specific projects for implementation.

Once these projects are identified, design consultants will be selected to develop the necessary contract documents for implementing the project. The purpose of the Basis of Design (BOD) document is to provide the design consultants with additional design concepts which would include process criteria, site features and any appropriate discipline specific information. This will provide a more complete understanding of the major project elements as well as the key design considerations. It is anticipated that the selected design consultant would be encouraged to develop alternative concepts for each specific project.

Working with the City and the PMC, the consultant would use this information to prepare design information memorandums (DIMs) to further refine the preliminary design direction for each selected project. The DIMs would be utilized as the basis for preparing the 30 percent design submittal documents.

1.2 CONTENTS

Contents for the BOD were based on selecting those major improvements that were likely to be implemented with the first ten years of the Master Plan. Based on expected technological advances and uncertainty with future regulations, it was decided that developing a BOD for certain of the master planned processes (i.e., denitrification filters, ozone, etc.) is not effort well spent. In addition, a BOD was not developed for expansion of existing technologies (i.e., digestion).

With that understanding, a BOD was developed for the following proposed WPCP improvements:

- Conventional Activated Sludge (CAS) Facilities.
- Membrane Bioreactor Activated Sludge Facilities.
- Sludge Thickening and Dewatering Facilities.
- Cogeneration Facilities.
- Administration/Lab and Maintenance Support Buildings.

2.1 BACKGROUND

Under the Master Plan and Primary Treatment Facility Design project, the City identified a wide range of planning activities, site investigations and technical documentation to help facilitate the renovation of the existing Water Pollution Control Plant (WPCP). The goal was to develop sufficient documentation to guide future design and construction activities at the WPCP in the most cost-effective and efficient manner (while complying with all regulatory and CEQA requirements).

The background efforts completed to date, which are summarized in the Tables 2.1, 2.2 and 2.3, are divided into the following major categories:

Master Plan - Site Investigations. This effort included documentation of existing conditions which involved land survey, geotechnical investigations, identification of existing utilities (i.e., process piping, drain piping, potable water, plant water, utility air, etc.) and soil contamination survey. An opportunities and constraints analysis was also completed for the site, with the primary emphasis on the biological constraints and/or opportunities of potential options for the oxidation ponds.

Master Plan - Process Evaluations. Process alternatives were evaluated for preliminary, primary, secondary, tertiary treatment alternatives in combination with solids treatment and energy considerations.

Master Plan - Site Considerations. Based on the treatment process analysis, these evaluations took into consideration site layout constraints, which included hydrology assessments, future utility needs, support facilities space requirements (i.e., administration, laboratory, maintenance, etc.), safety and security, landscaping and plant-wide automation upgrades. Based on the proposed site layout, a plant hydraulic profile was developed.

Master Plan - Program Implementation. An overall capital improvement program (CIP) was developed which describes the phasing and costs of the proposed plant renovations. To support the proposed CIP implementation plan, a programmatic environmental impact report (PEIR) was prepared to meet CEQA requirements for the overall master planning recommendations.

Design Standards. Documentation was prepared to identify site specific discipline design standards to be utilized by design engineers and construction contractors for consistency in the implementation of future projects.

Design Information Memorandums (DIMs). The first major WPCP upgrade to be implemented resulting from the master plan was the Primary Treatment Facilities project.

This project included a new influent pump station, headworks (with screening and grit handling), primary sedimentation tanks, new 12-kV switchgear building, standby generation facilities and the initial phase of the plant automation upgrades. DIMs were prepared based on the master plan and design standards recommendations.

In addition to these efforts, a process criticality analysis was conducted in a workshop setting with WPCP staff in late 2013 and early 2014. This analysis provided a basis for determining the required level of redundancy for all the unit processes and major support equipment. In addition, an initial determination was made as to the need to provide standby power for those processes and equipment deemed critical. A copy of the meeting notes from the two workshop as well as the summary table generated can be found in Appendix A. It is intended that this information be used as a starting point for discussions on redundancy and standby power needs during preliminary design for each process facility improvement.

Table 2.1	Master Plan Deliverables WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
1	SIP Validation Technical Memorandum (TM)
2	Basis of Cost TM
3	Flow and Loads TM
4	Preliminary Treatment TM
5	Primary Treatment TM
6	Secondary Treatment TM
7	Filtration TM
8	Disinfection TM
9	Solids TM
10	Electrical and Combined Heat and Power (ECHP) TM
11	Automation and Control Systems (ACS) TM
12	Operational Staffing TM
13	Site Investigation Analysis TM
14	Existing Utilities TM
15	Opportunities and Constraints TM
16	Building Programming TM
17	Hydrology TM
18	Site Layout Considerations TM
19	Capital Improvements Implementation (CIP) TM - CAS
20	CIP TM - MBR
21	Geotechnical Study Master Plan and Facilities Upgrade Project
22	Land Survey/Monumentation Documentation

Table 2.2	Design Standards WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
1	Civil
2	Structural and Seismic
3	Electrical
4	Mechanical
5	Corrosion
6	Instrumentation and Controls
7	Architecture
8	Landscape
9	Odor Control

Table 2.3	Primary Treatment Facilities - Design Information Memoranda (DIM) WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
1	Site Layout
2	Hydraulic Profile
3	Influent Monitoring and Sampling
4	Screening and Screenings Handling
5	Influent Pumping
6	Grit Removal and Grit Handling
7	Primary Sedimentation Tanks
8	Chemically Enhanced Primary Treatment (CEPT)
9	Odor Control and HVAC
10	Power Supply and Standby Power
11	HMI and Facility Automation
12	Construction Cost Estimate

SECONDARY TREATMENT (CAS)

3.1 BACKGROUND

This section includes the basis of design for a conventional activated sludge (CAS) secondary treatment process.

This Basis of Design is based on the key findings and recommendations of the Master Plan. As part of the Master Plan, Carollo/HDR conducted an analysis and selection of processes for secondary treatment at the WPCP. The analysis and recommendations are presented in the Master Plan Secondary Treatment TM. The selected secondary treatment processes proposed for the WPCP are based on providing the needed improvements through buildout to meet the City's goals and objectives. The Master Plan Secondary Treatment TM evaluated two secondary treatment options in detail: CAS and membrane bioreactor (MBR). Due to cost and non-cost considerations, the CAS alternative was used for finalizing the site layout considerations. Future decisions made by the City such as a decision to partner with a water agency to do indirect potable reuse (IPR) could change the analysis and provide more of a driver for MBR treatment. Due to uncertainties in flow and load projections as well as future regulations, the City has decided to phase in secondary treatment by utilizing a split-flow treatment approach. With this approach an initial stage of the CAS facilities would be built by 2025, with a portion of the flow going to the CAS facilities and a portion going to the WPCP's existing secondary facilities (ponds/FGRs/AFTs). Due to regulatory requirements, it is assumed that the WPCP would retire their existing secondary facilities and build the remainder of the CAS facilities by 2035.

Part 4 provides the basis of design for secondary treatment with a MBR process.

The key findings and recommendations of the Master Plan for the CAS secondary treatment processes are summarized below:

- A Modified Ludzack Ettinger (MLE) CAS process provides the process needs to accommodate future regulatory limits for nitrogen, and combined with chemically enhanced primary treatment (CEPT), will be able to accommodate future regulatory limits for phosphorus.
- The aeration basins will be designed with the ability to operate in either a MLE configuration or a step-feed configuration. This will provide the City with the flexibility to either maximize the nitrogen removal ability of the aeration basins with the MLE configuration or minimize operating costs with the step-feed configuration.
- To minimize site impacts, 8 million gallons (MG) of diurnal equalization is recommended within the existing pond space.

- The project team recommends setting aside footprint for a fifth aeration basin that would provide the additional aeration basin capacity should the projected 2035 maximum month ammonia loads be higher than the 4,800 ppd anticipated with the design ammonia load scenario. The fifth aeration basin would provide capacity to treat the projected 2035 maximum month high ammonia load scenario of 6,200 ppd.
- The project team recommends setting aside footprint for a future denitrification filter that could provide the ability to meet possible future total nitrogen limits of 3 milligrams per liter (mg/L).
- Implementation of CAS secondary treatment will allow the WPCP to continue to split flow between the mechanical secondary treatment process and the existing ponds for the foreseeable future.

3.2 AERATION BASINS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.2.2 Project Element List

The aeration basins will include the following major project elements:

- Aeration basins.
- Effluent channel.
- Internal recirculation pumps.
- Supplemental carbon feed facility.

3.2.3 Design Criteria and Redundancy

The WPCP influent flow and load values were developed as part of the Master Plan and are described in further detail in the Master Plan Flow and Loads TM. The Master Plan Flow and Loads TM proposed two different influent nitrogen load scenarios: design and high loads. The design criteria for the proposed aeration basins are summarized in Table 3.1. The criteria presented in Table 3.1 assume the design influent nitrogen load scenario. If the City were to experience influent nitrogen loads at the level planned for with the high nitrogen load scenario, an additional aeration basin may be required. The aeration basin configurations with both the design and high nitrogen load scenarios are presented in Section 3.12. The aeration basin influent flow and load values summarized in Table 3.1 assume 54 percent removal of TSS from the primary clarifiers in 2025 and 68 percent removal of TSS from the primary clarifiers in 2035 with CEPT.

The Secondary Treatment TM developed a scenario in which the City would phase in secondary treatment by operating in a split flow configuration. Table 3.1, presents the design criteria for the year 2025 for a split-flow configuration. By the year 2035, it is assumed that the City will need to meet both nitrogen and phosphorus limits and will completely retire their existing secondary system. Detailed process modeling (BioWin) results are included as an Appendix to the Secondary Treatment TM.

Table 3.1 Design Criteria – Aeration Basins
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	Split-Flow CAS 2025 Design[1]	2035 Design[2]
Effluent Quality Goals		
TSS, mg/L	20 average monthly 30 max daily	20 average monthly 30 max daily
CBOD, mg/L	10 average monthly 20 max daily	10 average monthly 20 max daily
Ammonia, mg/L (October - May)	18 average monthly 26 max daily	2 average monthly 5 max daily
Ammonia, mg/L (June - September)	2 average monthly 5 max daily	2 average monthly 5 max daily
Total Nitrogen, mg/L	NA	8
Total Phosphorus, mg/L	NA	1
Feed to Aeration Basin[3]		
Feed Type	Primary Effluent	
Average Dry Weather Flow, mgd	14	20.7
Maximum Month Flow, mgd	17	27.8
Equalized Peak Flow, mgd	17	40.0
Maximum Month TSS, ppd	14,000[4]	18,900[5]
Maximum Month BOD, ppd	21,100[4]	27,800[5]
Maximum Month Ammonia, ppd	3,200	4,800
Minimum Month Temperature, C[6]	16.5	
Aeration Basins		
Number of Units	2	4
Redundancy	Ponds as backup	1 AB or SC OOS during ADWF
SWD, ft	24	
Outside dimension each, Length (ft) x Width (ft) x Height (ft)	207 x 82 x 30[7]	
Liquid volume per basin, MG	2.69[8]	

Table 3.1 Design Criteria – Aeration Basins WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**Split-Flow CAS 2025 Design(1)**	**2035 Design(2)**
Total liquid volume, MG	5.4	10.8
Zone Configuration (% of total volume, MG each)		
Zone 1 Swing (MLE – Aerobic/CaRRB; SF – Anoxic)	3.7%, 0.1 MG,	
Zone 2 Swing (MLE – Anoxic; SF – Aerobic)	13.6%, 0.365 MG,	
Zone 3 Swing (MLE – Anoxic; SF – Aerobic)	13.6%, 0.365 MG,	
Zone 4 Anoxic	13.6%, 0.365 MG,	
Zone 5 Swing (MLE, SF – Aerobic, High N - Anoxic)	7.9%, 0.213 MG,	
Zone 6 Aerobic	6.5%, 0.175 MG,	
Zone 7 Swing (MLE – Aerobic; SF – Anoxic)	23.4%, 0.63 MG,	
Zone 8 Aerobic	17.7%, 0.477 MG,	
Max Month SRT, days (aerobic/total)	5/9	7/11
MLSS, mg/L	3,000	2,500
Mixers		
Type	Surface mounted	
Number x power (hp) per zone(9)		
Zone 1	1 x 7.5	2 x 7.5
Zone 2	2 x 15	4 x 15
Zone 3	2 x 15	4 x 15
Zone 4	2 x 15	4 x 15
Zone 5	2 x 7.5	4 x 7.5
Zone 7	2 x 25	4 x 25
Aeration Diffusers		
Type	Fine Bubble	
Number (per basin)	3,100 +/-	
MM Air flow,	10,000	14,000
Effluent Channel		
Aeration Diffusers		
Type (provisions for maintenance removal)	Coarse bubble	
Airflow, scfm	300	600

Table 3.1 Design Criteria – Aeration Basins WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**Split-Flow CAS 2025 Design(1)**	**2035 Design(2)**
Internal Recirculation Pumps		
Type	Wall mounted axial flow	
Number of pumps, each aeration basin	1	
Capacity each, mgd	35	
Design flow at maximum month, mgd	46	100
Horsepower, each	5	
Supplemental Carbon Feed Facility		
Carbon Source		Methanol
Grade	NA	Pure
Storage capacity, gal	NA	2 x 4000
Design dose, mg/L as COD	NA	10
Feed pumps		
Type (explosion proof)	NA	chemical metering
No. of pumps	NA	2 + 1
Capacity each, gph	NA	10
Chemical usage at maximum month, ppd as COD	NA	2310

Notes:
(1) No CEPT, MLE configuration.
(2) CEPT, MLE configuration with methanol addition.
(3) Includes recycle flows from filtration, dewatering and thickening but excludes internal mixed liquor return flows.
(4) Assumes 54% removal of particulate in the primary clarifiers.
(5) Assumes 68% removal of particulate in the primary clarifiers with CEPT.
(6) Since Sunnyvale doesn't routinely monitor influent temperature, the design minimum month temperature was based on minimum 7-day running average temperature measured at the San Jose TPS wet well from December 21, 2008 - September 17, 2013.
(7) Assumes 1.5-foot thick inner walls, 2-foot thick outer walls, 3-foot thick floor slabs and 3-foot freeboard. Includes CaRRB basin and not effluent channel.
(8) Includes the CaRRB basin and excludes the effluent channel.
(9) Mixers provide between 35 and 45 hp per MGal.

3.2.3.1 Site Layout and Process Impacts

Section 3.12 includes a site layout depicting the location for the aeration tanks with general dimensions. WPCP site has limited space in which new unit processes will fit. A corridor has been reserved between the Primary and Secondary Treatment areas. This corridor is to accommodate the following:

- Vehicular access, including a minimum 20-foot wide driving lanes and 50-foot turning radii.
- Below grade utilities such as air and process piping, electrical ductbanks and conduits, etc.
- Based on master plan considerations, provisions for future tankage, including but not limited to digesters.

Due to site limitations, the aeration basins are planned to be a deeper than typical at a side water depth (SWD) of 24 feet. This depth is a key design criteria, as it balances the need for bioreactor volume with the tight site plan. For this reason this depth must be carefully evaluated early in the preliminary design process. Section 3.12 also includes a section through those tanks reflecting this. Process modeling indicates that at this depth minor degassing will be needed to protect against rising sludge in the secondary clarifiers. The effluent channel was sized to allow sufficient degassing while maintaining a low G value (less than 100 sec^{-1}) to minimize floc sheering.

The overall site layout implications for the entire WPCP site is discussed in detail in the Site Layout Considerations Technical Memorandum. Refer to this document for further details. Key impacts discussed in this document include:

- Access for O&M personnel.
- Identification of utility corridors.
- Traffic routes for chemical deliveries and residual solids handling.
- Fire access.
- Site flood protection.
- Parking allocation.
- Landscape concepts.

The capital improvement plan (CIP) includes aggressive projections for future flows and loads and therefore assumes that the secondary treatment system will be built with limited phasing. Under the split flow scenario, it is assumed that the first phase of secondary expansion would include two aeration basins and three final clarifiers. The remaining two aeration basins (three under the high nitrogen load projection) and three remaining final clarifiers would be constructed once the anticipated total nitrogen effluent standards are implemented. Phasing should be revisited as part of preliminary design of the secondary treatment train. If increased flows and loads to the City's collection system have not materialized on the timeline assumed in the CIP and/or if there is a relaxation of future nitrogen standards, construction of fewer facilities should be considered, while leaving sufficient space for future expansion.

3.2.3.2 Primary Effluent Flow Splitting

To execute an even split of primary effluent to each aeration basin, active flow control is recommended. Ideally, a weir structure would be built downstream of the primary sedimentation tanks. In this case, site constraints make construction of a weir structure impractical. Instead, a below grade vault housing a flow distribution manifold, with actuated valves and flow meters to feed each aeration tank is proposed.

3.2.3.3 Nitrogen Removal

Due to uncertainly in the future effluent nitrogen limits and the anticipated timing of these limits, the aeration basins are planned to allow for flexibility to operate in two modes:

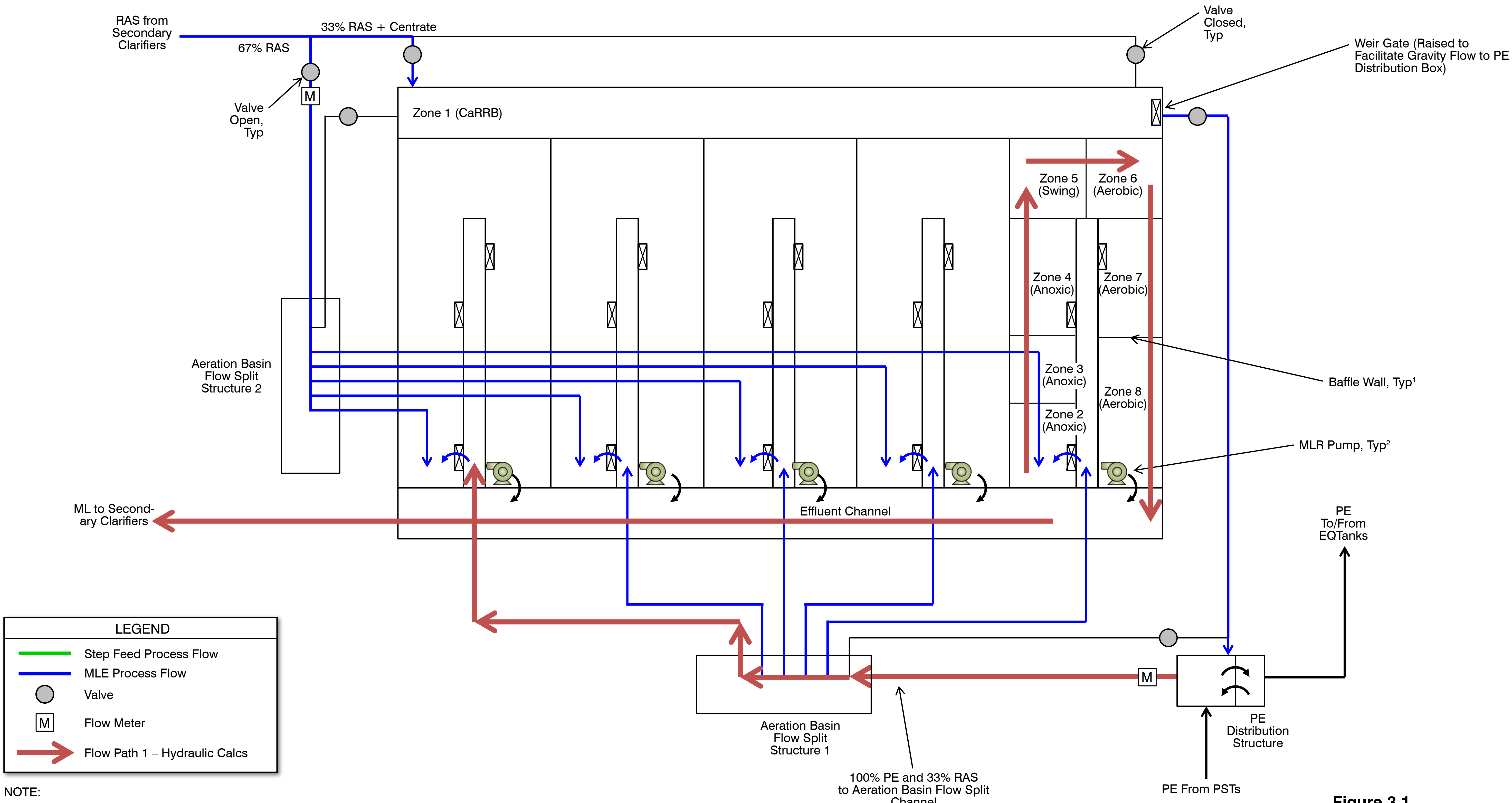
- Modified Ludzak-Ettinger (MLE). This process is anticipated to produce a lower effluent nitrogen concentration but requires higher yearly operation and maintenance costs.
- Step-Feed (SF). This process is not anticipated to meet a total effluent limit of 8 mg/L, but can be operated with lower power costs.

Figures 3.1 and 3.2 show process schematics for each mode of aeration tank operation. Within the MLE configuration, the basins were designed for an aerobic solids retention time (aSRT) of 7 days. The basins were designed with a swing zone (Zone 5) which can be aerobic for a 7 day aSRT or anoxic to provide additional denitrification ability with operation at a 6 day aSRT.

To minimize site impacts and the impacts of the dewatering return stream, the recommendation of the Master Plan was to incorporate sidestream treatment with a centrate and return activated sludge (RAS) re-aeration (CaRRB) zone (Zone 1) into the MLE configuration. In this configuration, a portion of the RAS (25 percent) is combined with the dewatering return and aerated. This zone can efficiently nitrify the dewatering return's high ammonia concentration, provide aerobic inventory at a higher mixed liquor suspended solids (MLSS) concentration (thus saving footprint) and can provide a seed of nitrifiers to the aeration basin. The CaRRB process has been implemented elsewhere, including at the Denver Metro Wastewater Treatment Plant. It is similar in concept to other sidestream processes such as BABE® and InNitri®. If the WPCP is interested in pursuing a deammonification sidestream treatment process in the future, the CaRRB zone could be retrofitted at that time to allow for these processes.

3.2.3.4 Phosphorus Removal

Additional flexibility to operate in a biological phosphorus removal configuration such as an anaerobic, anoxic, oxic (A2O) or a five-stage Bardenpho is not planned at this time. However, with modifications, these basins can be designed with this additional flexibility if this is desired. The design criteria presented in Table 3.1 assumes operation in a MLE



NOTE:
(1) Baffle walls only shown in one basin for clarity.
(2) 4Q internal mixed liquor return (MLR) within each basin.
(3) Pumped flow pipes. To be sized during design.

Figure 3.1
MLE PROCESS SCHEMATIC
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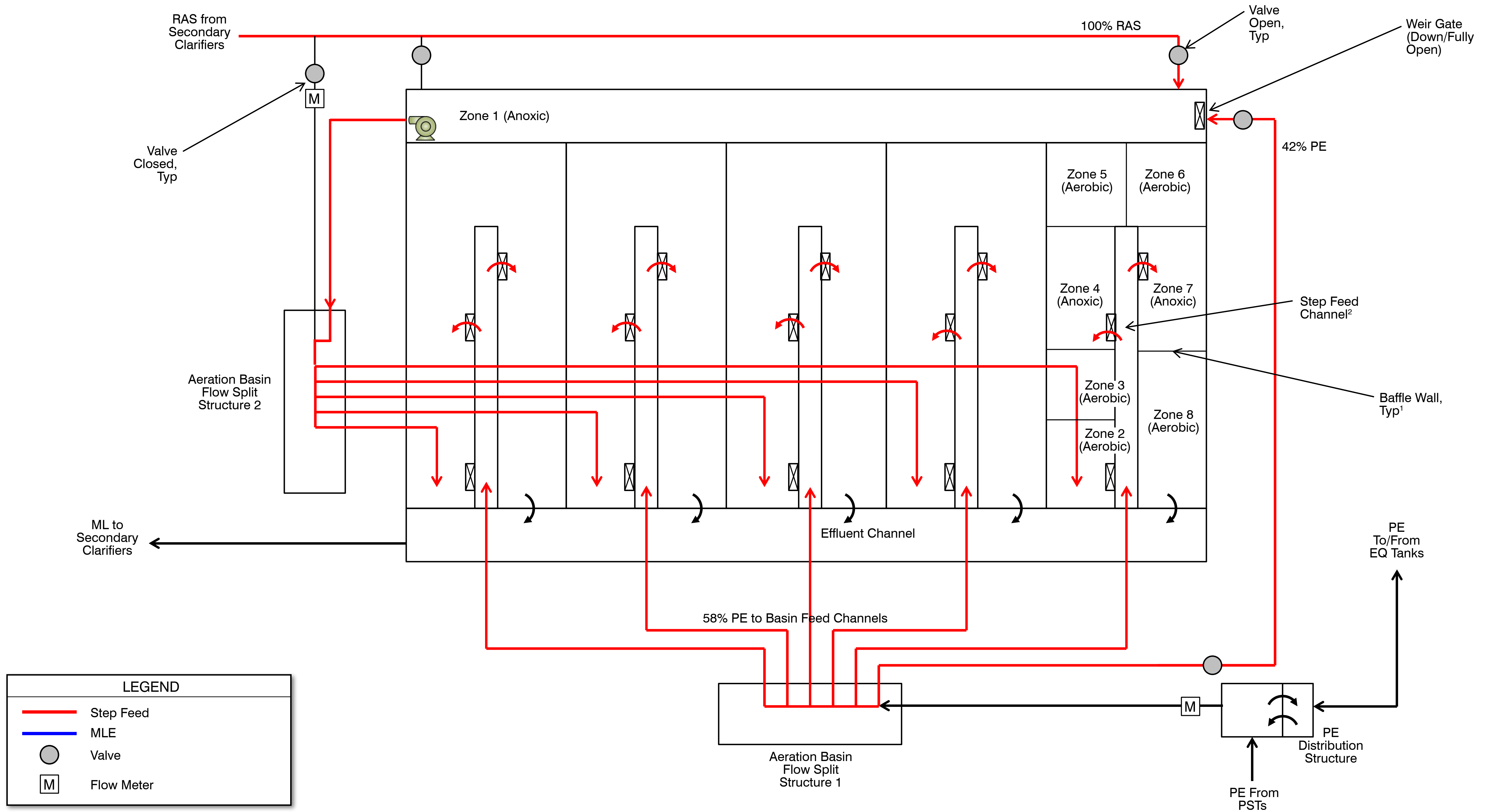
sun0316f2-9265BOD.ai



NOTE:
(1) Baffle walls only shown in one basin for clarity.
(2) 35% PE sent to Anoxic Zone 2; 23% PE sent to Anoxic Zone 3.
(3) Pumped flow pipes. To be sized during design.

Figure 3.2
STEP FEED PROCESS SCHEMATIC
BASIS OF DESIGN
CITY OF SUNNYVALE

sun0316f3-9265BOD.ai

configuration. Additionally, Table 3.1 assumes that the City will not need to meet phosphorus limits until the year 2035 and, if implemented, these limits (anticipated to be 1.0 mg/L as P) could be met with two-stage chemical addition (CEPT plus a second chemical does following secondary clarification). Once chemical phosphorus removal is implemented it is anticipated that the aeration basins will no longer receive sufficient readily degradable biochemical oxygen demand (BOD) from the primary effluent and it is anticipated that a supplemental carbon feed facility will be required to supplement the BOD load to the aeration basins.

Methanol was selected as an external carbon source at this level of analysis since it is generally the least expensive external carbon source. However, methanol use has a several disadvantages:

- Methanol is a flammable liquid and fire and explosion protection will need to be carefully designed into the system and into the operational program. The methanol feed and storage system will need to meet the requirements of NFPA 30 Flammable Liquids;
- Since methanol is used by methylotrophs and not ordinary heterotrophs, methanol will need to be added continuously to maintain a population of methylotrophs, even if the external carbon source is needed intermittently.

Due to these two factors, the City may wish to look at alternate external carbon sources such as acetate or MicroC. These sources, although generally more expensive per unit weight, can be added intermittently and do not have the safety concerns associated with methanol use. A location for supplemental carbon-feed facilities has not yet been determined, because of the uncertainty with respect to need, and the type of chemical being used. For this reason, this evaluation should be included with the preliminary design of the secondary treatment facilities.

3.2.3.5 Additional Equipment

Alkalinity is critical to nitrification. Nitrifying bacteria consume carbonate as their food source while utilizing ammonia in their energy transfer mechanism. Since carbonate is consumed, water discharge from secondary processes including nitrification can lack alkalinity. Influent and primary effluent alkalinity are not routinely monitored. During the master planning process, two weeks of discreet monitoring was done which resulted in an average primary effluent alkalinity of 247 mg/L. Based on this value, BioWin modeling indicates that after secondary treatment, the mixed liquor alkalinity would be approximately 160 mg/L. Generally, an effluent alkalinity of 100 mg/L or greater is targeted, so this falls within acceptable limits. However, since the sampling duration was limited, further monitoring is warranted. Caustic feed provisions to increase alkalinity may be warranted if alkalinity is shown to vary. This should be evaluated during preliminary design.

A surface wasting or spray box is also recommended to be included in the aeration tank design. This feature will aid in mitigating built up scum or foam that may form on the surface of the aeration tanks. If surface wasting provisions are included, mixed liquor could be wasted directly in addition to or in place of the waste that would normally occur from the RAS line. This should be evaluated during preliminary design.

3.3 SECONDARY CLARIFIERS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.3.2 Project Element List

This section will describe the secondary clarifiers. Section 3.4 will describe the RAS/WAS pump stations.

3.3.3 Design Criteria and Redundancy

The design criteria for the proposed secondary clarifiers are summarized in Table 3.2.

**Table 3.2 Design Criteria – Secondary Clarifiers
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Parameter	Split-Flow CAS 2025 Design	2035 Design
Secondary Clarifiers		
Number of Units	3	6
Redundancy	Ponds as backup	1 AB or SC OOS during AAF
Inside diameter, ft	95	
Side water depth, ft	16	
Overflow rate, gpd/sf(1)		
MMF	800	650
PHF	800	940
Solids loading rate, ppd/sf(2)		
MMF	32	23
PHF	32	33
Design SVI, mL/g	150	

Notes:
(1) Does not include RAS in the calculation.
(2) Includes RAS in the calculation.

A site layout depicting the planned layout for the secondary clarifiers along with the RAS pump stations is shown in Section 3.12. A section view of a typical secondary clarifier as planned for this plant is also included with these layouts.

Based on WPCP staff preference, circular clarifiers were used for site layout purposes. As further detailed engineering is completed, site constraints may dictate the use of rectangular clarifiers. This should be evaluated during preliminary design.

In the conceptual-level hydraulic analysis that was performed for purposes of this Master Plan, weirs were assumed to execute proportional flow splitting between the secondary clarifiers. This assumption is conservative. Weirs generally utilize more head than other methods available to accomplish such flow splits. These other methods, such as valves and flow metering, should be explored during preliminary design.

Flat-bottom clarifier tanks with Tow-Brow style clarifier mechanisms are recommended for the WPCP. Clarifier inlet design can impact clarifier performance. Appropriate energy dissipation measures can prevent short circuiting and floc shear that could adversely affect effluent water quality. The clarifier design should include appropriate inlet baffling and/or other energy dissipation features. The preliminary design engineer may want to preform computational fluid dynamics (CFD) modeling to design these inlets.

The need for density current baffles should be examined during preliminary design. Such baffles, attached to the outside walls of circular clarifiers, prevent solids from being carried by density currents up tanks walls and into the effluent trough. The need for such baffles should be confirmed during preliminary design. Double-sided, in-board effluent troughs are also recommended to convey secondary effluent to the effluent pipe.

3.4 RAS/WAS PUMPING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.4.2 Project Element List

The RAS/WAS pumping facilities will include the following major project elements:

- RAS pump station (three separate stations are proposed - one for each pair of the secondary clarifiers).
- WAS pumps (to be located in the Thickening/Dewatering Building).

3.4.3 Design Criteria and Redundancy

The design criteria for the proposed RAS/WAS pumping facilities is summarized in Table 3.3.

Table 3.3 Design Criteria – RAS / WAS Pumping Facilities
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	Split-Flow CAS - 2025 Design	2035 Design
RAS Pump Station		
Number	2	3
RAS Pumps		
Type	Centrifugal	
Number of pumps (firm + standby)	4 + 2	6 + 3
Total number of pumps	6	9
Capacity each, mgd	3.6	
Total RAS flow at MMF, mgd	10	17
WAS Pumps		
Type	Centrifugal / Progressive Cavity	
Number of pumps (firm + standby)	2 + 2	3 + 3
Capacity each, mgd	0.4	

Generally, it is preferred to provide direct pumping off individual clarifiers. This gives the maximum operational control over the secondary treatment process as a whole, including blanket control within the clarifier and the quality of RAS sent back to the bioreactors. In the case of the WPCP, one RAS pump station is planned for each group of two secondary clarifiers, resulting in three RAS stations total (see Section 3.12 for conceptual layout drawings). Each RAS pump station will include two duty and one standby RAS pump,

The RAS flow rates shown in Table 3.3 were used in concept level process modeling completed as part of the WPCP Master Plan. The pumps installed to service the secondary treatment system will be built to handle a range of flows. It's recommended that the total RAS pumping capacity be designed to pump 50 to 100 percent of ADWF.

As shown in the secondary clarifier site layout drawing, the discharge pipe from each RAS pump station will be routed to the northeast corner of the secondary clarifier area. These discharge pipes will come together into a single pipe which will run along the northern perimeter of the WPCP to the aeration tanks. A WAS discharge header would be routed to the Thickening/Dewatering Building where the WAS pumping is located. The precise routing for this WAS pipe should be further evaluated during preliminary design. A suggested route would divert flow from the RAS pipe at approximately the midpoint of the western wall of the aeration tanks. The WAS pipe could be then be routed through the proposed utilidor to the Thickening/Dewatering Building.

3.5 DIURNAL EQUALIZATION

To provide secondary treatment to meet the 2035 peak hour flow of 58.5 mgd would require more space than is available on the limited site. For the full CAS treatment option, the ponds would be retired and 8 MG of diurnal equalization would be provided. In addition to the diurnal equalization, three (3) days of emergency storage would also be provided. The planned equalization and emergency storage volume would be located in the current site of Pond 1. The diurnal equalization would limit the peak flow to around 38 mgd. Figure 3.3 provides a layout concept for these facilities. For the split-treatment option, the ponds would be retained and would provide equalization and emergency storage volume, thus allowing construction of these facility to be delayed until the ponds are retired.

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.5.2 Project Element List

Diurnal equalization will include the following major project elements:

- Extension of the primary effluent pipeline.
- Improvements to the access road.
- Equalization storage basins.
- Equalization distribution structure.
- Equalization pump station.

3.5.3 Design Criteria and Redundancy

The design criteria for the proposed diurnal equalization facility are summarized in Table 3.4.

The diurnal equalization facilities will include a Distribution/Pumping Structure and three (3) pre-stressed concrete tanks containing the 8 MG of required storage capacity, shown in Figure 3.3. These tanks would be designed to overflow into the emergency storage basin. The emergency storage basin would be connected to the same pumping structure. To protect against future sea level rise, the access road and storage facilities working grades would be elevation 116.00 (plant datum). Construction of these facilities will require removal of the solids from Pond 1.

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 3.3
DIURNAL EQUALIZATION/EMERGENCY STORAGE FACILITIES
BASIS OF DESIGN
CITY OF SUNNYVALE

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Table 3.4 Design Criteria – Diurnal Equalization WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**Split-Flow CAS 2025 Design**	**2035 Design**
Diurnal Equalization		
Capacity	NA	8 MG
Three storage tanks	NA	2.7 MG each
Maximum peak flow return rate, mgd	NA	30
Equalization Pump Station		
Number of pumps	NA	4 + 1
Pump capacity each, mgd	NA	7.5

The Distribution/Pumping Structure will receive flows from the primary treatment train in excess of 34.7 mgd. This flow will then be distributed to each of the three pre-stressed holding tanks. Elevation of these three tanks will have to be coordinated with the hydraulic profile established at the WPCP to maintain sufficient flow capacity for the primary effluent. The structure will also house pumps used to pump the stored primary effluent (through the same primary effluent pipeline) back to the WPCP during lower flow periods. Since low diurnal flows are estimated to be in the range of 5 mgd, a maximum flow return rate was assumed to be the difference between the low flow and peak flow to the activated sludge system (30± mgd).

The existing primary effluent pipeline which currently conveys flow to the facultative ponds will be used to convey flow to the diurnal equalization facilities as well as to pump flow back to the main plant site for treatment. This pipeline will need to be rehabilitated to withstand pressurized flow from the diurnal equalization pumps.

Because of the costs to construct these facilities, along with the expected extensive permitting process, an alternate site should be pursued. One potential site would include the use of Pond A4 which is currently owned by the Santa Clara Valley Water District. This location is more contiguous with the WPCP and therefore should be less costly to construct. Significant permitting issues are anticipated, but could be less complicated that pursuing the Pond 1 site.

The blower building layout is based on a one-story building. The blower building should include space for a restroom and operator control room. The cost and benefit of adding meeting space to this building should be considered during preliminary design. To accommodate this additional meeting space and/or to maximize site space, the potential to implement a two-story building should be considered during preliminary design.

Designing blowers on peak loads carries a risk of oversizing blowers. This can be mitigated selecting a variety of blower sizes, as well as considering realistic turndown rates. Blower turndown and sizing should be evaluated during preliminary design.

3.6 BLOWER BUILDING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.6.2 Project Element List

The Blower Building will house the following equipment:

- Aeration blowers.

3.6.3 Design Criteria and Redundancy

A common set of blowers have been assumed for both the aeration basins and the channel aeration. The design criteria for the proposed blower building are summarized in Table 3.5.

Table 3.5 Design Criteria – Blower Building
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	Split-Flow CAS 2025 Design	2035 Design
Blowers		
Type	Single stage centrifugal	
Number of blowers (firm + standby)	2 + 1(1)	3 + 1(1)
Capacity each, scfm	1 x 7,500 2 x 12,500	2 x 7,500 2 x 12,500

Notes:
(1) 1 large blower standby

Peak air flow rates for the aeration basin were calculated assuming the high nitrogen load scenario during the simulated peak day load with summer temperatures of 22.5º C while operating a 7 day aSRT. This resulted in a projected peak airflow demand of 28,000 scfm. The selected blowers will provide turndown to meet the projected minimum airflow demand of 4000 scfm which is projected to occur at startup during ADW flows and the design nitrogen load scenario, with winter temperatures of 16.5°C while operating at a 6 day aSRT with CEPT.

Section 3.12 includes a conceptual site layout drawing showing the blower building location as well as a conceptual blower building layout. Single stage centrifugal blowers were assumed for the layout, however use of high-speed turbo blowers should be considered during final design.

- Potable Water (WP) from the Potable System.
- Utility Water (3W) from the No. 3 Water System.
- Plant (Service) Air (SA) from the Plant Air System.

The following major process and utility pipes would be routed from aeration basins, secondary clarifiers, blower building and RAS pump station:

- Aeration Basins:
  - Mixed Liquor from the effluent channel to the ML distribution box.
  - Scum/foam to the anaerobic digesters and / or thickening.
  - Floor drains and miscellaneous drains to the Headworks.
- Secondary Clarifiers:
  - RAS to the RAS pump station.
  - Scum/foam to the anaerobic digesters and / or thickening.
  - Floor drains and miscellaneous drains to the Headworks.
- Blower Building:
  - Aeration air to the aeration basins.
  - Floor drains and miscellaneous drains to the Headworks.
- RAS Pump Station:
  - RAS pipeline to the aeration basins.
  - WAS pipeline from the RAS return pipeline to the Thickening/Dewatering Building.
  - Floor drains and miscellaneous drains to the Headworks.

3.7.3 Support Utilities

Major support utilities that should be considered when planning and designing the aeration basins, secondary clarifiers, diurnal equalization, blower building and RAS pump station are summarized in Table 3.6.

3.7.4 Specialty Tools

Jib cranes are recommended to provide a means to pick up submersible mixers and the coarse bubble aeration from the effluent channel.

Table 3.6 Support Utilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale	
Ancillary Facility	**Description**
Potable Water	• Provide at emergency shower eyewash stations and handwashing stations • Provide at aeration basins, secondary clarifiers and RAS and WAS pump station for future chemical use.
Utility Water	• Provide at hose bibs in all areas for general housekeeping • Provide at all pumps for pump seal water • Provide at aeration basins and secondary clarifier spray bars • Provide at diurnal equalization for washing down the basins • Blower building and RAS/WAS pumps station for house keeping
Plant Air	• Provide plant air at air tool connection as required.
Drainage	• Provide floor drains in all areas for general housekeeping • Route all floor drains to the headworks

3.7 CIVIL/SITE CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

3.7.2 Piping Layout

The following major process and utility pipes would be routed to the aeration basins, secondary clarifiers, diurnal equalization, blower building and RAS pump station:

- Aeration Basins:
  - Primary effluent (PE) from the primary effluent distribution structure to the Aeration Basin Flow Split Structure 1.
  - Return activated sludge (RAS) from the RAS pump stations to Zone 1 and to the Aeration Basin Flow Split Structure 2.
  - Pressate from the thickening/dewatering building to Zone 1.
  - Aeration air from the blower building.
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Secondary Clarifiers:
  - Mixed liquor from the ML distribution box.
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Diurnal Equalization:
  - Extension of the existing primary effluent pipeline.
  - Utility Water (3W) from the No. 3 Water System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Blower Building:
  - Plant (Service) Air (SA) from the Plant Air System.
  - Utility Water (3W) from the No. 3 Water System.
- RAS Pump Station:
  - RAS from the secondary clarifiers.

3.8 ELECTRICAL CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

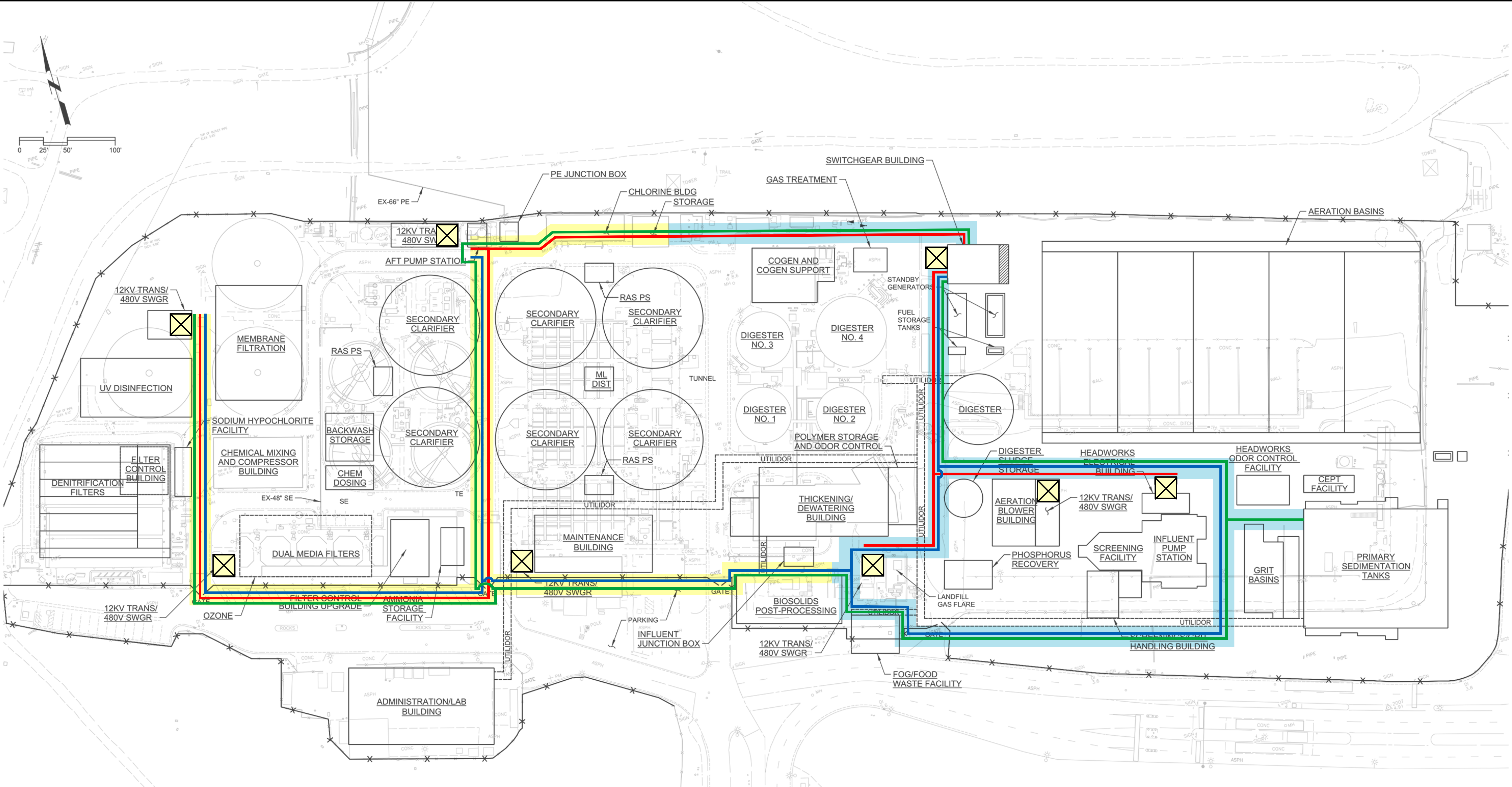
3.8.2 Electrical Distribution

Based on the Master Plan recommendations, a proposed 12-kilovolt (kV) radial loop distribution layout was developed to replace the existing 4,160-kV system. The first phase of that transition was completed as part of the Primary Treatment project. The second phase of that transition is planned to be completed as part of the secondary treatment improvements. Figure 3.4 presents the site layout for the 12-kV distribution system. This figure shows transformers located in selected locations around the WPCP to provide a 480 volt supply to the various process loads. For the secondary treatment facilities, two of these transformers were recommended: (1) one adjacent to the proposed aeration blower building and (2) one along the north plant perimeter north of the proposed secondary clarifiers. Each transformer would be sized for the complete load of these facilities. Depending on the final location of the diurnal equalization facilities, a separate 12-kV supply would be provided for these facilities.

Each transformer would feed a 480-volt switchgear/MCC.

3.8.3 Electrical Loads

The electrical loads for the aeration basins, secondary clarifiers, diurnal equalization, blower building and RAS/WAS pumping are summarized in Appendix A. This table also summarizes the number of units, the number of standby units, the peak load, the connected load, and whether the loads would be supplied with standby power.



LEGEND

☒ 12 kV Transformer/480V Switchgear	Expansion Stage:
12 kV Radial Loop "A"	Stage 1 – Primary Treatment Facility
12 kV Radial Loop "B"	Stage 2 – Secondary Treatment Improvements
Fiber Optics Loop	

Figure 3.4
ELECTRICAL DISTRIBUTION SYSTEM
BASIS OF DESIGN
CITY OF SUNNYVALE

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3.9 INSTRUMENTATION AND CONTROL CONSIDERATIONS

3.9.1 Process Flow Diagram

The process flow diagram for the conventional activated sludge process is show in Section 3.12.

3.9.2 Automation and Control Considerations

The level of instrumentation through the secondary treatment system is dependent on the level of automation desired by plant staff and equipment selections. The instrumentation discussed herein assumes a high level of automation.

3.9.3 Aeration Basins

The aeration tanks may be automated to a level that allows virtually unattended operation. Primary effluent flow into each aeration basin will be regulated via flow metering and automatically actuated valves. Online DO, total suspended solids (TSS), ammonia, nitrate, and oxidation reduction potential (ORP) analyzers can be tied to the aeration, mixing and wasting systems to regulate bioreactor performance.

3.9.4 Secondary Clarifiers

Secondary Clarifiers require relatively little operator intervention. The clarifier mechanism will be controlled via a panel provided by the manufacturer. The main process aspect requiring regular intervention is sludge blanket level. Sludge blanket monitoring may be used to automate these levels. Blanket levels are also tied closely to RAS pump station operation. These two systems should be operated in concert.

3.9.5 RAS Pump Stations

RAS pumping operations can be controlled via wet well level monitoring (via level transducers or floats), flow meters, variable frequency pump drives, and valves.

3.9.5.1 Diurnal Equalization

Flow into the diurnal equalization system will be controlled passively. A weir structure will divert flows in excess of 34.7 mgd to the receiving structure. Actuated valves can be used to control which of the three equalization tanks fill. Pumping equalized flow back to the secondary treatment system can be controlled using flow metering, tank level sensors, and variable frequency pump drives.

3.9.5.2 Blower Building

Blower operation will be tied to DO concentrations monitored in the aeration tanks. PLCs can be utilized to maintain oxygen levels in each MLE process zone to maintain organics and ammonia removal within the unit process.

3.10 MAJOR O&M CONSIDERATIONS

The major operations and maintenance (O&M) considerations for the aeration basins, secondary clarifiers, diurnal equalization, blower building and RAS pump stations are summarized in Tables 3.7 to 3.11.

**Table 3.7 Operations and Maintenance Considerations – Aeration Basins
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Equipment	O&M Consideration
General	• Provide air tool connections as required.
Aeration Basins	• Provide washdown provisions. • Provide sample ports on effluent from Zone 1. • Record DO measurements in Zones 1, 2, 3, 5, 6, 7 and 8. • Provide online ammonia analyzers in Zone 8. • Provide online nitrate analyzers in Zones 4 and 8. • Provide ability to access the diffusers. • Provide ability to access mixers. • Provide surface wasting to remove scum/foam from Zone 1. • Provide spray bars.
Effluent Channel	• Provide sample ports on the effluent channel. • Provide ability to access and remove the diffusers while the channel's in service. • Provide ability to surface waste to remove scum/foam. • Provide online TSS analyzer for SRT control. • Provide spray bars.
Internal Recirculation Pumps	• Provide ability to easily remove pumps for maintenance.
Supplemental Carbon Feed Facility	• Provisions to meet NFPA 30 requirements for operational safety.

Table 3.8	Operations and Maintenance Considerations – Secondary Clarifiers WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
Equipment	**O&M Consideration**
General	• Provide air tool connections are required. • Provide washdown provisions.
Secondary Clarifier	• Provide sample ports on secondary effluent and RAS lines from each clarifier. • Provide ability to measure sludge blanket depth. • Provide spray bars.

Table 3.9	Operations and Maintenance Considerations – Diurnal Equalization WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
Equipment	**O&M Consideration**
General	• Provide air tool connections are required.
Diurnal Equalization	• Provide access to inspect and hose down basins.
Diurnal Equalization pump station	• Provide sufficient clearance in front of pump for stator removal. • Provide ability to flush lines.

Table 3.10	Operations and Maintenance Considerations – Blower Building WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
Equipment	**O&M Consideration**
General	• Provide air tool connections are required.
Blowers	• Provide ability to flush lines. • Provide access to all components.

Table 3.11	Operations and Maintenance Considerations – RAS and WAS Pump Station WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale
Equipment	**O&M Consideration**
General	• Provide air tool connections are required
RAS and WAS Pumps	• Provide ability to flush lines. • Provide sufficient clearance in front of pump for stator removal. • Provide access to all components. • Provide ability to chlorinate the RAS if needed to maintain SVI.

3.11 POTENTIAL VENDORS

The major equipment proposed for the Secondary Treatment Facility and the recommended vendors for each type of equipment are summarized in Table 3.12. The major equipment proposed may be competitively bid.

**Table 3.12 Potential Equipment Vendors
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

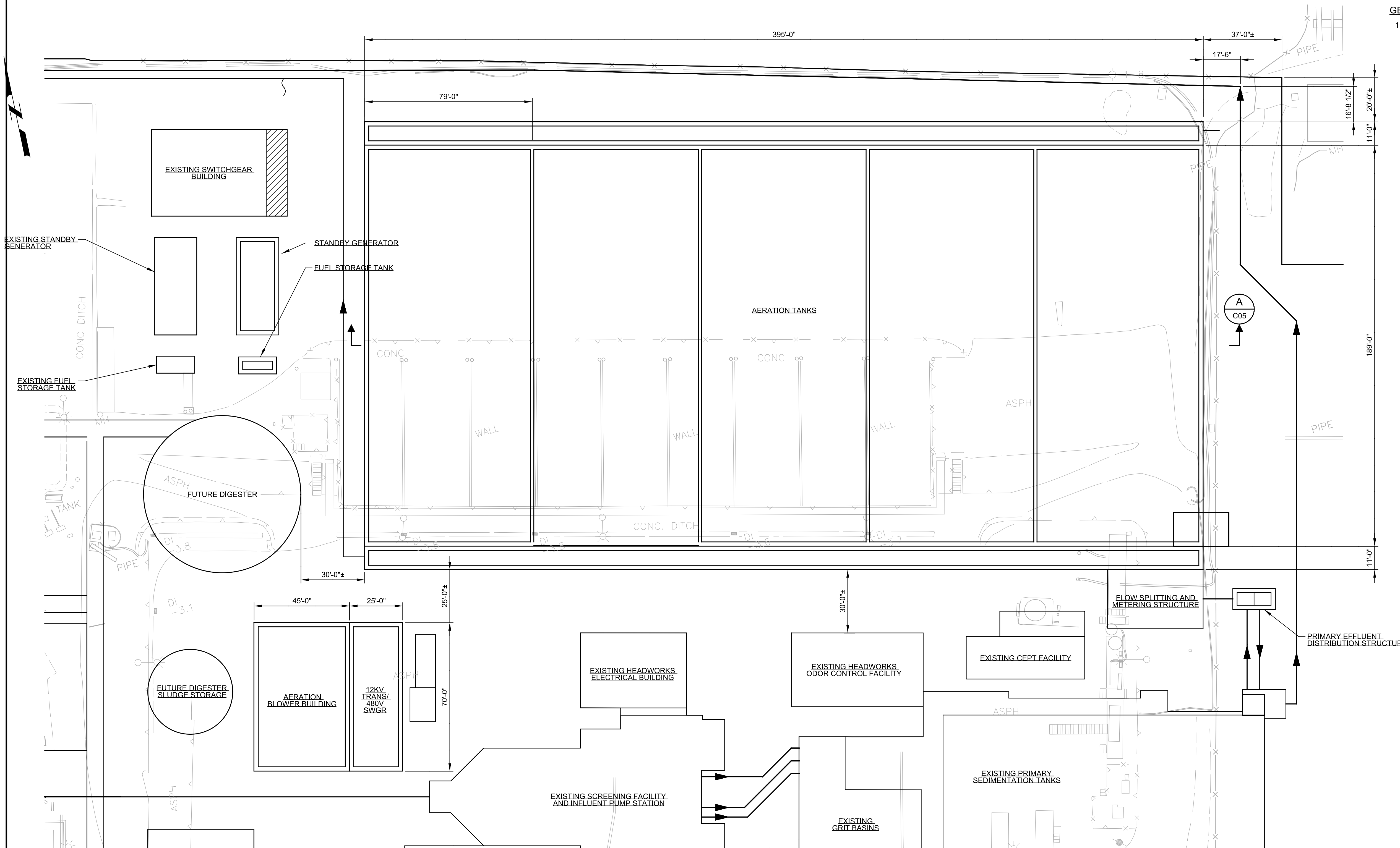
Equipment	Vendor
Aeration Basin	
Diffusers	Sanitaire, EDI, Parkson
Mixers	Invent, Lightning, Philadelphia
Secondary Clarifier	
Mechanism	Evoqua, Ovivo
Diurnal Equalization	
Tanks	DN Tank, Caldwell
Blower Building	
Blowers	Hoffman, Gardner-Denver, Neuros, Aerzen

Notes:
(1) Includes sole-source requirements, recommended considerations for pre-qualifying or pre-purchasing equipment, etc.
(2) "Or equal" equipment should be considered provided it meets project specifications.

3.12 LAYOUT DRAWINGS

Drawings 3.1 and 3.2 are conceptual site layout drawings showing unit processes and their locations. Drawing 3.3 shows typical tank sections. A conceptual layout for the blower building is included as Drawing 3.4. Drawing 3.5 is a process flow diagram for the CAS secondary treatment process.

All facilities would be designed and implemented in accordance with the Structural and Seismic and Architectural Design Standards developed as part of the Master Plan.



GENERAL NOTES:

1. STRUCTURES SHOWN AS EXISTING ARE TO BE CONSTRUCTED AS PART OF THE ONGOING PRIMARY TREATMENT PROJECT. STRUCTURES SHOWN AS FUTURE ARE PART OF FUTURE PLANNED IMPROVEMENTS LISTED IN THE CAPITAL IMPROVEMENTS PLAN.

Drawing 3.1

SITE LAYOUT - AERATION TANKS
BASIS OF DESIGN

CITY OF SUNNYVALE

carollo

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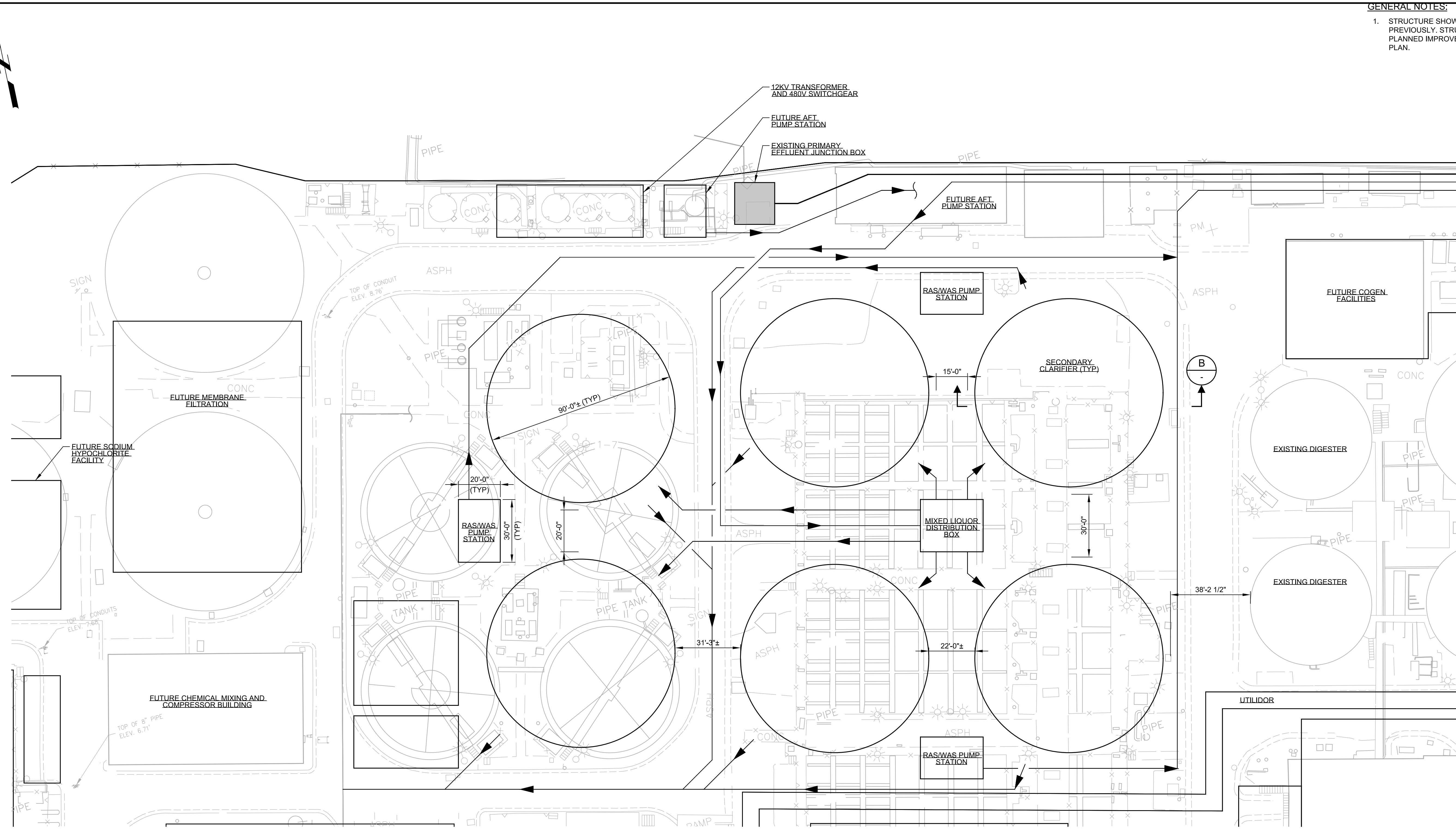
GENERAL NOTES:

1. STRUCTURE SHOWN AS EXISTING HAVE BEEN CONSTRUCTED PREVIOUSLY. STRUCTURES SHOWN AS FUTURE ARE PART OF PLANNED IMPROVEMENTS LISTED IN THE CAPITAL IMPROVEMENTS PLAN.



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Drawing 3.2

SITE LAYOUT - SECONDARY CLARIFIERS
BASIS OF DESIGN

CITY OF SUNNYVALE

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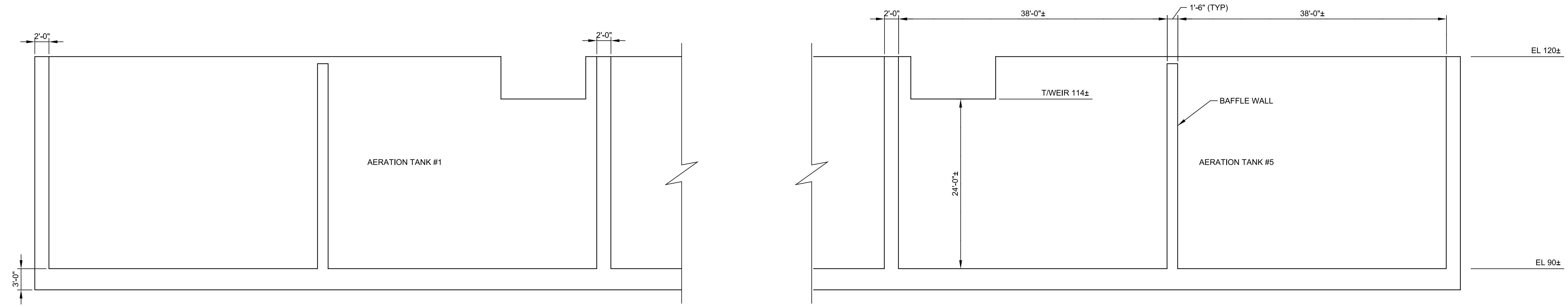

A SECTION
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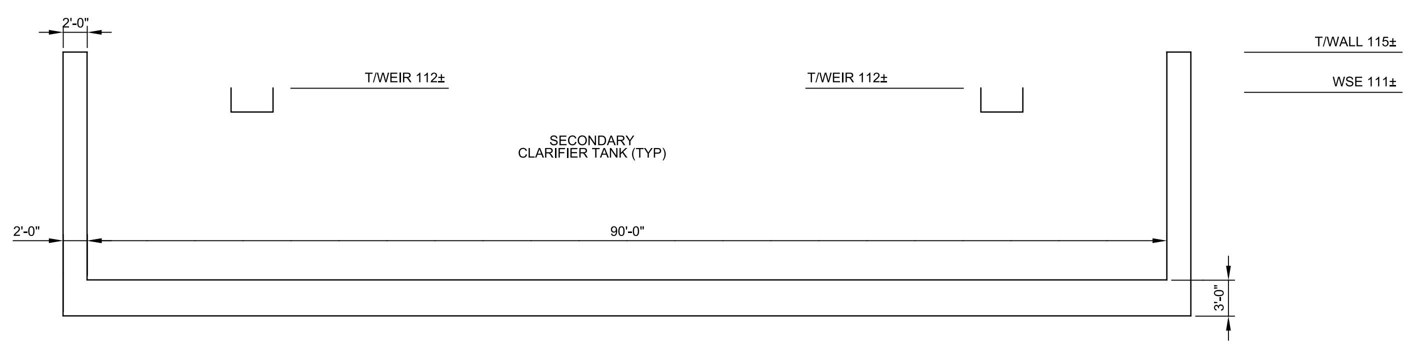

B SECTION
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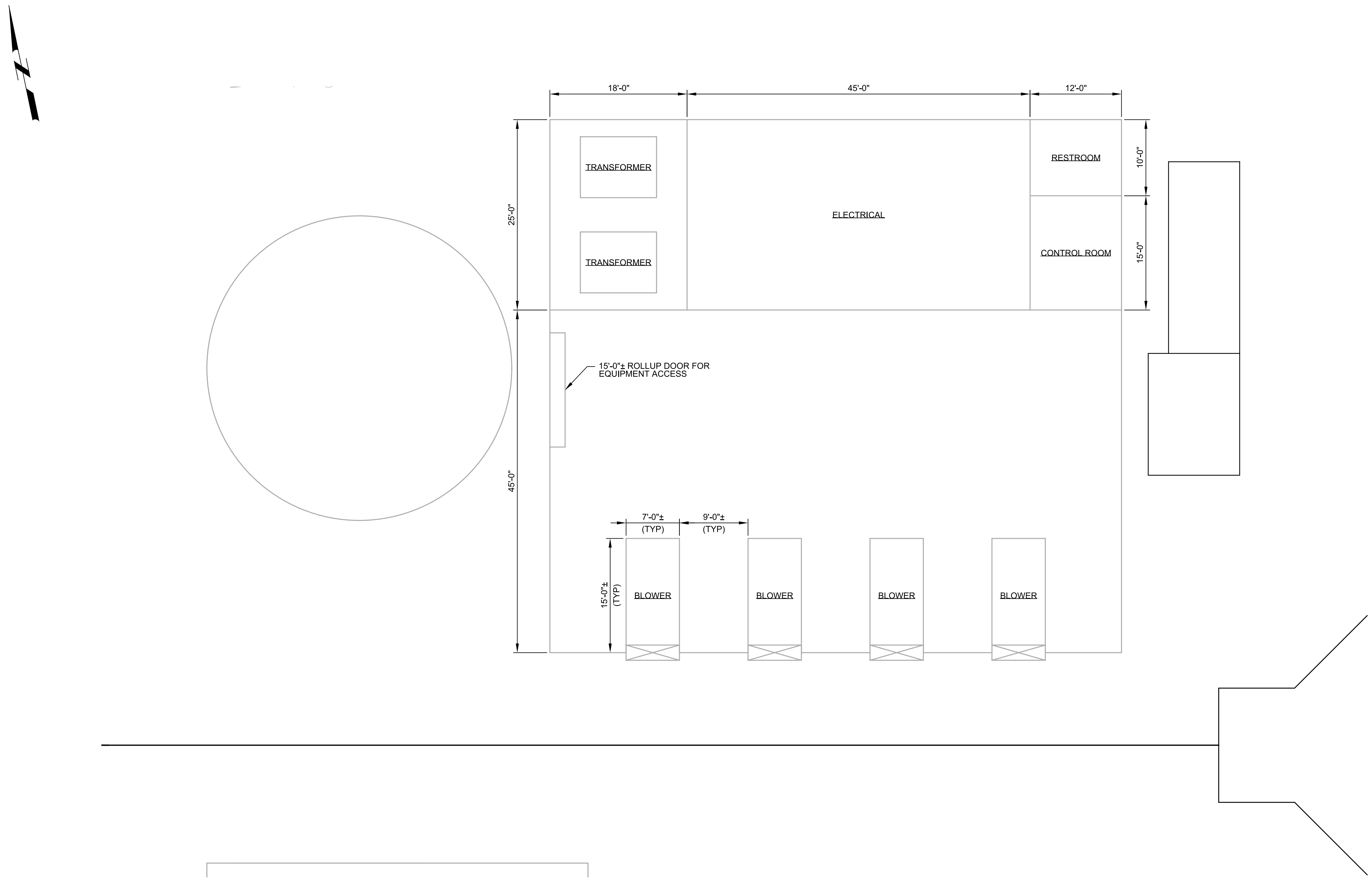
Drawing 3.3

TANK SECTIONS
BASIS OF DESIGN

CITY OF SUNNYVALE

carollo



Drawing 3.4

BLOWER BUILDING
CONCEPTUAL LAYOUT
BASIS OF DESIGN

CITY OF SUNNYVALE

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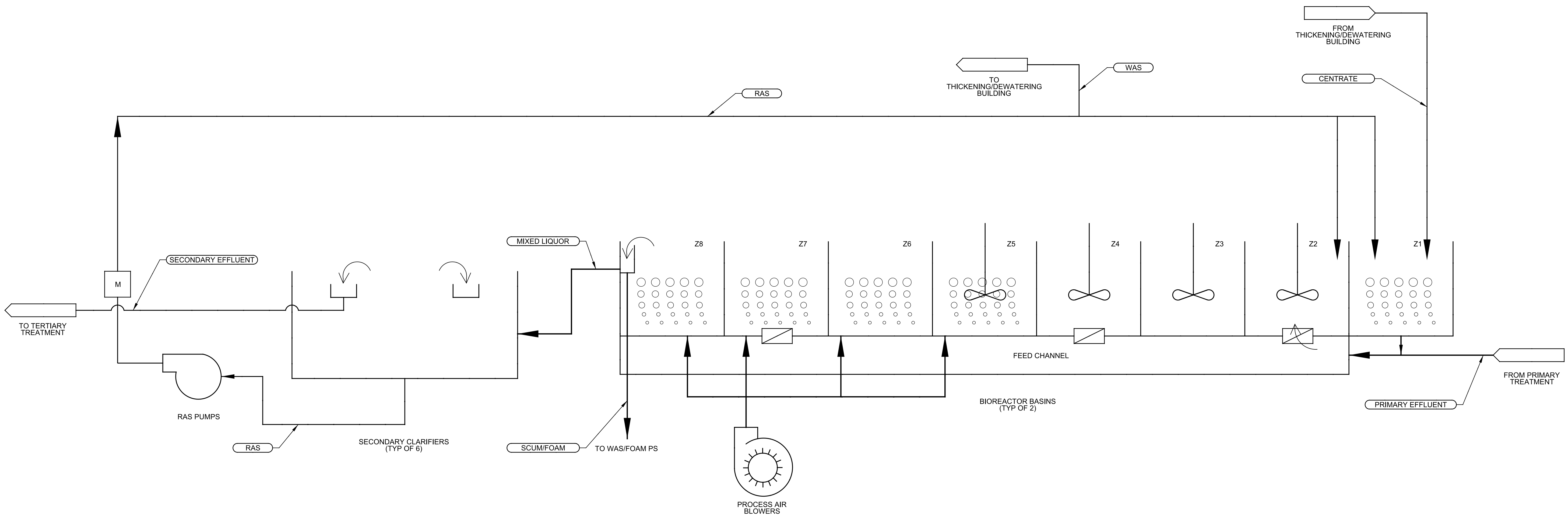
GENERAL NOTES:

1. MLE MODE OF OPERATION SHOWN HERE. REFER TO FIGURE 3.2 FOR INFORMATION ON STEP-FEED MODE OF OPERATION.



Drawing 3.5

PROCESS FLOW DIAGRAM
BASIS OF DESIGN

CITY OF SUNNYVALE

SECONDARY TREATMENT (MBR)

4.1 BACKGROUND

This section includes the basis of design for a membrane bioreactor (MBR) treatment process. The term MBR refers to a secondary wastewater treatment system comprised of aeration tanks (bioreactors) and aerated membrane filtration tanks. Throughout this document, bioreactors will be referred to as aeration tanks. The membranes, which are used to accomplish solid/liquid separation, will be referred to as membrane filters.

This Basis of Design is based on the key findings and recommendations of the Master Plan. As part of the Master Plan, Carollo/HDR conducted an analysis and selection of processes for secondary treatment at the WPCP. The analysis and recommendations are presented in the Master Plan Secondary Treatment TM. The selected secondary treatment processes proposed for the WPCP are based on providing the needed improvements through buildout (2035) to meet the City's goals and objectives. Future decisions made by the City such as a decision to partner with a water agency to do indirect potable reuse (IPR) could change the analysis and provide a driver for MBR treatment. Thus, the key findings and recommendations of the Master Plan for the MBR secondary treatment processes are summarized below:

- A Modified Ludzack Ettinger (MLE) AS process provides the process needs to accommodate future regulatory limits for nitrogen and, combined with chemically enhanced primary treatment (CEPT), will be able to accommodate future regulatory limits for phosphorus.
- To minimize site impacts and manage flow variations, 8 million gallons (MG) of diurnal equalization is recommended within the existing pond space.
- The project team recommends setting aside footprint for a fifth aeration basin that would provide the additional aeration basin capacity should the projected 2035 maximum month ammonia loads be higher than the 4,800 pounds per day (ppd) anticipated with the design ammonia load scenario. The fifth aeration basin would provide capacity to treat the projected 2035 maximum month high ammonia load scenario of 6,200 ppd.
- Current phasing calls for 7 Membrane Filter Tanks to be constructed to handle flows and loads through 2035. These tanks include extra space reserved for future membrane cassettes should flows increase or conditions require flux to decrease.
- MBR system will be constructed to create a high quality liquid effluent from the secondary process. Construction would coincide with construction of facilities providing for advanced water reuse, located where the existing Fixed Growth Reactors (FGRs) are positioned. This requires the decommissioning and demolition

of the FGRs. Consequently, this precludes the WPCP from splitting flow between the ponds and a MBR treatment train.

- The project team recommends setting aside footprint for a future denitrification filter that could provide the ability to meet possible future total nitrogen limits of 3 milligrams per liter (mg/L).

4.2 FINE SCREENING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

4.2.1 Project Element List

Fine screening is required upstream of MBR systems to protect the membrane filters. The fine screening will include the following major project elements:

- Screening.
- Washer / compactor.

4.2.2 Design Criteria and Redundancy

The design criteria for the proposed fine screens are summarized in Table 4.1.

Table 4.1 Design Criteria – Fine Screening
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	2025	2035
Fine Screening		
Type	In-Channel Rotary Drum, Perforated Plate	
Number (firm + standby)	2 + 1	
Capacity each, mgd	19	
Clear Opening, mm	2	
Washer Compactor		
Type	Screw Auger	
Number (firm + standby)	2 + 1	
Capacity, ft^3/hr	40	
Press zone opening, mm	2	
Storage bin, cu yd	5	

Generally speaking, membrane manufacturers prefer perforated plate fine screening for the following reasons:

- Openings are more uniform.
- They provide more efficient removal of materials.

- They provide more efficient removal of hair, as hair is susceptible to "stapling" around the screen openings.

As a result, the design information presented in Table 4.1 is based upon perforated plate screens. Alternative screening technologies could be utilized in place of rotary drum screens. These include band, wedge-wire, and mesh screens. All of these technologies should be evaluated during preliminary design. It is recommended the fine screening system be designed per the MBR manufacturer's requirements to ensure the membrane warranty will be valid.

To mitigate screen blockage, it is recommended a hot water wash system be provided to wash grease and other materials that may accumulate on the screens.

Screenings must be conveyed from the screening area to the washer compactor. Following the washer/compactor, a storage bin with adequate vehicular access for emptying its contents must also be provided. While primary treatment should remove most organic content responsible for offensive odors, some odor control provisions may be necessary. odor potential of these screenings should be evaluated during preliminary design.

4.3 AERATION BASINS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

4.3.1 Project Element List

The aeration basins will include the following major project elements:

- Aeration basins.
- Effluent channel.
- Supplemental carbon feed facility.

4.3.2 Design Criteria and Redundancy

The aeration basin influent flow and load values included in the table were developed as part of the Master Plan and are described in further detail in the Master Plan Secondary Treatment Technical Memorandum (TM). The Master Plan Flow and Loads TM proposed two different influent nitrogen load scenarios: design and high loads. The design criteria presented in Table 4.2 assumes the design influent nitrogen load scenario. If the City were to experience influent nitrogen loads at the level planned for with the high nitrogen load scenario, an additional aeration basin may be required. Space has been reserved for this fifth basin. Influent nitrogen loads should be tracked and this issue should be reviewed during Preliminary Design. Detailed process modeling (BioWin) results are included as an Appendix to the Secondary Treatment TM.

Table 4.2 presents the design criteria for the year 2025 and 2035.

Table 4.2 Design Criteria – Aeration Basins WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025(1)**	**2035(2)**
Effluent Quality Goals		
TSS, mg/L	20 average monthly 30 max daily	20 average monthly 30 max daily
CBOD, mg/L	10 average monthly 20 max daily	10 average monthly 20 max daily
Ammonia, mg/L (October - May)	18 average monthly 26 max daily	2 average monthly 5 max daily
Ammonia, mg/L (June - September)	2 average monthly 5 max daily	2 average monthly 5 max daily
Total Nitrogen, mg/L	NA	8
Total Phosphorus, mg/L	NA	1
Feed to Aeration Basin(3)		
Feed Type	Primary Effluent	
Average Dry Weather Flow, mgd	17.2	19.7
Maximum Month Flow, mgd	23.2	26.5
Equalized Peak Flow, mgd	30.0	38.0
Maximum Month TSS, ppd	20,300(4)	18,900(5)
Maximum Month BOD, ppd	30,000(4)	27,800(5)
Maximum Month Ammonia, ppd	4,900	5,700
Minimum Month Temperature, C(6)	16.5	
Aeration Basins		
Number of Units	4	4
Redundancy	1 AB OOS during ADWF	
SWD, ft	17	
Outside dimension each, Length (ft) x Width (ft) x Height (ft)	188 x 220 x 23(7,8)	
Liquid volume per basin, MG	0.915(8)	
Total liquid volume, MG	3.66	3.66
Zone Configuration (% of total volume, MG each)		
Zone 1 Deox(9)	11%, 0.105 MG,	
Zone 2 Anoxic	11%, 0.105 MG,	
Zone 3 Anoxic	11%, 0.105 MG,	
Zone 4 Anoxic	11%, 0.105 MG,	

Table 4.2 Design Criteria – Aeration Basins WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025**(1)	**2035**(2)
Zone 5 Swing	11%, 0.105 MG,	
Zone 6 Aerobic	21%, 0.195 MG,	
Zone 7 Aerobic	21%, 0.195 MG,	
Max Month SRT, days (aerobic/total)	7/13	
MLSS, mg/L	8,000	
Mixers(9)		
Type	Submersible or surface-mounted	
Number x power (hp) per zone, per basin		
Zone 1	1 x 5	
Zone 2	1 x 5	
Zone 3	1 x 5	
Zone 4	1 x 5	
Zone 5	1 x 5	
Aeration Diffusers		
Type	Fine Bubble	
Number (per basin)	2,000 +/-	
MM Air flow, scfm	15,000	
Mixed Liquor Channel		
Aeration Diffusers		
Type (provisions for maintenance removal)	Coarse bubble	
Airflow, scfm	900	
Supplemental Carbon Feed Facility		
Carbon Source		Methanol
Grade	NA	Pure
Storage capacity, gal	NA	2 x 4000
Design dose, mg/L as COD	NA	15
Feed pumps		
Type (explosion proof)	NA	chemical metering
No. of pumps	NA	2 + 1
Capacity each, gph	NA	13
Chemical usage at maximum month, ppd as COD	NA	3200

Table 4.2 Design Criteria – Aeration Basins WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025(1)**	**2035(2)**

Notes:
(1) No CEPT, MLE configuration.
(2) CEPT, MLE configuration with methanol addition.
(3) Includes recycle flows.
(4) Assumes 54% removal of particulate in the primary clarifiers.
(5) Assumes 68% removal of particulate in the primary clarifiers with CEPT.
(6) Since Sunnyvale doesn't routinely monitor influent temperature, the design minimum month temperature was based on minimum 7-day running average temperature measured at the San Jose TPS wet well from December 21, 2008 - September 17, 2013.
(7) Assumes 1.5-foot thick inner walls, 2-foot thick outer walls, 3-foot thick floor slabs and 3-foot freeboard.
(8) Does not include the effluent channel.
(9) Deox volume provided to de-aerate (reduced oxygen concentration) the return activated sludge (RAS) upstream of the anoxic zone.
(10) Mixers provide between 35 and 45 hp per MGal.

4.3.2.1 Construction Phasing

Section 4.12 presents a site plan and section view depicting the location for the secondary treatment train with general dimensions. The WPCP site has limited space in which new unit processes will fit. A corridor has been reserved between the Primary and Secondary Treatment areas. This corridor is planned to accommodate the following:

- Vehicular access, including a minimum 20-foot wide driving lanes and 50-foot turning radii.
- Below grade utilities such as air and process piping, electrical ductbanks and conduits, etc.
- Based on master plan considerations, considerations for future tankage.

Due to the site limitations and because of the difference in configurations between membrane vendors, the layout of the tankage and support facilities should be carefully evaluated during preliminary design. The overall site layout implications for the entire WPCP are discussed in detail in the Site Layout Considerations TM. Refer to this document for further details. Key impacts discussed in the document include:

- Access for O&M personnel.
- Identification of utility corridors.
- Traffic routes for chemical deliveries and residual solids handling.
- Fire access.
- Site flood protection.

- Parking allocation.
- Landscape concepts.

The capital improvement plan (CIP) includes aggressive projections for future flows and loads and therefore assumes that the secondary treatment system will be built with limited phasing. The plan calls for all four (4) aeration tanks required under the design nitrogen load scenario to be built at once. Phasing should be revisited as part of preliminary design of the secondary treatment train. If increased flows and loads to the City's collection system have not materialized on the timeline assumed in the CIP, construction of fewer tanks while leaving sufficient space for future expansion should be considered.

4.3.2.2 Primary Effluent Flow Splitting

Primary effluent flow will be split on the downstream side of the fine screening structure. This structure will utilize weirs to accomplish an even flow split amongst the individual aeration tanks. Flow will then be piped from the flow splitting structure to the aeration tanks. Pipes can be hung on the vertical side of the south wall of the aeration basins to provide access for maintenance.

4.3.2.3 Nitrogen Removal

The secondary system has been designed to provide a MLE process to accommodate future regulatory limits for nitrogen. Within the MLE configuration, the basins were designed for an aerobic solids retention time (aSRT) of 7 days and a total SRT of 13 days. The basins were designed with a swing zone (Zone 5) which can be aerobic for a 7 day aSRT or anoxic to provide additional denitrification with operation at a 6 day aSRT. Certain membrane manufacturers also require minimum SRTs. The designer should confirm that the design SRT listed in Table 4.2 meets manufacturer requirements.

The design mixed liquor suspended solids (MLSS) concentrations warrant reevaluation during preliminary design, specifically the option of operating at lower MLSS concentrations. The existing site layout is very tight, therefore an MLSS concentration of 8,000 mg/L was selected to balance reactor footprint with process needs. A lower 6,000 mg/L MLSS would require additional reactor volume above the current design value. However, this additional reactor volume would be useful in operating alternate biological nutrient removal (BNR) modes moving forward. The lower design MLSS will also allow operators the flexibility to increase the operating MLSS concentration in the future should flow and/or loading conditions change, and could potentially lower required blower horsepower.

Because RAS comes back to the aeration tanks from an aerated membrane filter tank, it can have a higher dissolved oxygen (DO) concentration. Since the denitrification process requires an anoxic environment to function, this higher RAS DO can lead to a reduced ability to denitrify. Allowing RAS to deoxygenate prior to entering anoxic zones mitigate this effect on denitrification efficiency. High DO RAS can also impede denitrification if the primary effluent is deficient in carbon. The two streams can react to create further denitrification interference.

Table 4.2 shows a portion of the aeration tank volume is dedicated to RAS deoxygenation. This 11 percent of the reactor volume constitutes 5.4 minutes of hydraulic retention time at 2035 MMF flows. This zone was sized using the BioWin model such that the elevated dissolved oxygen concentration in the RAS was reduced sufficiently prior to blending with the primary effluent and entering the first anoxic zone where denitrification occurs. This in-basin deoxygenation volume could be swapped out for an equivalent detention time in the RAS pump station. This alternative should be explored in preliminary design.

4.3.2.4 Phosphorus Removal

Table 4.2 assumes that the City will not need to meet phosphorus limits until the year 2035. Therefore, additional flexibility to operate in a biological phosphorus removal configuration such as an anaerobic, anoxic, oxic (A2O) or a five stage Bardenpho is not planned at this time. However, with modifications, these basins can be designed with this additional flexibility if desired.

Once phosphorus limits are in place, it is assumed that these limits will be met with CEPT. Once CEPT is implemented it is anticipated that the aeration basins will no longer receive sufficient readily degradable biochemical oxygen demand (BOD) from the primary effluent and it is anticipated that a supplemental carbon feed facility will be required to supplement the BOD load to the aeration basins.

Methanol was selected as an external carbon source at this level of analysis since it is generally the least expensive external carbon source. However, methanol use has several disadvantages:

- Methanol is a flammable liquid and fire and explosion protection will need to be carefully designed into the system and into the operational program. The methanol feed and storage system will need to meet the requirements of NFPA 30 Flammable Liquids;
- Since methanol is used by methylotrophs and not ordinary heterotrophs, methanol will need to be added continuously to maintain a population of methylotrophs, even if the external carbon source is needed intermittently.

Due to these two factors, the City may wish to look at alternate external carbon sources such as acetate or MicroC. These sources, although generally more expensive per unit weight, can be added intermittently and do not have the safety concerns associated with methanol use. A location for supplemental carbon-feed facilities has not yet been determined, because of the uncertainty with respect to need, and the type of chemical being used. For this reason, this evaluation should be included with the preliminary design of the secondary treatment facilities.

4.3.2.5 Additional Concerns

Alkalinity can be critical to nitrification. Nitrifying bacteria consume carbonate as their food source while utilizing ammonia in their energy transfer mechanism. Since carbonate is consumed, water discharge from secondary processes including nitrification can lack alkalinity. Influent and primary effluent alkalinity are not routinely monitored. During the master planning process, two weeks of discreet monitoring was done which resulted in an average primary effluent alkalinity of 247 mg/L. Based on this value, BioWin modeling indicates that after secondary treatment, the mixed liquor alkalinity would be approximately 160 mg/L. Generally, an effluent alkalinity of 100 mg/L or greater is targeted, so this falls within acceptable limits. However, since the sampling duration was limited, further monitoring is warranted. Caustic feed provisions to increase alkalinity may be warranted if alkalinity is shown to vary. This should be evaluated during preliminary design.

A surface wasting or spray box is also recommended to be included in the aeration tank design. This feature will aid in mitigating built up scum or foam that may form on the surface of the aeration tanks. If surface wasting provisions are included, mixed liquor could be wasted directly from the aeration tanks in addition to or in place of the waste that would normally occur from the RAS line.

4.4 MEMBRANE FILTERS

All facilities would be designed and implemented in accordance with the Mechanical Corrosion Control and Odor Control Design Standards developed as part of the Master Plan.

4.4.1 PROJECT ELEMENT LIST

The membrane filters will include the following major project elements:

- Membrane tanks.
- Membrane cassettes.
- Membrane cleaning facilities.
- Permeate pumps.
- Backwash pumps.
- Mixed liquor conveyance.
- Mixed liquor screening.

4.4.2 Design Criteria and Redundancy

The design criteria for the proposed membrane filters are summarized in Table 4.3.

4.4.2.1 Construction Phasing

The CIP includes aggressive projections for future flows and loads. It assumes that the MBR system will be built with limited phasing. The plan calls for all seven (7) MBR tanks to be built in the initial phase, which is expected to be online by 2024. These tanks are sized such that each tank contains an empty area where future membrane cassettes may be installed for future flows and loads. Phasing should be revisited as part of preliminary design of the secondary system. If increased flows and loads to the City's collection system have not materialized on the timeline assumed in the CIP, construction of fewer tanks while leaving sufficient space for future expansion could be considered. Another factor driving phased implementation of MBRs is advanced water reuse. Additional stakeholders' investments, such as the Santa Clara Water District, may should be to be taken into consideration when phasing is reevaluated.

Table 4.3 Design Criteria – Membrane Filters WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025**	**2035**
Membrane Tanks		
Number	6+1 spare[(1)]	7
Redundancy	1 membrane tank out of service during MMF	
Outside dimension total, Length (ft) x Width (ft) x Height (ft)	210 x 80 x 16[(2,3)]	
Liquid volume per basin, MG	0.086	
Total liquid volume, MG	0.52[(4)]	0.6
Membrane Cassettes		
Number of Units[(5)]	96	109
Number of Units/tank	14	15.5
Total number of spaces/tank	18	18
Surface area, sf	1,710,000	1,930,000
Flux with one membrane tank out of service, gfd[(6)]		
AAF	13	
MMF	16	
PHF	23	
Membrane air scour, scfm		
AAF	7,700	8,700
MMF	15,400	17,400
Membrane Cleaning System		
Maintenance Clean		
Frequency	2 x week	
Sodium Hypochlorite Concentration, mg/L	200	
Recovery Clean		
Frequency	2 x year	
Sodium Hypochlorite Concentration, mg/L	1,000	
Citric Acid Concentration, mg/L	2,000	
Sodium Hypochlorite (10.3% w/w, SG 1.1168)		
Storage Volume, gal	4,000	
Chemical metering pump, hp	< 5	
Annual consumption, gal	17,700	19,700
Citric acid (50% w/w, SG 1.24)[(7)]		
Storage Volume, gal	1,500	
Chemical metering pump, hp	< 5	

Table 4.3 Design Criteria – Membrane Filters WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025**	**2035**
Annual consumption, gal	2,400	2,700
Permeate Pumps		
Type	Centrifugal	
Number of pumps	6	7
Capacity each, mgd	6.3	
Design peak flow, mgd	40	
TDH, ft	20	
Horsepower, each	40	
Mixed Liquor Screening(8)		
Type	Step screens(9)	
Number	4	4
Screen capacity, each	9.5	
Screen opening, mm	3	

Notes:
(1) Seven membrane tanks are planned for 2025, however only six of the tanks are planned to be equipped in 2025.
(2) Assumes 1.5-foot thick inner walls, 2-foot thick outer walls, 3-foot thick floor slabs and 3-foot freeboard.
(3) Does not include the effluent channel.
(4) Assumes that one membrane tank will not be in service in 2025.
(5) Based on GE: 370 sf per module, up to 48 modules per cassette.
(6) Flux rates based on quotes received from vendors and operating experience.
(7) Sulfuric acid could be required in addition to citric acid.
(8) May not be required depending on MBR manufacturer's screening requirements.
(9) Alternative screen types could be considered.

4.4.2.2 Basic Tank Infrastructure

The basis of design assumes that one membrane tank will be out of service for cleaning (N + 1 system reliability). The cost of additional redundancy (N + 2) should be evaluated during preliminary design along with the phasing plan.

Covering the tanks should be considered during preliminary design, however costs for covers have not been included in the CIP budgetary estimates. Instead mixed liquor step screens have been included in the layout to protect the membrane filters. The cost/benefit for providing covers should be evaluated.

Isolation gates should be provided for each tank for isolation during cleaning and drainage. To execute an even flow split between the membrane tanks, it is assumed that downward opening weir gates will be constructed.

To verify even flow splits, computational fluid dynamic (CFD) modeling is recommended in the following areas:

- Membrane Influent channel.
- Membrane effluent channel.

4.4.2.3 MBR Equipment

The tanks have been sized to accommodate hollow fiber membrane cassettes. Flat plate membranes are an alternative to hollow fiber membranes. Flat plate membranes generally require a greater footprint, and do not appear to fit on the plant site. This should be reevaluated during preliminary design to confirm flat plate membrane system space requirements.

Currently there are two leading vendors who supply hollow fiber MBR equipment, Evoqua (formerly Siemens) and GE/Zenon. While both offer similar filter cassettes, the feed configuration differs significantly between both types. GE filters feed longitudinally through the tank in a plug-flow arrangement, with mixed liquor entering at the upstream end of a tank and RAS discharging at the downstream end. This results in a tank footprint which is longer and narrower compared to Evoqua. Evoqua feeds flow through the tank laterally. Flow enters from the side of the tank, through a series of ports located near the bottom along the long edge of each tank. This feed method requires dual influent channels to even out flow distribution. This widens the tank footprint considerably. This feed configuration is meant to mitigate any MLSS concentration gradient that might otherwise develop via plug-flow through the tank.

Figures 4.1 and 4.2 show these different feed configurations. The site plan included in the Master Plan reserves enough space to accommodate both MBR feed configurations. Depending on the vendor selected for the tanks, the MBR footprint may be slightly smaller than shown.

One additional difference between membrane manufacturers is the space required for clean-in-place facilities. Generally, Evoqua systems have a pH neutralization tank included on the downstream end of the clean in place system. This tank is used to neutralize spent washing solution, which contains acid. GE systems generally do not. Space has not been

reserved for such a tank, It is assumed this fluid will be routed to the plant headworks.. The need for this tank should be further evaluated during final design.

A conceptual space allocation layout for clean-in-place facilities is included in Section 4.13. This drawing reflects space allocation for CIP chemical storage appropriate for both preferred manufacturers. Due to site limitations in this area of the WPCP, the layout impacts of the MBR tankage and support facilities must be carefully evaluated early on in the preliminary design process. Because of the difference in configurations between

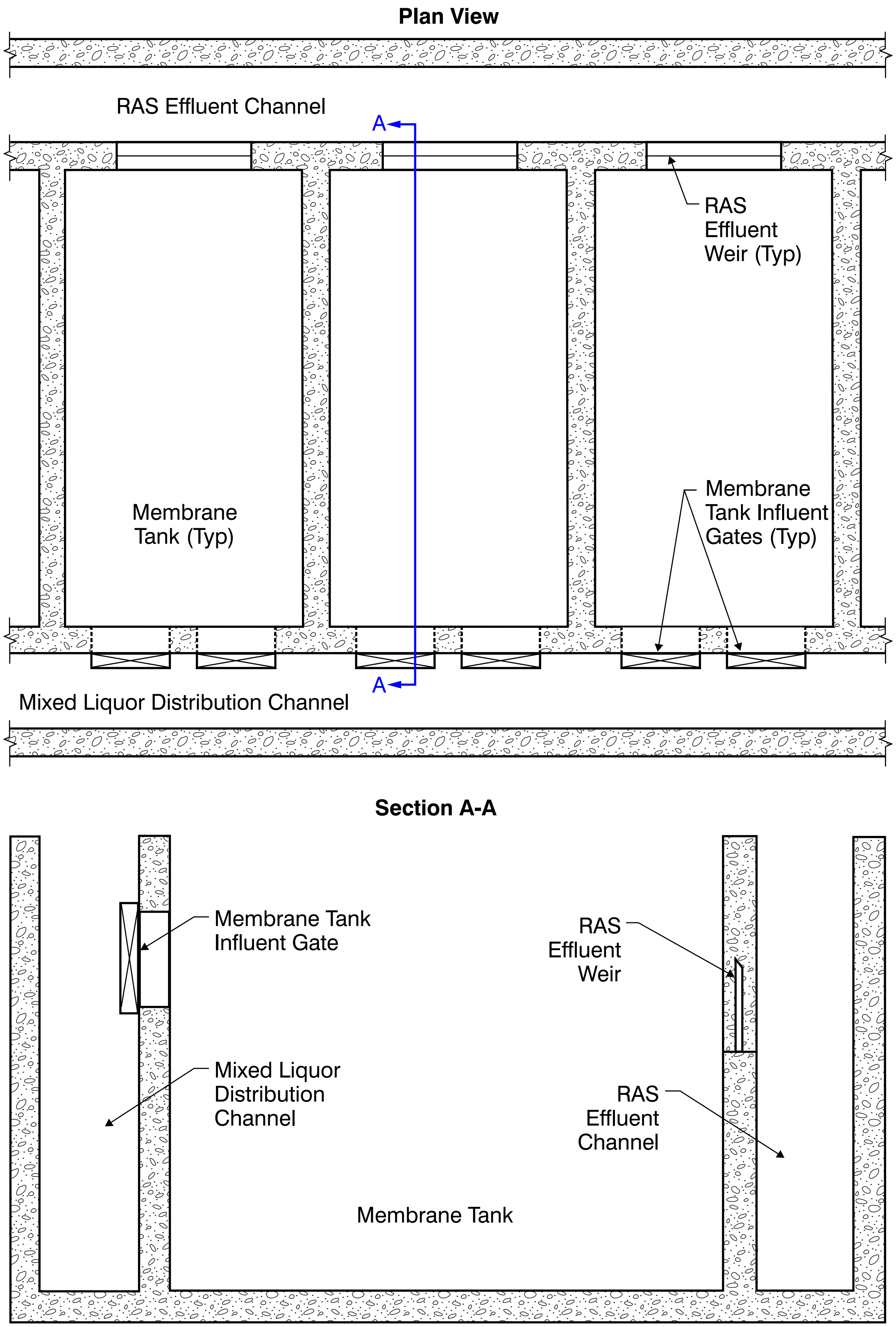


Figure 4.1
GE MEMBRANE FILTER CONFIGURATION
BASIS OF DESIGN
CITY OF SUNNYVALE

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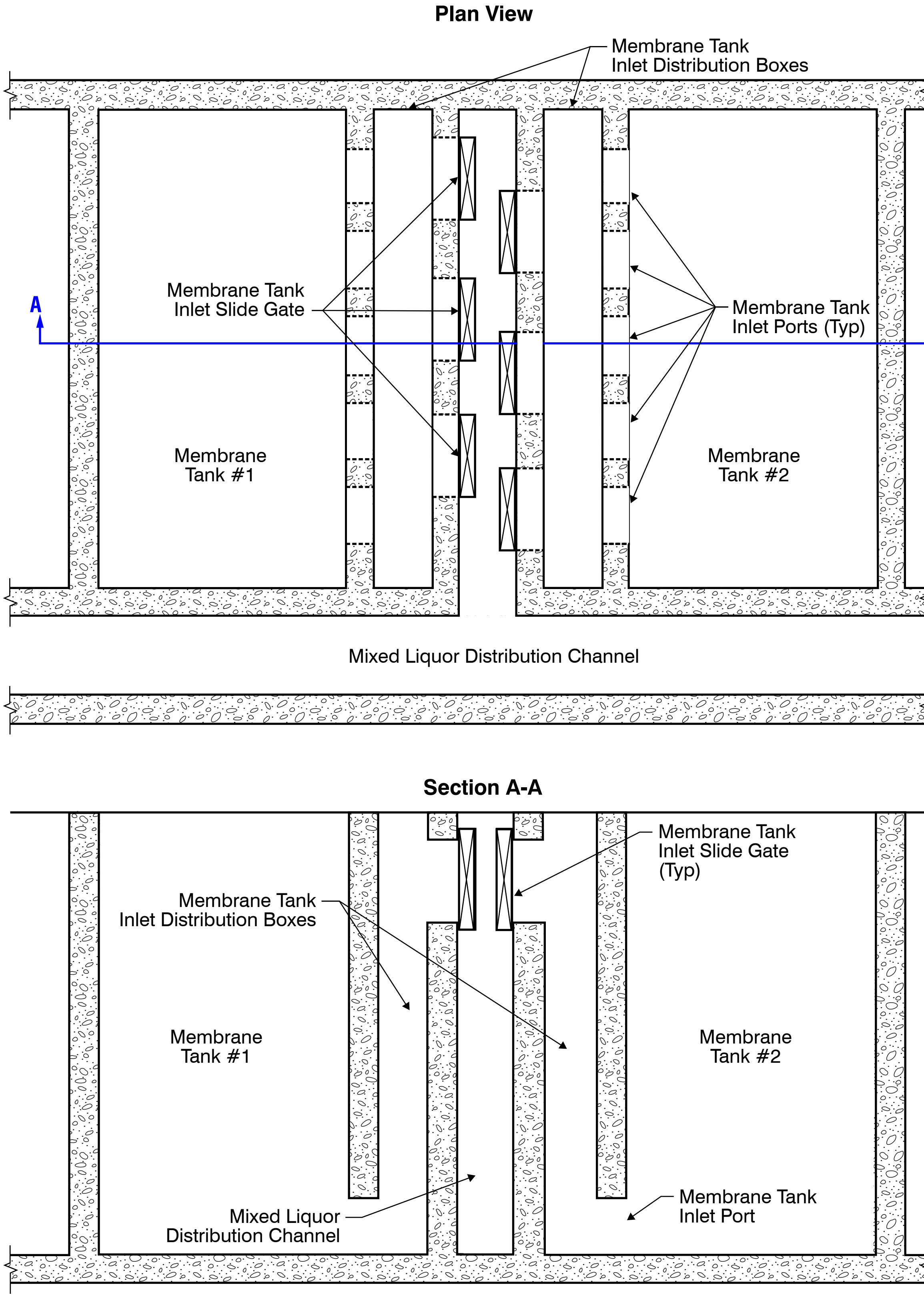

Figure 4.2
EVOQUA MEMBRANE FILTER CONFIGURATION
BASIS OF DESIGN
CITY OF SUNNYVALE

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vendors, a single vendor should be selected as early as possible in the preliminary design process. This will require development of a procurement approach to drive this selection process.

4.4.2.4 MBR Operation

The flux rate stated in Table 4.3 is based on previously received vendor data from both Evoqua and GE and operating experience. This rate should also be confirmed during preliminary design. Maximum allowable flux rates should be obtained from the manufacturers, including supporting data from 5 installations (minimum), preferably with similar influent characteristics to that of the WPCP.

Sound engineering practice is to select lower flux rates than the max flux rates quoted from the manufacturers. Generally, at least 15 percent spare membrane capacity above the number dictated by the maximum flux rates is recommended. The flux rate in Table 4.3 reflects this safety factor.

MBRs are pumped systems. Permeate must be pumped from the membrane cassettes to draw water through the membranes. The mixed liquor or RAS is also pumped, depending on in-situ hydraulics. In "pump-to" configurations, mixed liquor is pumped from aeration basins to the MBR tanks. Alternatively, "pump-back" MBR configurations require RAS to be pumped from the membrane tanks back into the aeration tanks. "Pump-to" systems are generally selected due to hydraulic constraints as the mixed liquor pumps need to be sized to handle the influent flow in addition to the RAS flow. "Pump-back" systems are more efficient as the pumps only need to be sized to handle the RAS flow and this allows more control of the RAS pumping rates, as this is the only stream being pumped. Since plant hydraulics can accommodate a "pump-back" system the information presented in Table 4.3 assumes a "pump-back" configuration.

The "pump-back" configuration can also be used to mitigate fluctuations in the membrane tanks' water surface elevation when tanks are brought in and out of service for cleaning. Membrane manufacturers recommend that MBRs be operated within a relatively narrow hydraulic band between high and low water levels. Tank can be designed to overcome this issue but sacrifices hydraulic control within the aeration tanks and the membrane filter tanks, and may raise capital costs. The change in water level as tanks are brought on/off-line for servicing would be mitigated by eliminating weirs at the downstream end of the aeration tanks, as well as on the inlet side of the membrane tanks. These hydraulic modifications should be further explored during preliminary design.

4.5 RAS/WAS PUMP STATION

All facilities would be designed and implemented in accordance with the Mechanical Corrosion Control and Odor Control Design Standards developed as part of the Master Plan.

4.5.1 Project Element List

The RAS/WAS Pump Station will include the following major project elements:

- RAS pumps.
- WAS pumps.

4.5.2 Design Criteria and Redundancy

The RAS/WAS pump station will include one standby RAS pumps and one standby WAS pump. The design criteria for the proposed RAS/WAS pump station is summarized in Table 4.4.

**Table 4.4 Design Criteria – RAS / WAS Pump Station
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Parameter	2025	2035
RAS Pumps		
Type	Centrifugal	
Number of pumps (firm + standby)	5 + 1	
Capacity each, mgd	25	
RAS flow duration	24 hours/day, 7 days/week	
Total RAS flow at MMF, mgd	105	110
WAS/Foam Pumps		
Type	Centrifugal / Progressive Cavity	
Number of pumps (firm + standby)	2 + 1	3 + 1
Capacity each, mgd	0.7	
WAS flow duration	8 hours/day, 7 days per week	

Pump sizing is based on providing firm capacity equivalent to between four to five times the influent flow during maximum month flows. During peak events the RAS flows can drop as long as the MLSS concentration in the membrane tank does not exceed approximately 12,000 mg/L. Providing for a maximum RAS flow of approximately 125 million gallons per day (mgd) allows for sufficient RAS return during both maximum month and peak flow conditions.

4.6 DIURNAL EQUALIZATION

To provide secondary treatment to meet the 2035 peak hour flow of 58.5 mgd would require more space than is available on the limited site. For the MBR treatment option, the ponds would be retired and 8 MG of diurnal equalization would be provided. In addition to the diurnal equalization, three (3) days of emergency storage would also be provided. The planned equalization and emergency storage volume would be located in the current site of Pond 1. The diurnal equalization would limit the peak flow to around 38 mgd. Figure 4.3 provides a layout concept for these facilities.

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

4.6.1 Project Element List

Diurnal equalization will include the following major project elements:

- Extension of the primary effluent pipeline.
- Improvements to the access road.
- Equalization storage basins.
- Equalization distribution structure.
- Equalization pump station.

4.6.2 Design Criteria and Redundancy

The design criteria for the proposed diurnal equalization facility are summarized in Table 4.5.

Table 4.5 Design Criteria – Diurnal Equalization
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	2025	2035
Diurnal Equalization		
Capacity	NA	8 MG
Three storage tanks	NA	2.7 MG each
Equalized peak flow return rate, mgd	NA	30
Equalization Pump Station		
Number of pumps	NA	4 + 1
Pump capacity each, mgd	NA	7.5

The diurnal equalization facilities will include a Distribution/Pumping Structure and three (3) pre-stressed concrete tanks containing the 8 MG of required storage capacity. These tanks would be designed to overflow into the emergency storage basin. The emergency storage basin would be connected to the same pumping structure. To protect against future sea level rise, the access road and storage facilities working grades would be elevation 116.00 (plant datum). Construction of these facilities will require removal of the solids from Pond 1.

The Distribution/Pumping Structure will receive flows from the primary treatment train in excess of 34.7 mgd. This flow will then be distributed to each of the three pre-stressed holding tanks. Elevation of these three tanks will have to be coordinated with the hydraulic profile established at the WPCP to maintain sufficient flow capacity for the primary effluent. The structure will also house pumps used to pump the stored primary effluent (through the same primary effluent pipeline) back to the WPCP during lower flow periods. Since low diurnal flows are estimated to in the range of 5 mgd, a maximum flow return rate was assumed to be the difference between the low flow and peak flow to the activated sludge system (30± mgd).

The existing primary effluent pipeline, which currently conveys flow to the facultative ponds, will be used to convey flow to the diurnal equalization facilities as well as to pump flow back to the main plant site for treatment. This pipeline will need to be rehabilitated to withstand pressurized flow from the diurnal equalization pumps.

Because of the costs to construct these facilities, along with the expected extensive permitting process, an alternate site should be pursued. One potential site would include the use of Pond A4 which is currently owned by the Santa Clara Valley Water District. This location is more contiguous with the WPCP and therefore should be less costly to construct. Significant permitting issues are anticipated, but could be less complicated that pursuing the Pond 2 site.

4.7 BLOWER BUILDING

All facilities would be designed and implemented in accordance with the Mechanical Corrosion Control and Odor Control Design Standards developed as part of the Master Plan.

4.7.1 Project Element List

The Blower Building will house the following aeration equipment:

- Aeration Blowers.
- Membrane Air Scour Blowers.

4.7.2 Design Criteria and Redundancy

A common set of blowers have been assumed for both the aeration basins and channel aeration. A second set of dedicated blowers was assumed for membrane air scour. The design criteria for the proposed blower building are summarized in Table 4.6.

**Table 4.6 Design Criteria – Blower Building
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Parameter	2025	2035
Aeration Basin and Channel Aeration Blowers		
Type	High speed turbo	
Number of blowers (firm + standby)	4 + 1[(1)]	5 + 1[(1)]
Capacity each, scfm	6,000	6,000
Membrane Air Scour Blowers		
Type	High speed turbo	
Number of blowers (firm + standby)	3 + 1	
Capacity each, scfm	6,000	

Notes:
(1) 1 blower standby.

Peak air flow rates for the aeration basin were calculated assuming the high nitrogen load scenario during the simulated peak day load with summer temperatures of 22.5°C while operating a 7 day aSRT. This resulted in a projected peak airflow demand of 29,000 scfm. The selected blowers will provide turndown to meet the projected minimum airflow demand of 6000 scfm which is projected to occur during startup during ADW flows and the design nitrogen load scenario, with winter temperatures of 16.5°C while operating at a 6 day aSRT with CEPT. Peak air flow rates for the membrane air scour system were based on an assumed 0.009 scfm/sf of membrane area.

The building layout shown in Figure 4.3 depicts a building sized to house high-speed turbo blowers. Centrifugal blowers should be considered during preliminary design. Designing blowers on peak loads carries a risk of oversizing blowers. This risk can be mitigated selecting a variety of blower sizes, as well as considering realistic turndown rates. Blower turndown should be considered during preliminary design.

The blower building layout is based on a one-story building. The blower building should include space for a restroom and operator control room. The cost and benefit of adding meeting space to this building should be considered during preliminary design. To accommodate this additional meeting space and/or to maximize site space, the potential to implement a two-story building should be considered during preliminary design.

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 4.3
DIURNAL EQUALIZATION/EMERGENCY STORAGE FACILITIES
BASIS OF DESIGN
CITY OF SUNNYVALE

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4.8 CIVIL/SITE CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

4.8.1 Piping Layout

The following major process and utility pipes would be routed to the aeration basins, membrane filters, diurnal equalization, blower building, RAS/WAS pump station and fine screens:

- Aeration Basins:
  - Screened primary effluent (PE) from the fine screens to the Aeration Basin Zone 2.
  - Return activated sludge (RAS) from the RAS/WAS pump stations to Zone 1.
  - Aeration air from the blower building.
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Membrane Filters:
  - Screened mixed liquor from the ML channel.
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Diurnal Equalization:
  - Extension of the existing primary effluent pipeline.
  - Utility Water (3W) from the No. 3 Water System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Blower Building:
  - Plant (Service) Air (SA) from the Plant Air System.
  - Utility Water (3W) from the No. 3 Water System.
- RAS/WAS Pump Station:
  - RAS from the membrane filters.
  - Potable Water (WP) from the Potable System.

- Utility Water (3W) from the No. 3 Water System.
- Plant (Service) Air (SA) from the Plant Air System.

- Fine Screening:
  - Primary effluent (PE) from the primary effluent distribution structure to the Aeration Basin Flow Split Structure 1.
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.

The following major process and utility pipes would be routed from the aeration basins, membrane filters, blower building, RAS/WAS pump station and fine screens:

- Aeration Basins:
  - Mixed Liquor from the effluent channel to the ML channel.
  - Scum/foam to the anaerobic digesters and / or thickening.
  - Floor drains and miscellaneous drains to the Headworks.
- Membrane Filters:
  - RAS to the RAS/WAS pump station.
  - Scum/foam to the anaerobic digesters and / or thickening.
  - Floor drains and miscellaneous drains to the Headworks.
- Blower Building:
  - Aeration air to the aeration basins.
  - Floor drains and miscellaneous drains to the Headworks.
- RAS/WAS Pump Station:
  - RAS to the aeration basins Zone 1.
  - WAS to the thickening/dewatering building.
  - Floor drains and miscellaneous drains to the Headworks.
- Fine screens:
  - Screened primary effluent to the aeration basins Zone 2.
  - Screened solids to the container.

4.8.2 Support Utilities

Major support utilities that should be considered when planning and designing the aeration basins, membrane filters, diurnal equalization, blower building and RAS/WAS pump station and fine screens are summarized in Table 4.7.

Table 4.7 Support Utilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale	
Ancillary Facility	**Description**
Potable Water	• Provide tempered water at emergency shower eyewash stations and handwashing stations. • Provide at aeration basins, membrane filters and RAS/WAS pump station for future chemical use.
Utility Water	• Provide at hose bibs in all areas for general housekeeping. • Provide at all pumps for pump seal water. • Provide at aeration basins, membrane filters and fine screens spray bars. • Provide at diurnal equalization for washing down the basins. • Provide at blower building and RAS/WAS pumps station for housekeeping.
Plant Air	• Provide plant air at air tool connection as required.
Drainage	• Provide floor drains in all areas for general housekeeping. • Route all floor drains to the Headworks.

4.8.3 Specialty Tools

The following tools should be provided to aid in the operation and maintenance of these facilities:

- 5-ton bridge crane for lifting membrane cassettes.
- Jib cranes to pick up submersible mixers.
- Lifting hoist for permeate pumps or extend bridge crane.
- Lifting hoist for screens.

4.9 ELECTRICAL CONSIDERATIONS

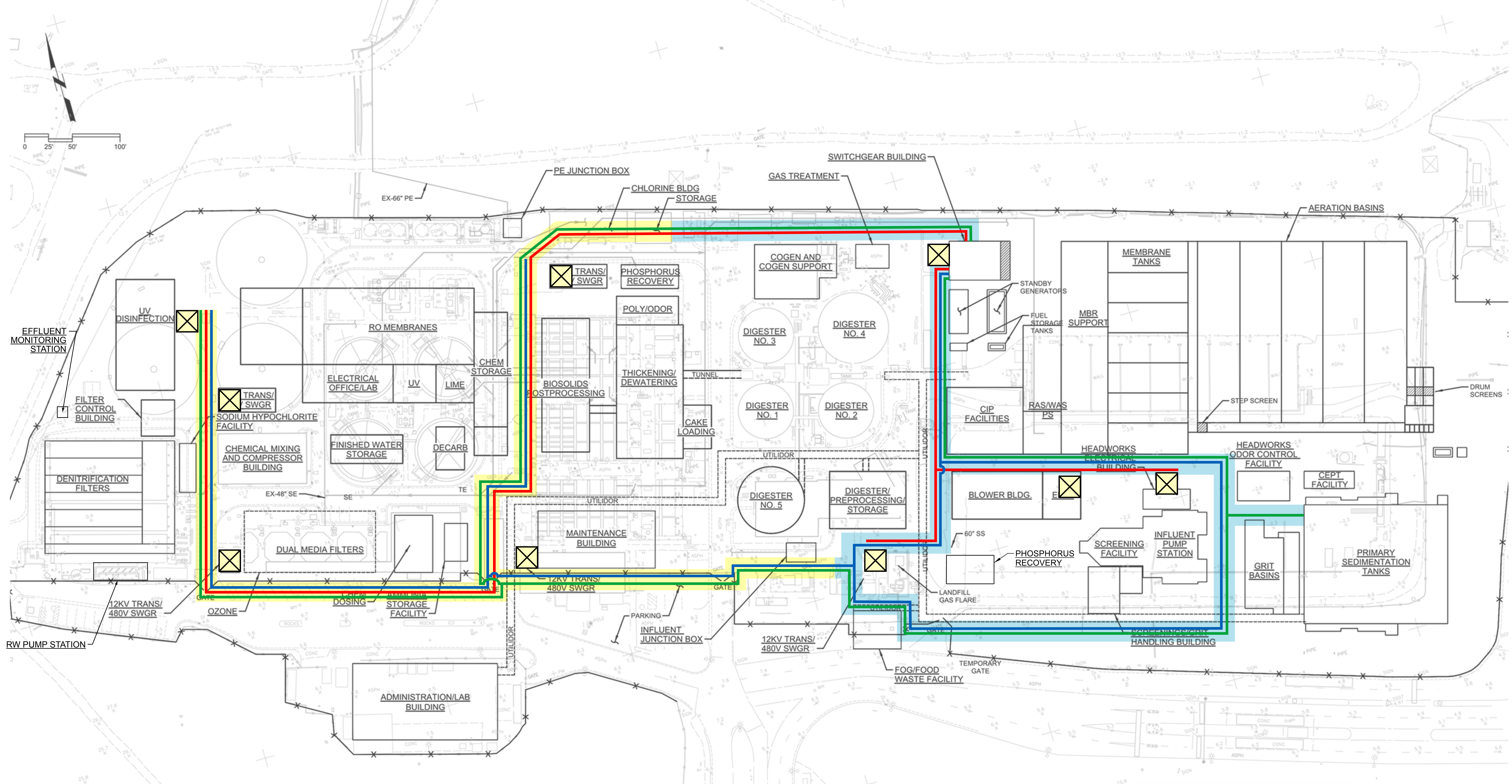
All facilities would be designed and implemented in accordance with the Electrical Design Standards developed as part of the Master Plan.

4.9.1 Electrical Distribution

Based on the Master Plan recommendations, a proposed 12-kilovolt (kV) radial loop distribution layout was developed to replace the existing 4,160 kV system. The first phase of that transition was completed as part of the Primary Treatment project. The second phase of that transition is planned to be completed as part of the secondary treatment improvements. Figure 4.4 presents the site layout for the 12-kV distribution system. This figure shows transformers selected locations around the WPCP to provide a 480-volt supply to the various process loads. For the secondary treatment facilities, one of these transformers was recommended. It would located adjacent to the proposed aeration blower building. The transformer would be sized for the complete load of the MBR facilities. The transformer would feed a 480-volt switchgear/MCC. Depending on the final location for the diurnal equalization facilities, a separate 12-kV supply would be provided for these facilities.

4.9.2 Electrical Loads

The electrical loads for the aeration basins, secondary clarifiers, diurnal equalization, blower building and RAS pump station are summarized in Appendix A. This table also summarizes the number of units, the number of standby units, the peak load, the connected load, and whether the loads would be supplied with standby power.



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 4.4
ELECTRICAL DISTRIBUTION SYSTEM
BASIS OF DESIGN
CITY OF SUNNYVALE

4.10 INSTRUMENTATION AND CONTROL CONSIDERATIONS

4.10.1 Process Flow Diagram

The process flow diagram for the conventional activated sludge process is show in Section 13.

4.10.2 Automation and Control Considerations

The level of instrumentation through the secondary treatment system is dependent on the level of automation desired by plant staff and equipment selections. The instrumentation discussed herein assumes a high level of automation.

4.10.2.1 Fine Screening

Fine screen operation will be controlled via a PLC provided by the screen manufacturer. Differential head should drive cleaning cycles, including hot water wash.

4.10.2.2 Aeration Basins

The aeration tanks may be automated to a level that allows virtually unattended operation. Primary effluent flow into each aeration basin will be regulated via flow metering and automatically actuated valves. Online DO, total suspended solids (TSS), ammonia, nitrate, and oxidation reduction potential (ORP) analyzers can be tied to the aeration, mixing and wasting systems to regulate bioreactor performance.

4.10.2.3 Membrane Filters

MBR operation will be automated with a PLC provided by the selected vendor. Permeate turbidity and the transmembrane pressure (TMP) should be monitored and used to control cleaning cycles. Permeate flow rates should be controlled based on a combination of tank level and influent flow. Water level in the tanks must also be measured to regulate operation and drain/fill cycles for various cleaning procedures.

4.10.2.4 RAS/WAS Pump Stations

RAS pumping operations can be controlled via wet well level monitoring (via level transducers or floats), flow meters, variable frequency pump drives, and valves.

4.10.2.5 Diurnal Equalization

Flow into the diurnal equalization system will be controlled passively. A weir structure will divert flows in excess of 34.7 mgd to the receiving structure. Actuated valves can be used to control which of the three equalization tanks fill. Pumping equalized flow back to the secondary treatment system can be controlled using flow metering, tank level sensors, and variable frequency pump drives.

4.10.2.6 Blower Building

Aeration basins blower operation will be tied to DO concentrations measured in the aeration basins while the membrane basins air scour blower operation will be triggered based on time, TMP and influent flow. PLCs can be utilized to maintain oxygen levels in each process zone to maintain organics and ammonia removal within the unit process.

4.11 MAJOR O&M CONSIDERATIONS

The major operations and maintenance (O&M) considerations for the aeration basins, membrane filters, diurnal equalization, blower building, RAS/WAS pump station and fine screens are summarized in Tables 4.8 to 4.13.

Table 4.8 Operations and Maintenance Considerations – Aeration Basins
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections as required
Aeration Basins	• Provide washdown provisions • Record DO measurements in Zones 1, 5, 6 and 7. • Provide ability access online ammonia analyzers in Zone 7 • Provide ability to access online nitrate analyzers in Zones 4 and 7 • Provide ability to access the diffusers • Provide ability to access mixers • Provide surface wasting to remove scum/foam • Provide spray bars
Effluent Channel	• Provide sample ports on the effluent channel • Provide ability to access and remove the diffusers while the channel's in service • Provide ability to surface waste to remove scum/foam • Provide online TSS analyzer for SRT control • Provide spray bars
Supplemental Carbon Feed Facility	• Provisions to meet NFPA 30 requirements for operational safety

Table 4.9 Operations and Maintenance Considerations – Membrane Filters
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required • Provide washdown provisions
Membrane Bioreactor	• Provide sample ports on the permeate piping from each membrane tank to for turbidity measurements. • Provide sample ports on combined RAS flow • Provide spray bars

Table 4.10 Operations and Maintenance Considerations – Diurnal Equalization
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required
Diurnal Equalization	• Provide access to inspect and hose down basins
Diurnal Equalization pump station	• Provide sufficient clearance in front of pump for stator removal • Provide ability to flush lines

Table 4.11 Operations and Maintenance Considerations – Blower Building
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required
Blowers	• Provide ability to flush lines • Provide access to all components

Table 4.12 Operations and Maintenance Considerations – RAS/WAS Pump Station
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required
RAS / WAS Pumps	• Provide ability to flush lines • Provide sufficient clearance in front of pump for stator removal • Provide access to all components

Table 4.13 Operations and Maintenance Considerations – Fine Screens
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required
Fine Screens	• Provide ability to flush lines • Provide access to all components

4.12 POTENTIAL VENDORS

The major equipment proposed for the Secondary Treatment Facility and the recommended vendors for each type of equipment are summarized in Table 4.14. The major equipment proposed may be competitively bid.

Table 4.14 Potential Equipment Vendors
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	Vendor
Aeration Basin	
Diffusers	Sanitaire, EDI, Parkson, or equal
Mixers	Invent, Lightning, Philadelphia, or equal
Membrane Filters	
Membranes	GE, Siemens, Koch
Diurnal Equalization	
Tanks	DN Tank, Caldwell
Blower Building	
Blowers	Hoffman, Gardner-Denver, APG-Neuros, Aerzen
Fine Screens	
Screens	Huber, Envirocare, Westech, Parkson

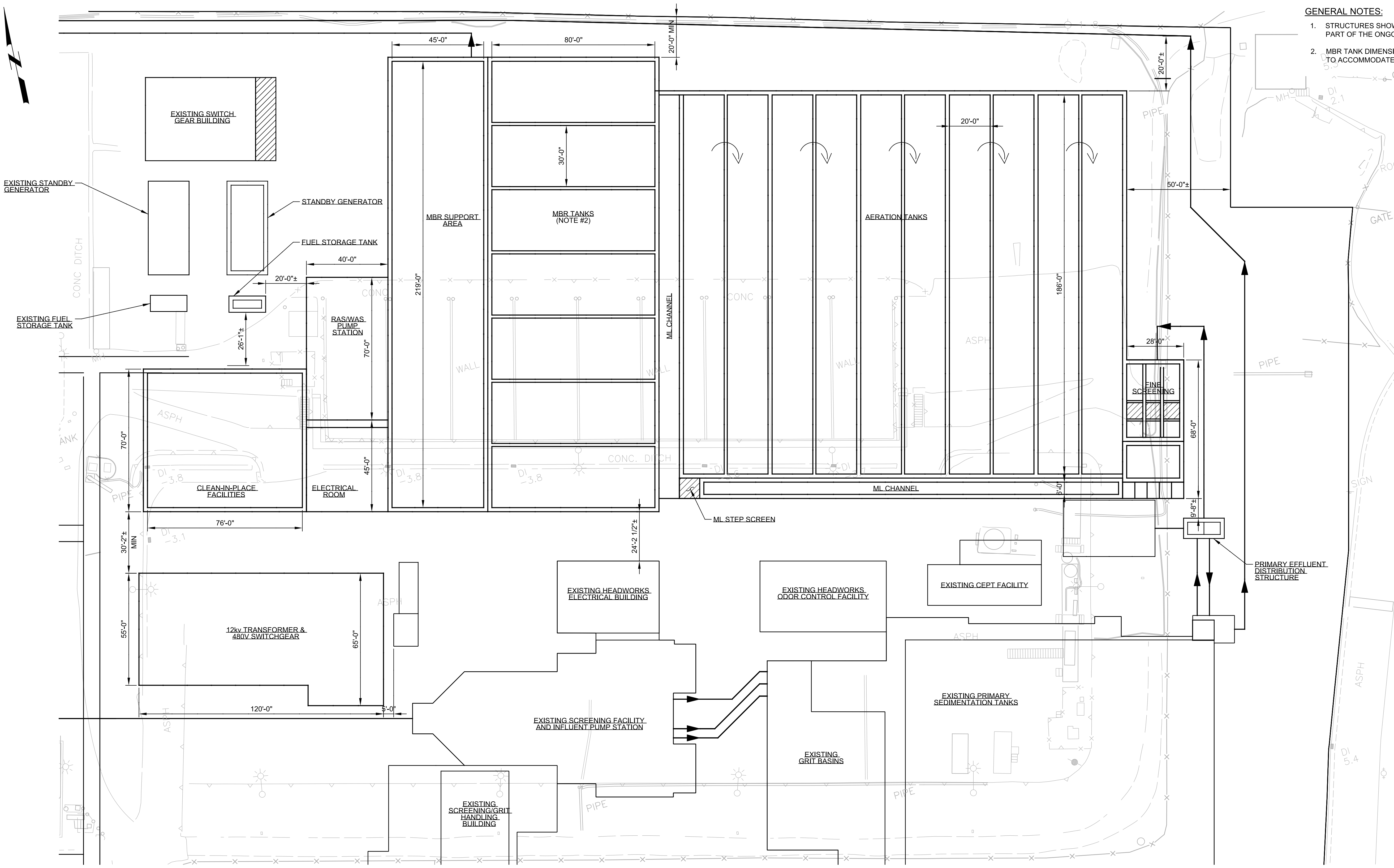
Notes:
(1) Includes sole-source requirements, recommended considerations for pre-qualifying or pre-purchasing equipment, etc.
(2) "Or Equal" equipment meeting project specifications should be considered unless otherwise specified.

4.13 LAYOUT DRAWINGS

Drawing 4.1 shows a site plan depicting the MBR system and its ancillary unit processes. Drawing 4.2 depicts a section though the MBR tank system, as well as a conceptual-level plan for the clean in place facilities. Drawing 4.3 shows a conceptual layout for the blower building. Drawing 4.4 is a process flow diagram depicting the entire MBR process.

GENERAL NOTES:

1. STRUCTURES SHOWN AS EXISTING ARE TO BE CONSTRUCTED AS PART OF THE ONGOING PRIMARY TREATMENT FACILITY PROJECT.
2. MBR TANK DIMENSIONS REFLECT MAXIMUM DIMENSIONS REQUIRED TO ACCOMMODATE BOTH PREFERRED VENDORS.



Drawing 4.1

SITE LAYOUT - MBR TANKS
BASIS OF DESIGN

CITY OF SUNNYVALE

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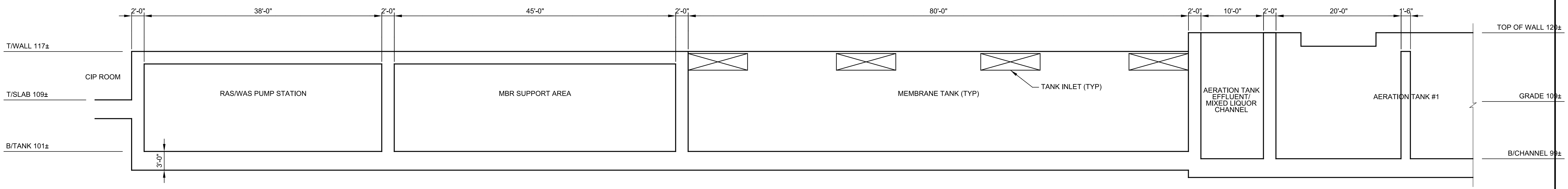
GENERAL NOTES:

1. HYDRAULIC CALCULATIONS HAVE NOT YET BEEN PERFORMED FOR THE MBR SCENARIO. RELATIVE ELEVATIONS BETWEEN THE AERATION TANKS AND MBR'S ARE ASSUMED BASED ON A "PUMP BACK" MBR CONFIGURATION. VERTICAL TANK PLACEMENT SHOULD BE RE-EVALUATED DURING PRELIMINARY DESIGN.
2. CHEMICAL STORAGE AREAS SHALL INCLUDE SPILL CONTAINMENT. THIS DRAWING SHOWS TANK FOOT PRINT ONLY FOR PURPOSE OF RESERVING SPACE.



A - **SECTION**
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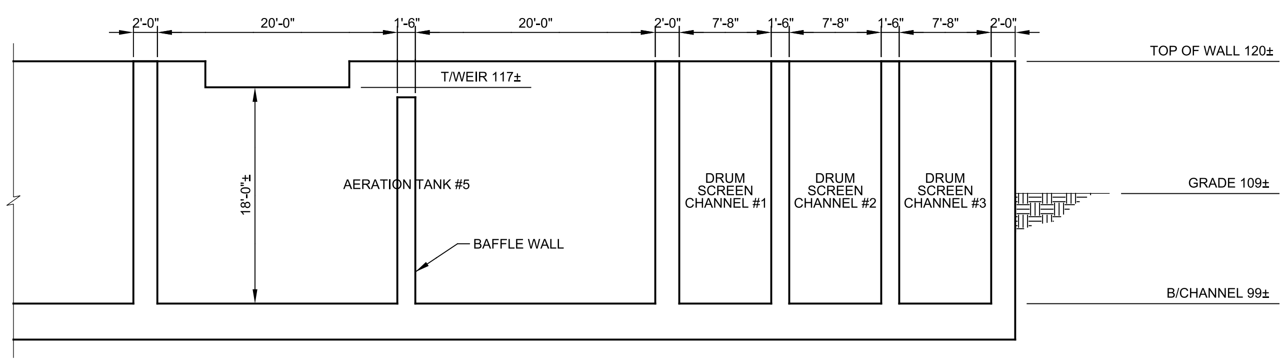

B - **SECTION**
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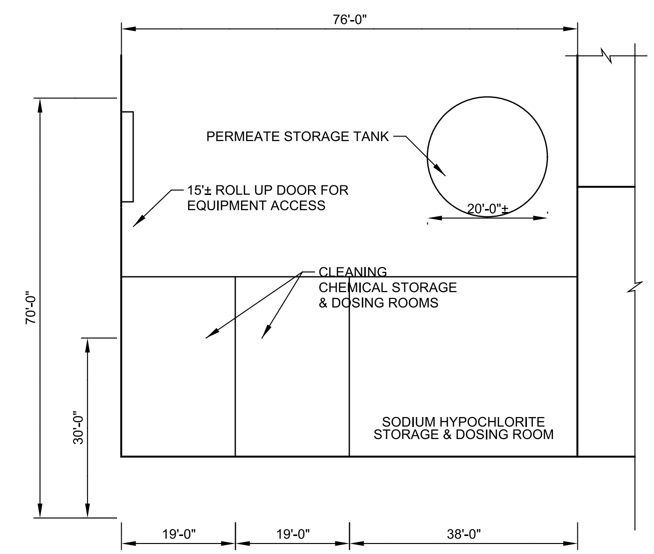

NOTE:
DEPENDING ON CHEMICALS BEING USED FOR CLEANING, FIRE-RATED WALLS AND SEPARATE VENTILATION EQUIPMENT MAY BE REQUIRED.

1 - **CIP FACILITIES PLAN**
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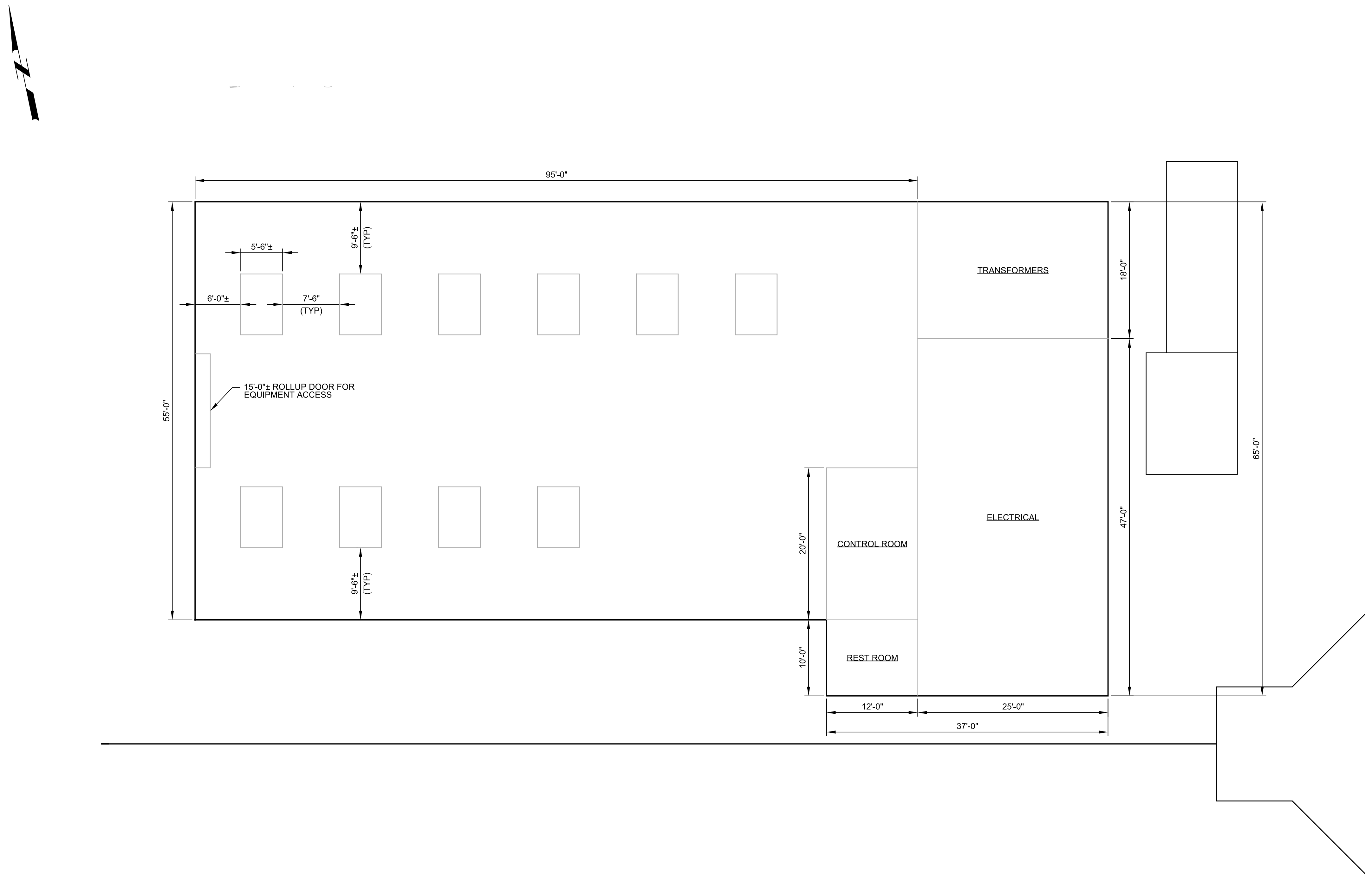
Drawing 4.2

TANK SECTIONS AND CLEANING FACILITY LAYOUT

BASIS OF DESIGN

CITY OF SUNNYVALE



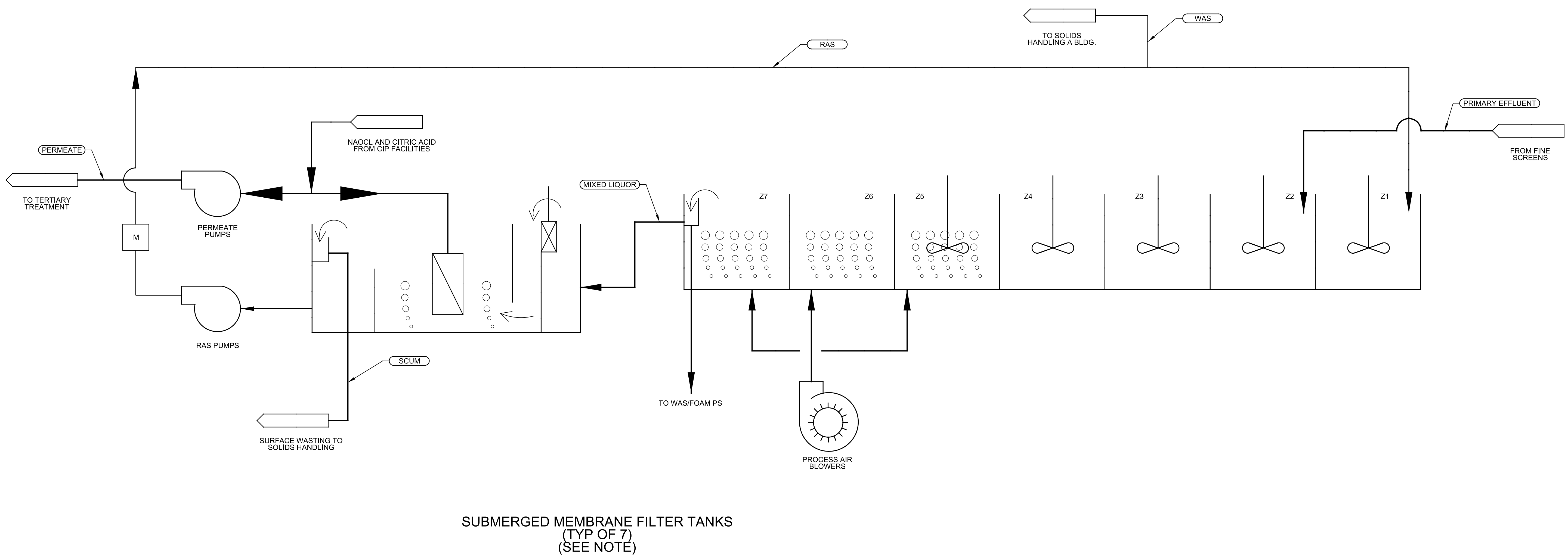
Drawing 4.3

BLOWER BUILDING
CONCEPTUAL LAYOUT
BASIS OF DESIGN

CITY OF SUNNYVALE

carollo®

GENERAL NOTES:
1. EVOQUA FEED SCHEME IS DEPICTED HERE AS IT REQUIRES ADDITIONAL FLOW ELEMENTS.



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Drawing 4.4

MBR PROCESS FLOW DIAGRAM
BASIS OF DESIGN

CITY OF SUNNYVALE

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THICKENING/DEWATERING FACILITIES

5.1 BACKGROUND

This section includes the basis of design for the thickening and dewatering facilities along with the associated support facilities (pumping, chemical feed, cake loading and odor control).

The facilities described in this basis of design are based on the key findings and recommendations of the Master Plan. As part of the Master Plan, Carollo/HDR conducted an analysis and selection of process technologies for thickening and dewatering. The analysis and recommendations are presented in the Master Plan Solids Treatment TM. The selected solids treatment processes proposed for the WPCP are based on providing the needed improvements through buildout.

The key findings and recommendations of the Master Plan for the thickening and dewatering processes are summarized below:

- All process facilities required for solids treatment should be designed to accommodate the 2035 maximum month (MM) load generated from the primary and secondary treatment processes. The 2035 MM Load is projected to be 46,000 pounds per day (ppd) of total suspended solids (TSS) and 40,000 ppd of volatile suspended solids (VSS). Equipment would be sized and/or installed in phases to accommodate flows as they increase. Equipment sizing and phasing would be determined as part of the Basis of Design to be completed as part of the Master Plan.
- Thickening:
  - Thicken primary sludge in the new primary sedimentation basins (PSTs).
  - Thicken secondary waste activated sludge (WAS) with rotary drum thickeners (RDTs).
  - Feed thickened primary sludge and secondary sludge to the digesters separately.
  - Install three RDTs (two duty and one standby) as part of the initial phase of thickening to accommodate the 2025 MM load. Given the incremental size of RDT units available, three RDT units will have enough capacity to accommodate the 2035 MM Load.
  - Operate the RDT thickening facility seven hours a day and five days a week.
  - Co-locate the thickening facility with the dewatering facility inside a building.
  - Provide site space adjacent to the thickening facility for thickening polymer storage and odor control facilities.

- Dewatering:
  - Dewater digested sludge with screw presses.
  - Install three screw presses (two duty and one standby) as part of the initial phase of dewatering to accommodate the 2025 MM Load. Install one additional screw press as part of the second phase of dewatering to accommodate the 2035 MM load.
  - Operate the dewatering facility 24 hours a day and five days a week.
  - Co-locate the dewatering facility with the thickening facility inside a building.
  - Provide site space adjacent to the dewatering facility for: dewatering polymer storage; odor control facilities; digested sludge storage; and dewatered cake conveyance, storage and truck loading.
  - Provide a digested sludge storage tank upstream of the dewatering process for digested sludge equalization. The storage tank would provide two days of digested sludge storage during maximum month loads and have a storage capacity of approximately 0.25 MG. Dewatering feed pumps would be located adjacent to this storage tank.
  - Provide dewatered cake conveyance, cake storage, and truck loading facilities to convey, store and offload dewatered cake. The cake storage hopper would provide one day of cake storage during average annual loads and have a storage capacity of approximately 125 CY.

- Odor Control:
  - Provide a bioscrubber system to treat odors collected at the thickening and dewatering equipment.
  - Locate the odor control system near the thickening and dewatering building to simplify the odor piping design.
  - Include the following provisions to adequately contain odors generated at the thickening and dewatering building and exhaust them to a bioscrubber system:
    * Cover and enclose the RDTs and screw presses and install exhaust fans to extract air from the covered and enclosed RDTs and screw presses.
    * Install a ventilation system for areas that will be accessed by personnel to provide sufficient air changes required for worker safety.

5.2 THICKENING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

5.2.1 Project Element List

The thickening facility would include the following major project elements:

- Waste activated sludge (WAS) pumps.
- Rotary drum thickeners (RDTs).
- Thickened waste activated sludge (TWAS) pumps.
- Polymer storage system and feed system comprised of:
  - Polymer storage tank and recirculation pump.
  - Polymer blender units.
  - Flocculator tanks (part of RDTs).
- Thickening/Dewatering Building to enclose the thickening and dewatering processes.
- Provisions to remove equipment from the building (e.g., bridge crane).
- Ventilation system.
- Provisions to contain and exhaust odors from the RDTs (e.g., enclosures) to a bioscrubber.

5.2.2 Design Criteria and Redundancy

The design criteria for the proposed thickening facilities are summarized in Table 5.1. The sludge feed flow and load values included in the table were developed as part of the Master Plan and are described in further detail in the Master Plan Solids Treatment TM.

Space is allocated in the Thickening/Dewatering Building for the WAS pumps. For information on the WAS pumps refer to Part 3 Conventional Activated Sludge and Part 4 Membrane Bioreactors of the Basis of Design Report.

Table 5.1 Design Criteria – Thickening Facilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Operating Time		
Operating Time, hr/day	24	
Operating Time, days/wk	7	
Feed Sludge to Thickening Process		
Feed Sludge Type	Waste Activated Sludge (WAS)	
Total Suspended Solids, mg/L	6,000 – 9,000	6,000 – 9,000
Feed Sludge Load, ppd (1)	17,000	18,000
Feed Sludge Flow, gpm (2)	160 - 240	160 - 300
Rotary Drum Thickeners		
Type of Thickener	Rotary Drum Thickener	
Number of Units	2 Duty + 1 Standby	
Solids Capacity per Unit, lb/hr (3)	1,400	
Hydraulic Capacity per Unit, gpm	300	
Typical Polymer Consumption, lb active/dry ton feed(4)	7 - 15	
Typical Thickened Sludge Concentration, Percent Solids (4)	3 - 7	
Typical Percent Capture(4)	95	
TWAS Pumps		
Type of Pump	Progressive Cavity	
Number of Units(7)	2 Duty + 1 Standby	
Pump Flow Rate, gpm each(5)	60	
Speed Control	VFD	
Thickening Polymer System		
Polymer Type	Emulsion	
Polymer Dosage Capacity, lb active/dry ton feed(4)	15	
Number of Polymer Storage Tanks	1	
Volume of Polymer Storage Tank, gal each(6)	4,500	
Polymer Storage Tank Diameter, feet	8	
Number of Thickening Polymer Blender Units	2 Duty + 1 Standby	

Table 5.1 Design Criteria – Thickening Facilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Bridge Crane		
Type	Motorized Top Running Double Girder Bridge Crane (same bridge crane used for dewatering facilities)	

Notes:
(1) Based on replacing the existing oxidation pond process with a new conventional activated sludge plant. Solids flow to the digesters is based on an average combined PS and WAS solids concentration of 3.6 percent and 98% capture of WAS during thickening process.
(2) 8 hours per day, 5 days per week continuous operation.
(3) Based on a rated solids loading capacity of 2,000 lb/hr at a feed concentration of 10,000 mg/L.
(4) Performance highly dependent on sludge characteristics. Confirm during design.
(5) Preliminary estimate. To be confirmed during design.
(6) Sized to accommodate 4,000-gallon bulk delivery and additional polymer for maintained operation for approximately two weeks.
(7) One TWAS pump dedicated to each RDT.

5.3 DEWATERING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

5.3.1 Project Element List

The dewatering facility will include the following major project elements:

- Screw presses.
- Cake pumps.
- Polymer storage system and feed system comprised of:
  - Polymer storage tank and recirculation pump.
  - Polymer blender units.
  - Polymer aging tank.
  - Polymer solution feed pumps.
- Thickening/Dewatering Building to enclose the dewatering and thickening processes.
- Provisions to remove equipment from the building (e.g., bridge crane).
- Ventilation system.
- Provisions to contain and exhaust odors from the screw presses (e.g., enclosures) to a bioscrubber.

5.3.2 Design Criteria and Redundancy

The design criteria for the proposed dewatering facilities are summarized in Table 5.2. The sludge feed flow and load values included in the table were developed as part of the Master Plan and are described in further detail in the Master Plan Solids Treatment TM.

Table 5.2 Design Criteria – Dewatering Facilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Operating Time		
Operating Time, hr/day	24	
Operating Time, days/wk	5	
Feed Sludge to Dewatering Process		
Feed Sludge Type	Anaerobically Digested Blend of Primary Sludge and TWAS	
Feed Sludge, Percent Average Volatile Solids Content (1)	75 – 80	
Range of Feed Sludge Solids Content, Percent	1.5 – 3	
Average Feed Sludge Solids Content, Percent	2	
Feed Sludge Load, lb/hr (2) (3)	1,400	1,500
Feed Sludge Flow, gpm (2) (3)	140	150
Screw Presses		
Type of Dewatering Unit	Screw Press	
Number of Units (3)	2 Duty + 1 Standby	3 Duty + 1 Standby
Solids Capacity per Unit, lb/hr each	650 – 714	
Hydraulic Capacity per Unit, gpm each	57 – 68	
Typical Polymer Consumption, lb active/dry ton (4)	20 – 40	
Typical Cake Concentration, Percent (4)	16 – 20	
Typical Percent Capture, Percent (4)	95%	
Screw Press Wash Water Booster Pumps		
Type of Pump	Vertical, Centrifugal	
Number of Units (6)	3	4
Cake Pumps		
Type of Pump	Progressive Cavity (Cake)	
Number of Pumps (6)	3 Duty + 1 Standby	
Pump Flow Rate, gpm each	55	
Speed Control	VFD	

Table 5.2 Design Criteria – Dewatering Facilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Dewatering Polymer System		
Polymer Type	Emulsion	
Polymer Dosage Capacity, lb active/dry ton feed (4)	34	
Number of Polymer Storage Tanks	1	
Volume of Polymer Storage Tank, gal each (5)	5,800	
Polymer Storage Tank Diameter, feet	10	
Number of Dewatering Polymer Blender Units	1 Duty + 1 Standby	
Number of Aging Tanks	2	
Aging Tank Aging Time, min	30 - 60	
Type of Dewatering Polymer Solution Feed Pumps	Progressive Cavity or Rotary Lobe	
Number of Dewatering Polymer Solution Feed Pumps (6)	3 Duty + 1 Standby	
Polymer Solution Feed Pump Speed Control	VFD	
Bridge Crane		
Type	Motorized Top Running Double Girder Bridge Crane (same bridge crane used for thickening facilities)	

Notes:

(1) Based on digester feed sludge being comprised of 40 - 50 percent TWAS.

(2) Value based on 24 hours/day of dewatering, 5 days/week. Digester sludge storage tank would be provided upstream of the dewatering process to provide digester sludge equalization. Tank would provide two days of digester sludge storage during maximum month loads.

(3) If solids production values exceed equipment capacity and operating experience proves necessity of additional dewatering capacity, operate third installed unit temporarily and add another unit when necessary.

(4) Performance highly dependent on sludge characteristics. Confirm during design.

(5) Sized to accommodate 4,000-gallon bulk delivery and additional polymer for maintained operation for approximately two weeks.

(6) One pump is dedicated to each screw press.

As summarized in the table above, two duty and one standby screw presses are recommended to treat 2025 maximum month loads. Based on the solids projections, two duty units are anticipated to provide sufficient treatment capacity most of the year. During periods of peak solids production the standby unit may need to be used to provide sufficient treatment capacity. These periods are anticipated to be infrequent. Based on actual sludge production, performance of the dewatering equipment, and projections for future solids production, the need for and timing of installing a third duty unit should be evaluated.

5.4 CAKE LOADING

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

5.4.1 Project Element List

The cake loading facility will include the following major project elements:

- Sludge discharge valves.
- Sludge cake hopper.
- Truck loading conveyors (i.e., hopper live bottom conveyors).
- Cake hopper discharge gates.
- Truck loading bay.
- Truck load cell (to weigh truck contents).
- Provisions to contain odors from the cake hopper (e.g., enclosures).

5.4.2 Design Criteria and Redundancy

The design criteria for the cake storage facilities are summarized in Table 5.3.

Table 5.3 Design Criteria – Cake Storage Facilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Operating Time (Truck Loading)		
Operating Time, hr/day	8	
Operating Time, days/wk	5	
Feed Solids to Cake Hopper		
Dewatered Solids Weight, wet tons/day	100	110
Dewatered Solids Volume, CY/day	120	125
Truck Loading Facility Sludge Cake Hopper		
Hopper Type	Rectangular with Enclosure	
Number of Hoppers	1	
Hopper Side Slope (incline from horizontal), degree	75	
Air Volume, CY (1)	170	
Effective Storage Volume, CY	125	
Truck Loading System		
Conveyor Type	Live bottom, double-shafted screw conveyor	
Number of Conveyors	2	
Cake Hopper Discharge Gates		
Gate Type	Slide	
Number of Gates Actuator Type	3 Electric	
Truck Loading Bay		
Type of Bay (2)	Partially Enclosed	
Truck Capacity, CY (1)	30	
Truck Trips per Day	4	5

Notes:

(1) Preliminary estimate. To be confirmed during design.

(2) Enclosed on two sides of bay along entire length of semi-tractor trailer to protect cake from moisture and contain odors. Sized to enclose entire length of one 30 cubic-yard semi-tractor trailer.

5.5 ODOR CONTROL

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

5.5.1 Project Element List

The Thickening/Dewatering odor control facility would include the following major project elements:

- Provisions to convey odorous air from the RDTs and screw presses to the thickening/dewatering odor control system.
- Biotrickling scrubber with odor control fan.

5.5.2 Design Criteria and Redundancy

The design criteria for the odor control facilities are summarized in Table 5.4.

Table 5.4 Design Criteria – Thickening/Dewatering Odor Control Facility WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**2025 Maximum Month Design**	**2035 Maximum Month Design**
Operating Time		
Operating Time, hr/day	24	
Operating Time, days/wk	7	
Foul Air to Odor Control Facility		
Air Volume of RDTs, CF	6,000	6,000
Air Volume of Screw Presses, CF	6,000	8,000
Air Changes per Hour, AC/hr	12	
Foul Air from RDTs, scfm	1,200	1,200
Foul Air From Screw Presses, scfm	1,200	1,600
Foul Air from miscellaneous sources, scfm	3,000	3,000
Total Foul Air, scfm	5,400	5,800
Average Foul Air H_2S, ppm	< 50	
Peak Foul Air H_2S, ppm	< 100	
Bioscrubber		
Type of Scrubber	Biotrickling scrubber	
Number of Scrubbers	1	
Scrubber Diameter, ft	10	
Scrubber Height, ft (2)	25	
Required Media Depth, ft	12.3	
Total Media Volume, CF	970	
Required H_2S Removal Efficiency, %	99	
Required Odor Removal Efficiency, %	80	
Odor Control Fan		
Fan Type	Supplied with biotrickling scrubber	
Number of Fans	1 Duty	

Notes:

(1) Allowance for odor control required at cake storage facilities or within the Thickening/Dewatering Building.

(2) Consider extending the stack discharge above the roofline to minimize downwash effects if required.

5.6 SITE WASTE PUMP STATION

As part of the WPCP master planning effort, concepts for handling of various recycle loads at the plant were evaluated and discussed with staff. This evaluation, the results of which are presented in the Master Plan Site Layout TM, determined that the recycle streams from the east side of the WPCP would be generated from the thickening and dewatering operation. Therefore, it was recommended that the site waste pump station be included with the construction of the Thickening/Dewatering Building. Filtrate from the RDTs, pressate from the screw presses, and drain flows from the Thickening/Dewatering Building would be drained to the Site Waste Pump Station. The site waste pump station would pump these flows to the centrate and return activated sludge (RAS) re-aeration (CaRRB) zone of the aeration basins.

Depending on site constraints, the site waste pump station could be located either inside or just outside of the Thickening/Dewatering Building. The pump station would be located below grade and would include two submersible pumps (one duty + one standby), with provisions for metering and sampling so that the impact of these recycle loads could be determined.

5.7 CIVIL/SITE CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

5.7.1 Site Layout Considerations

Figure 5.1, which was prepared as part of the of Master Plan Site Layout TM, shows the proposed Thickening/Dewatering Building on the WPCP site plan located just south of Digester Nos. 1 and 2. As can be seen from this site layout, these critical solids handling facilities are tightly constrained in all directions. For that reason, the proposed building configuration presented in this document should be considered as a starting point for a more detailed layout evaluation during preliminary design (based on the latest information for current and future site constraints).

5.7.2 Piping Layout

The following major process and utility pipes would be routed to the thickening, dewatering, cake loading, and odor control facilities:

- Thickening/Dewatering Building:
  - Waste Activated Sludge (WAS) from the secondary treatment facilities.
  - Digester Sludge (DS) from the Dewatering Feed Pump Station (located at the Digester Facility).
  - Utility Water (3W) from the No. 3 Water System.
  - Potable Water (WP) from the Potable System.
  - Plant (Service) Air (SA) from the Plant Air System.
- Cake Loading Facility:
  - Dewatered Sludge (DWS) from the Thickening/Dewatering Building.
- Thickening/Dewatering Odor Control Facility:
  - Foul air (FA) from the Thickening/Dewatering Building and Cake Loading Facility.

The following major process and utility pipes would be routed from the thickening, dewatering, cake loading, and odor control facilities:

- Thickening/Dewatering Building:
  - Thickened WAS (TWAS) to the Digester Facility.

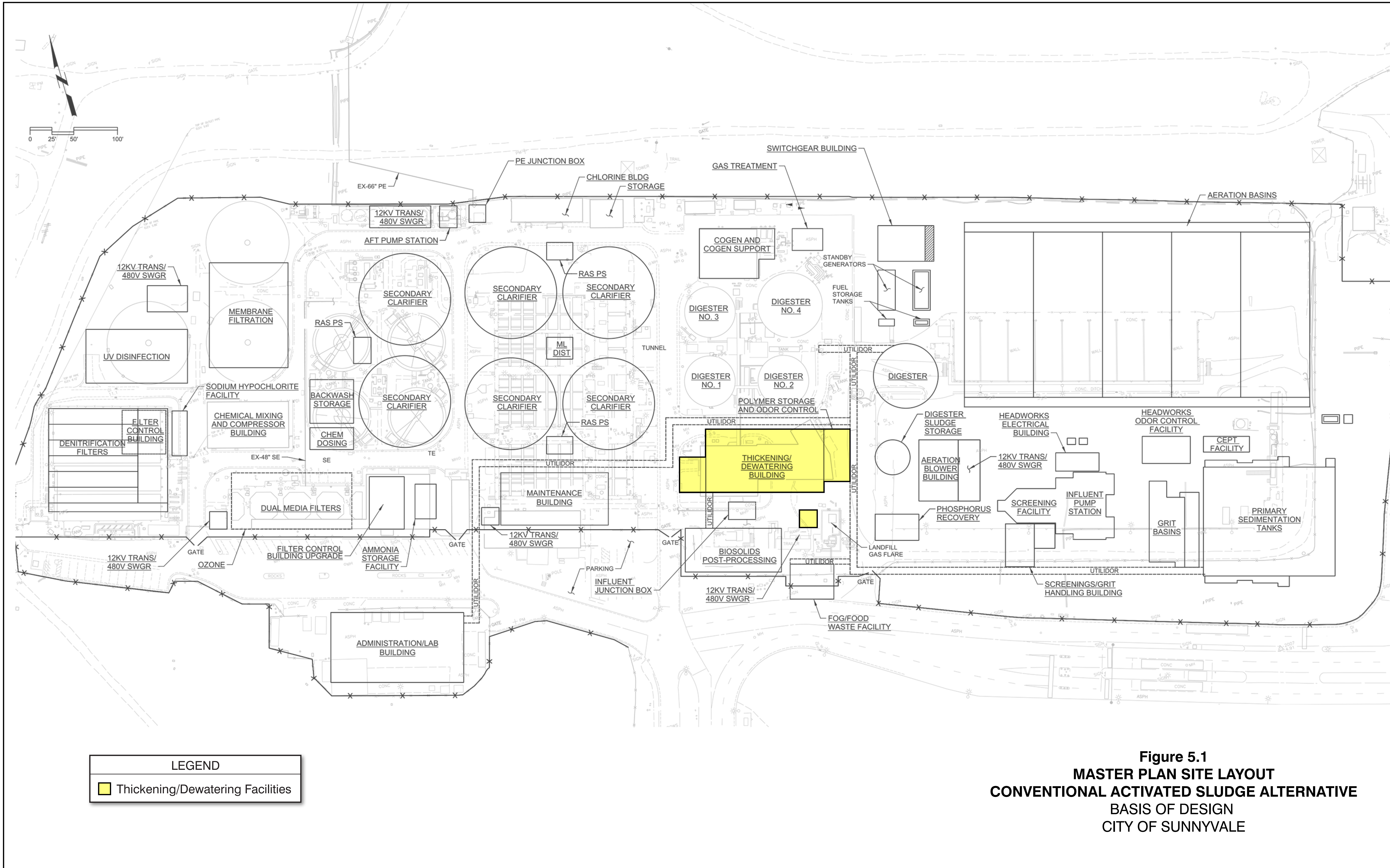

Figure 5.1
MASTER PLAN SITE LAYOUT
CONVENTIONAL ACTIVATED SLUDGE ALTERNATIVE
BASIS OF DESIGN
CITY OF SUNNYVALE

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- Dewatered Sludge (DWS) to the Cake Loading Facility.
- RDT Filtrate (FIL) to the Site Waste Pump Station, which would pump process recycle flows to the centrate and return activated sludge (RAS) re-aeration (CaRRB) zone of the aeration basins.
- Screw Press Pressate (PRS) to the Site Waste Pump Station, which would pump the process recycled flows to the CaRRB zone of the aeration basins.
- Floor drains and miscellaneous drains to the Site Waste Pump Station.
- Foul air to the Thickening/Dewatering Odor Control Facility.

- Cake Loading Facility:
  - Floor drains and miscellaneous drains to the plant drain system.
  - Foul air to the Thickening/Dewatering Odor Control Facility.
- Thickening/Dewatering Odor Control Facility:
  - Biotrickling Scrubber drain, floor drains and miscellaneous drains to the plant drain system.

5.7.3 Support Utilities

Major support utilities that should be considered when planning and designing the thickening, dewatering, cake loading and odor control facilities are summarized in Table 5.5.

Table 5.5 Support Utilities WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale	
Ancillary Facility	**Description**
Potable Water	• Provide at emergency shower eyewash stations and handwashing stations. • Provide at thickening polymer system. • Provide at dewatering polymer system.
Utility Water	• Provide at hose bibs in all areas for general housekeeping. • Provide at all pumps for pump seal water. • Provide at RDT spray bars. • Provide at screw press wash water booster pumps. • Provide at odor control biotrickling scrubber.
Plant Air	• Provide plant air to the Thickening/Dewatering Building and air tool connection as required. • Provide plant air to the screw press air compressor.
HVAC	• Provide sufficient ventilation/air changes such that the Thickening/Dewatering Building is an unclassified area per NFPA 820. • Provide adequate heating, cooling, and ventilation of the Thickening/Dewatering Building to maintain acceptable operating conditions.
Odor Control	• Convey foul air from RDTs, screw presses and miscellaneous areas of the Thickening/Dewatering Building and Cake Loading Facility to Thickening/Dewatering Odor Control System.
Drainage	• Provide floor drains in all areas for general housekeeping. • Provide process drain lines (i.e., filtrate pipelines) at the RDTs. • Provide process drain lines (i.e., pressate pipelines) at the screw presses. • Provide process drain line at biotrickling scrubber. • Route all floor drains and process drain lines to the Site Waste Pump Station.

5.8 ELECTRICAL CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Electrical Design Standards developed as part of the Master Plan.

5.8.1 Electrical Distribution

The electrical loads for the thickening, dewatering, cake loading, and odor control facilities will be distributed from a 12-V to 480-volt transformer located near the thickening/dewatering building. The transformer would be sized for the complete load of these facilities. This is consistent with the proposed 12-kV distribution system described in Part 5 - Secondary Treatment (CAS).

The transformer would feed a 480-volt switchgear/MCC. The 480-volt switchgear/MCCs would be located at the electrical room of the thickening/dewatering building.

5.8.2 Electrical Loads

The electrical loads for the thickening, dewatering, cake loading and odor control facilities are summarized in Appendix A. This table also summarizes the number of units, the number of standby units, the peak load, the connected load, and whether the loads would be supplied with standby power.

5.9 INSTRUMENTATION AND CONTROL CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Instrumentation and Control Design Standards developed as part of the Master Plan.

5.9.1 Process Flow Diagram

The process flow diagrams for the thickening, dewatering, loading and odor control processes are included in Section 5.12.

5.9.2 Automation and Control Considerations

Because of the interconnectivity between various subsystems (i.e., feed pumps, polymer feed, solids discharge, washwater), it is anticipated that the RDT and screw press vendors will supply control panels which will provide the main control function for this facility. Separate panels for the polymer feed systems and cake loading will also be provided. As part of the overall plant SCADA upgrades to the WPCP, a communication cabinet would be installed in the building to tie this facility into the plant-wide network. More information on the proposed SCADA concepts can be found in the Master Plan ACS TM.

5.10 MAJOR O&M CONSIDERATIONS

The major operations and maintenance (O&M) considerations for the thickening, dewatering, cake loading and odor control facilities are summarized in Tables 5.7 to 5.10.

**Table 5.7 Operations and Maintenance Considerations – Thickening Facility
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Equipment	O&M Consideration
General	• Provide air tool connections as required.
Rotary Drum Thickeners	• Provide ability to remove and maintain all major rotary drum thickener components, including drum. • Maintain clear access to trunnion wheel lubrication fittings for daily maintenance. • Provide access to all thickening system components. • Provide washdown provisions. • Provide flush drain and sample ports on feed sludge lines. • Provide sample ports on filtrate line. • Provide workspace within building to analyze sludge and filtrate.
TWAS Pumps	• Provide sufficient clearance in front of pump for stator removal. • Provide flush, drain and sample ports on TWAS lines.
Polymer Blender Units	• Provide ability to flush lines. • Provide strainers as necessary.

Table 5.8 Operations and Maintenance Considerations – Dewatering Facility
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required.
Screw Presses	• Provide ability to remove and maintain all major screw press components, including screw. • Maintain clear access to discharge end screw shaft bearing and feed end oil seal lubrication points for daily maintenance. • Provide access to all screw press system components. • Provide washdown provisions. • Provide flush drain and sample ports on feed digester sludge lines. • Provide sample ports on pressate line. • Provide workspace within building to analyze sludge and filtrate.
Cake Pumps	• Provide sufficient clearance in front of pump for stator removal. • Provide flush, drain and sample ports on dewatered sludge lines.
Polymer Feed Pumps	• Provide sufficient clearance in front of pump for stator removal. • Provide ability to flush lines.
Polymer Aging Tank	• Provide ability to flush lines.
Polymer Blender Units	• Provide ability to flush lines. • Provide strainers as necessary.

Table 5.9 Operations and Maintenance Considerations – Cake Loading Facility
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	O&M Consideration
General	• Provide air tool connections are required.
Cake Hopper	• Provide access to inspect and hose down hopper.
Hopper Live Bottom Conveyors	• Provide access to inspect conveyor. • Provide ability to remove and maintain all major conveyor components.
Cake Hopper Discharge Gates	• Provide access to inspect and clean gates. • Provide ability to remove and maintain all major gate components.
Cake Hopper Loading Bay	• Provide ability to inspect and maintain load cell.

Table 5.10 Operations and Maintenance Considerations – Thickening/Dewatering Odor Control Facility WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale	
Equipment	**O&M Consideration**
General	• Provide air tool connections are required.
Biotrickling Scrubber	• Provide ability to inspect, remove and maintain all major biotrickling scrubber components.
Odor Control Fans	• Provide sufficient clearance in front of pump for stator removal. • Provide flush, drain and sample ports on foul air ducts.

5.11 POTENTIAL VENDORS

The major equipment proposed for the Thickening/Dewatering Facilities and the recommended vendors for each type of equipment are summarized in Table 5.11. The major equipment proposed may be competitively bid.

Table 5.11 Potential Equipment Vendors
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Equipment	Vendor
Thickening	
Rotary Drum Thickeners	Parkson, Vulcan, or equal.
Thickened WAS Pumps	Moyno, Netzsch, or equal.
Polymer Blending Units	Velodyne, Fluid Dynamics, or equal.
Dewatering	
Screw Presses	Huber, or equal.
Polymer Blending Units	Velodyne, Fluid Dynamics, or equal.
Polymer Aging Tank	Velodyne, Fluid Dynamics, or equal.
Polymer Feed Pumps	Moyno, or equal.
Cake Pumps	Seepex, Schwing, or equal.
Cake Storage	
Truck Loading Conveyor	Custom Conveyor, Biosec Enviro Inc., or equal.
Cake Live Bottom Hopper	Custom Conveyor, Biosec Enviro Inc., or equal.
Thickening/Dewatering Odor Control	
Biotrickling Scrubber	Bioair, or equal.

Notes:
(1) Includes sole-source requirements, recommended considerations for pre-qualifying or pre-purchasing equipment, etc.

5.12 LAYOUT DRAWINGS

The process flow diagrams for the thickening, dewatering, loading and odor control processes are shown in Figures 5.2 and 5.3.

A proposed layout for the Thickening/Dewatering Building, Thickening/Dewatering Odor Control Facility and Cake Loading Facility are presented in Drawing 5.1. Note, the Odor Control Facility includes three separate odor control systems. As stated above, the thickening/dewatering odor control system would treat foul air generated at the thickening, dewatering and cake loading facilities. The other two odor control systems would treat foul air generated at the future Headworks and Primary Sedimentation Tanks.

Proposed sections for the Thickening/Dewatering Building and Cake Loading Facility are presented in Drawings 5.2 and 5.3 respectively.

All facilities would be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

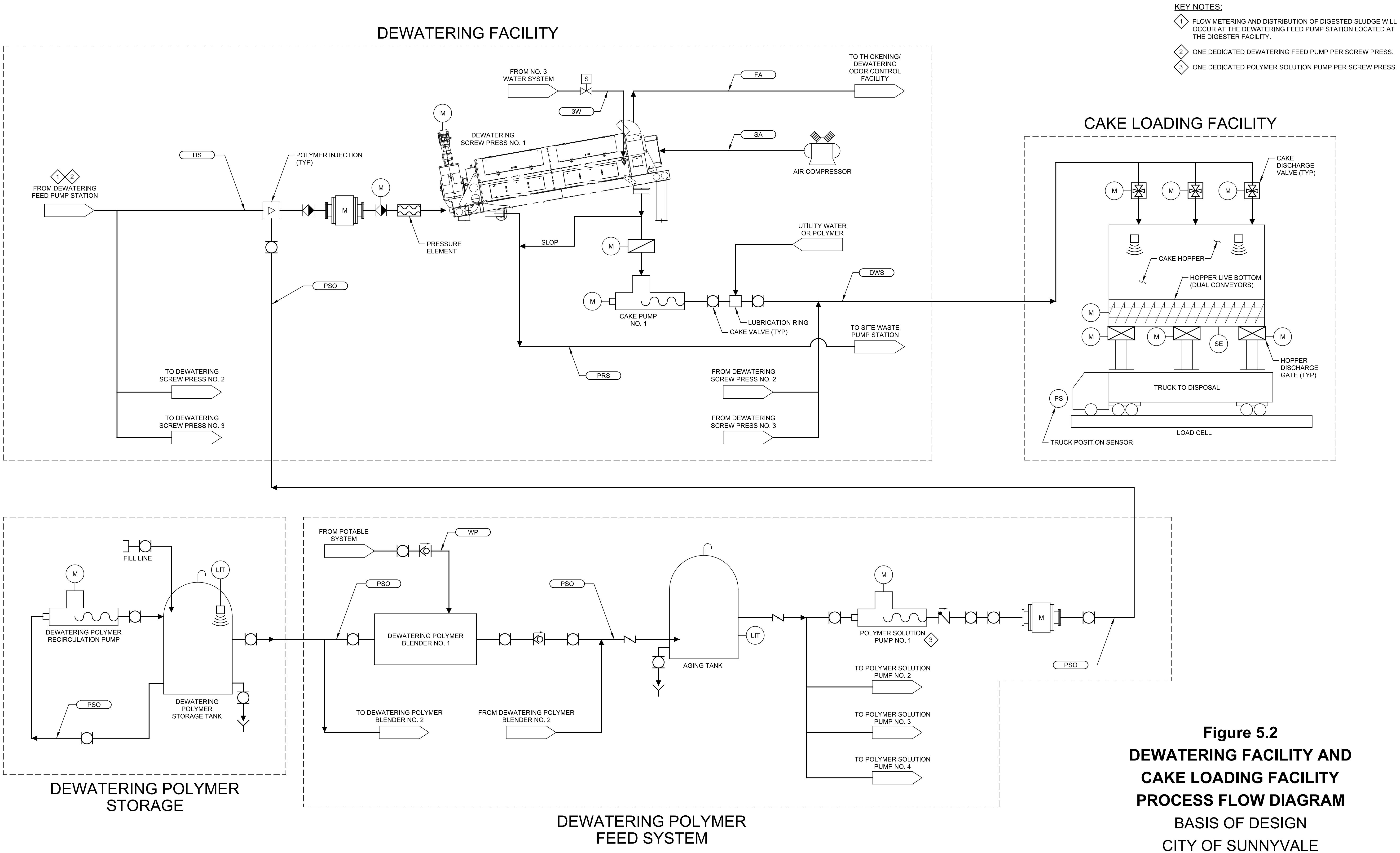

Figure 5.2
DEWATERING FACILITY AND CAKE LOADING FACILITY PROCESS FLOW DIAGRAM
BASIS OF DESIGN
CITY OF SUNNYVALE

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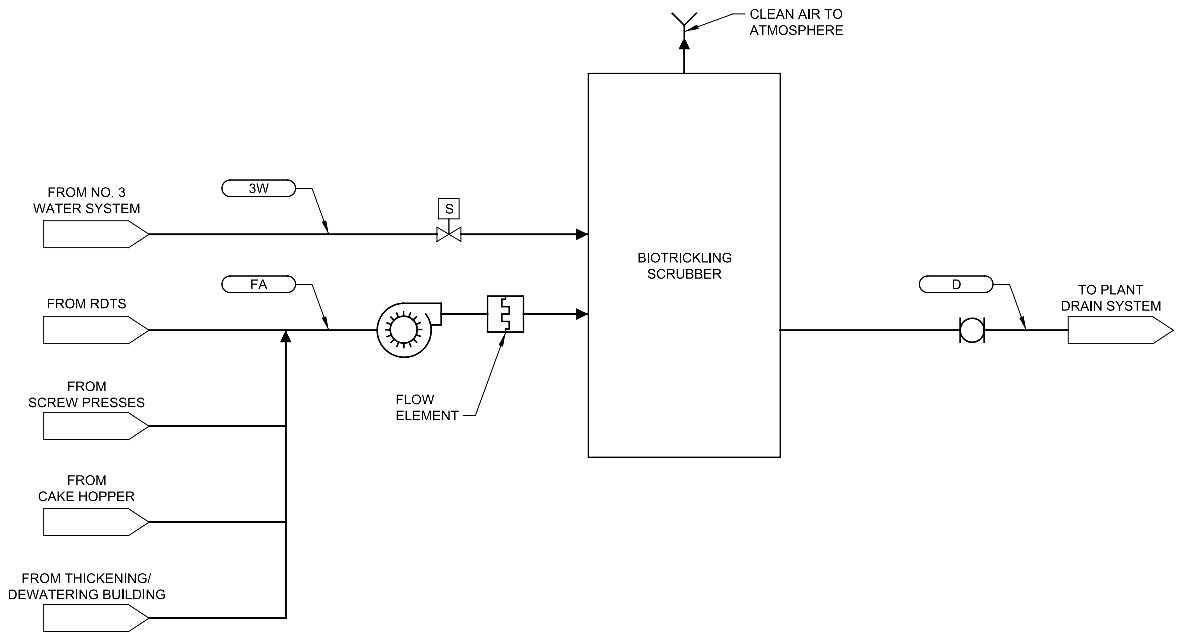


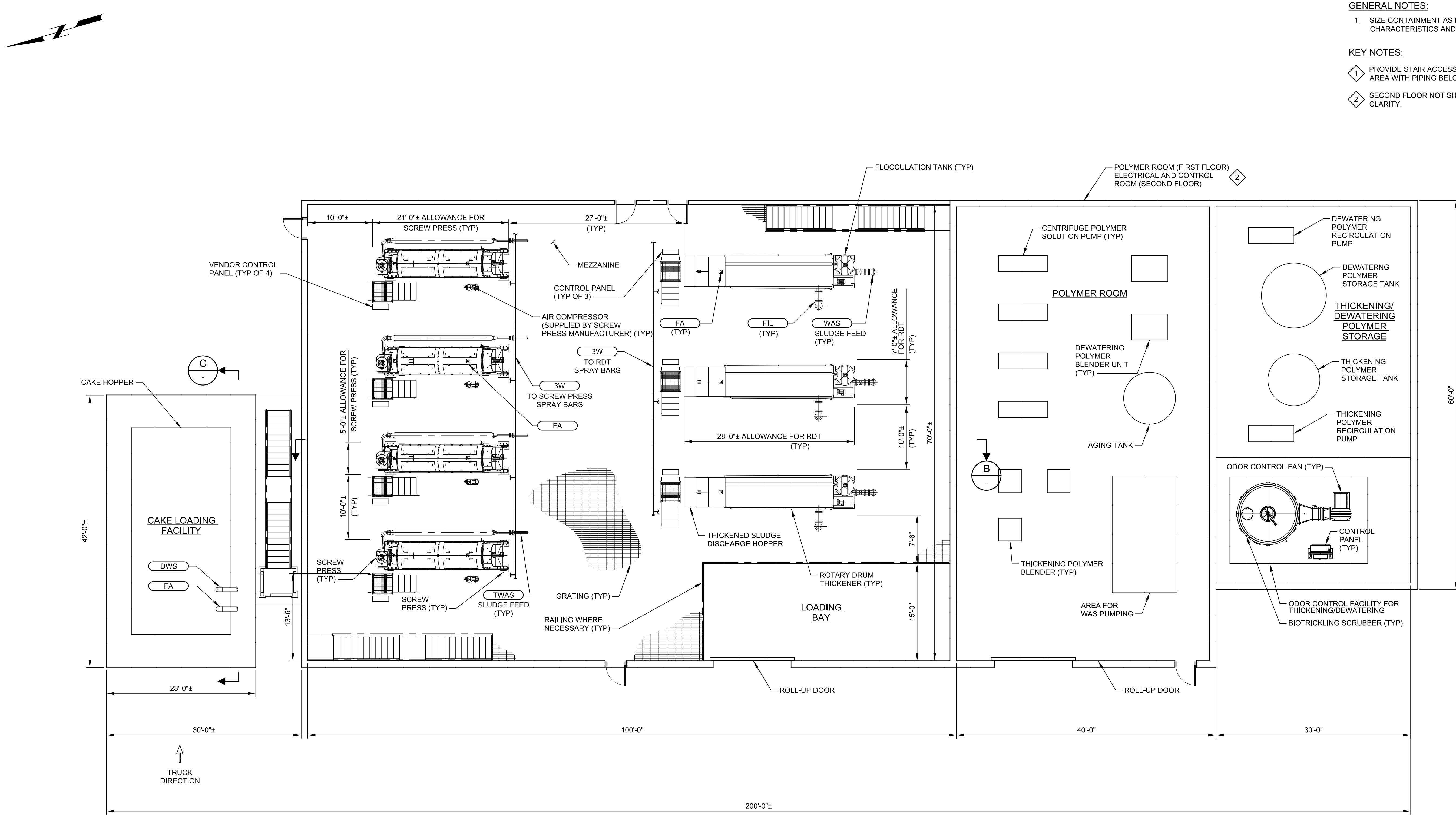
Figure 5.3
THICKENING/DEWATERING
ODOR CONTROL FACILITY
PROCESS FLOW DIAGRAM
BASIS OF DESIGN
CITY OF SUNNYVALE

GENERAL NOTES:

1. SIZE CONTAINMENT AS NECESSARY FOR SUNNYVALE HYDROLOGIC CHARACTERISTICS AND CODE.

KEY NOTES:

1. PROVIDE STAIR ACCESS OVER CURB AND AT RAISED GRATING IN AREA WITH PIPING BELOW.
2. SECOND FLOOR NOT SHOWN FOR CLARITY. NOT SHOWN FOR CLARITY.

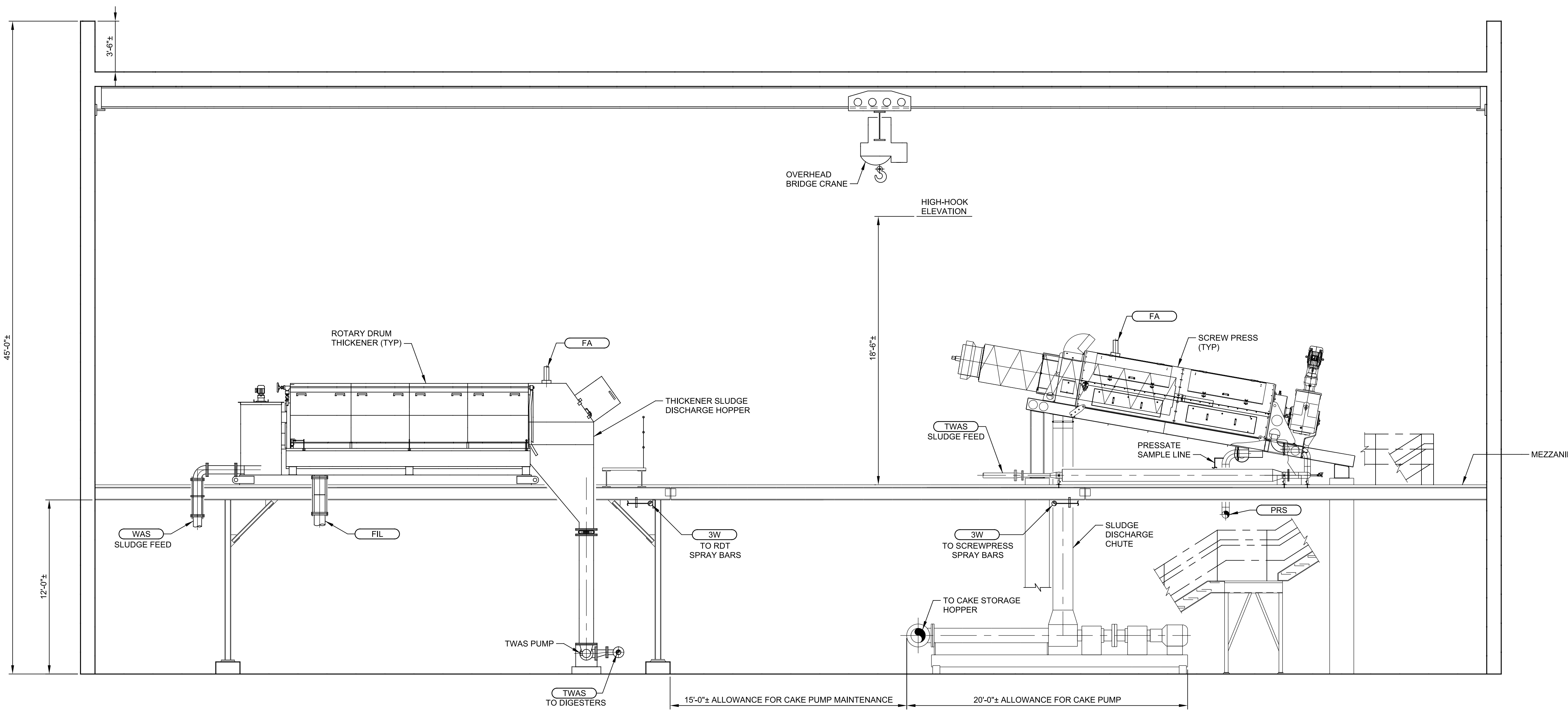


Drawing 5.1

THICKENING AND DEWATERING BUILDING PLAN

BASIS OF DESIGN

CITY OF SUNNYVALE



B / - **SECTION**
SCALE: 1/4" = 1'-0"
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Drawing 5.2
THICKENING AND DEWATERING BUILDING SECTION

BASIS OF DESIGN
CITY OF SUNNYVALE

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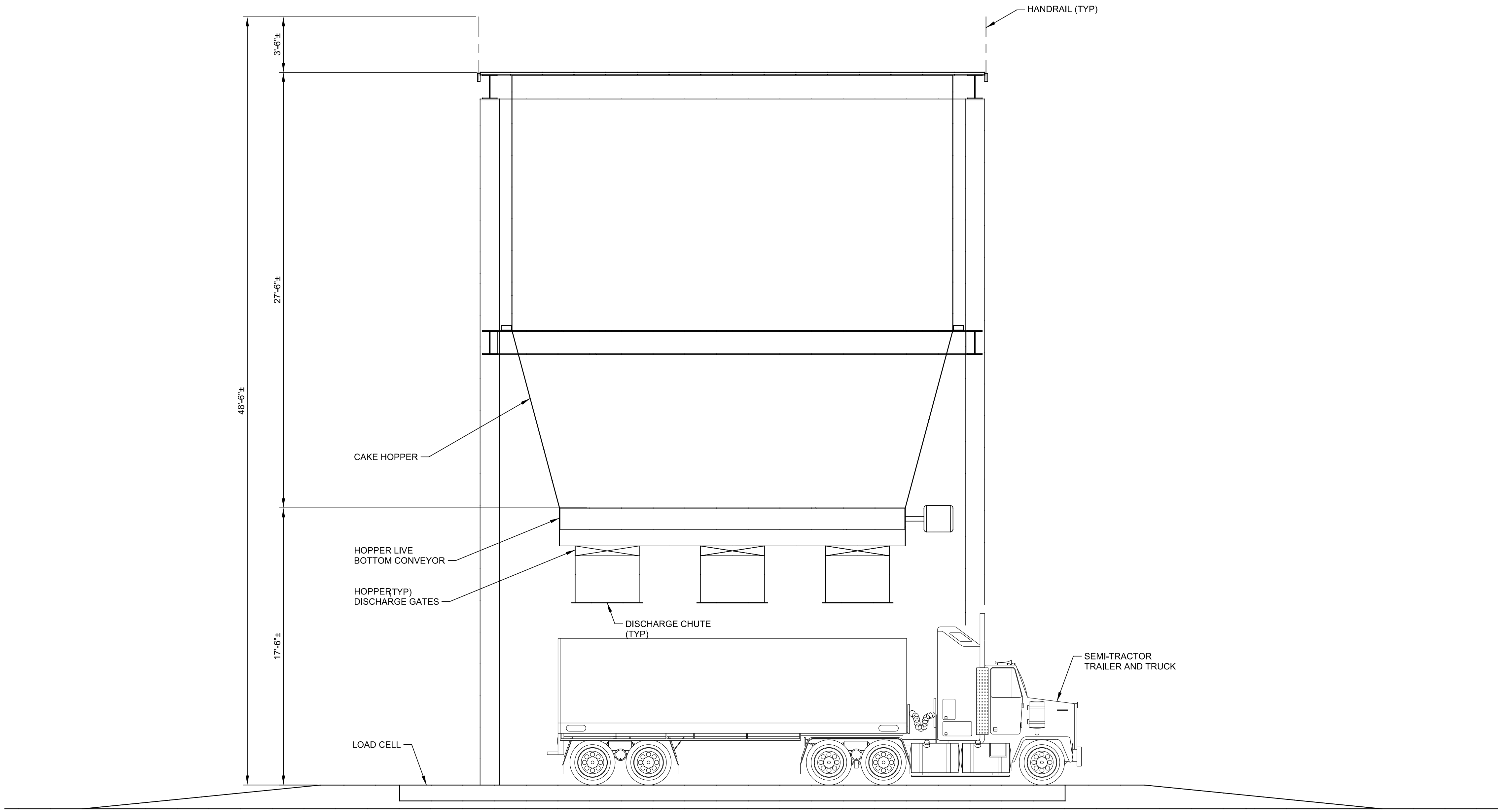

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SECTION
SCALE: 1/4" = 1'-0"
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Drawing 5.3
CAKE LOADING FACILITY
SECTION
BASIS OF DESIGN
CITY OF SUNNYVALE

POWER GENERATION FACILITY

6.1 BACKGROUND

This section includes the basis of design for the Power Generation Facility Engine Upgrade and Gas Conditioning projects.

This Basis of Design (BOD) is founded on the key finding and recommendations of the Master Plan. As part of the Master Plan, Carollo/HDR conducted an analysis of available processes for gas conditioning and power generation. The analysis and recommendations are presented in the Master Plan Electrical and Combined Heat and Power (CHP) Technical Memorandum (TM) and summarized below. The combined heat and power plan proposed for the WPCP is based on providing the needed improvements through build out to meet the City's goals and objectives.

- If CHP design begins within the next one to four years, internal combustion engines are the recommended technology due to many years of operating history. After 2018, if microturbines have shown a proven performance record using biogas, then they should be considered as an option to internal combustion engines.
  - This recommendation is still valid. The BOD is based on engine generators.
- Provide capability of using natural gas to augment biogas.
  - This recommendation is still valid.
- Use waste heat from the CHP to heat digesters, administration building and maintenance building.
  - This recommendation is still valid. The current Package 2 project incorporates exhaust heat recovery from the existing Caterpillar engines. Future engine replacement will need to reevaluate plant heat needs and recovery methods.
- Provide updated controls and exhaust heat recovery for the existing power generation facility (PGF) now. A backup boiler is not recommended now but could be added later in the third bay of the PGF building.
  - Most of this recommendation is still valid. A controls upgrade for the existing engines is being incorporated as part of the Package 2 project. Any new engines in the future would get a controls replacement as well. However the third bay is now being designated for future exhaust treatment equipment.
- Provide gas treatment for the future CHP to remove hydrogen sulfide (iron sponge or sulfatreat media), moisture (glycol chilled heat exchanger and separator), and siloxane removal (activated carbon).
  - This recommendation is still valid. This BOD examines options for each of the required removals listed above. Note that this gas treatment may be installed

earlier as a standalone project and upgraded as appropriate as part of the cogeneration upgrades.

In addition to the ECHP recommendations, the City intends to implement a portable standby generator. The City completed the design of the standby generator in early 2015. The standby generator will supply emergency power to the Auxiliary Pump Station, the MCCs loads powered by the Substation B 1,500 kVA transformer, and the MCC loads at Switchgear 40017. The primary function of the standby generator is to provide back-up power to the critical Plant loads in case of a utility power outage. This standby generator project is not discussed in this Basis of Design Report, as detailed design is already underway. For details on this project, refer to the design documents for that project.

6.2 FLOWS AND LOADS

6.2.1 Biogas Production from Landfill Gas and Anaerobic Digestion

The WPCP has two main sources of biogas (along with air blended natural gas [ABNG]) that provide a power source to the PGF: digester gas and landfill gas. The digester gas available to the plant in 2012/2013 was approximately 161,000 cubic feet per day (cfd), while the landfill gas available was approximately 384,000 cfd. Landfill gas is not as high quality as digester gas (415 BTU vs. 550 BTU), so the total blended biogas production now is 545,000 cfd at approximately 455 BTU.

Future biogas production (from biosolids digestion) is summarized in Table 6.1.

Table 6.1 Future Biogas Production from Biosolids Digestion Only
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Year	AAF(2) or MMF(3)	Cubic Feet Per Day(1) (cfd)
2025	AAF	196,000
	MMF	237,000
2035	AAF	209,000
	MMF	254,000

Notes:
(1) Based on 13 cubic feet per pound VSS destroyed.
(2) AAF-Average Annual Flow.
(3) MMF- Maximum Monthly Flow.

Landfill gas is projected to degrade at an approximate rate of two percent per year (per the SCS AB32 Annual Report for the Sunnyvale Landfill dated March 2013) for the life of the landfill. The gas available at this rate for the next 20 years is presented in Figure 6.1. This depletion of the available biogas will have a significant impact on the cogeneration capabilities of the PGF. Therefore, alternate forms of fuel generation (such as fats, oils and grease (FOG) and food waste) should be investigated by the future gas optimization design team to mitigate the increased purchases of natural gas to make up the difference. These alternate forms can be expanded in the future as well to accommodate the decreasing performance of landfill gas.

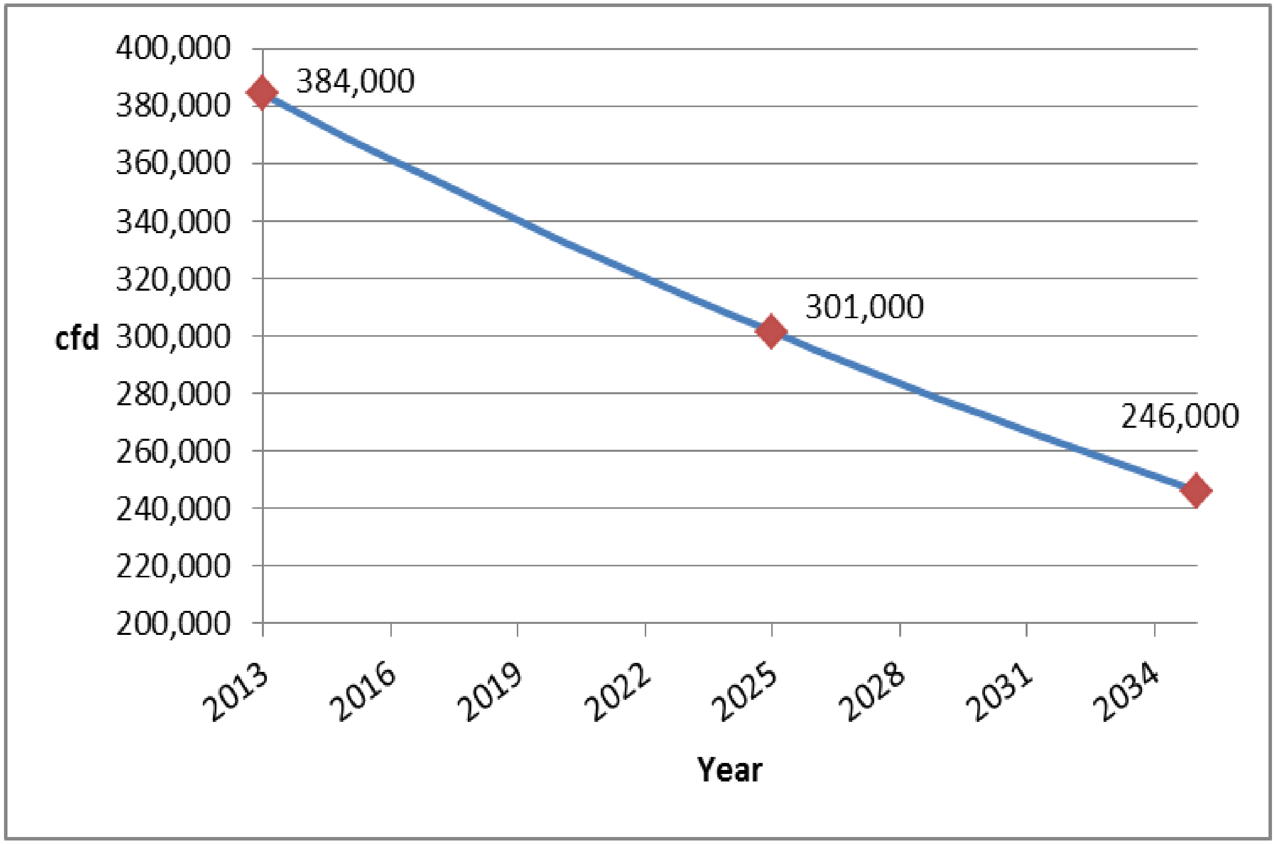

FIGURE 6.1
LANDFILL GAS FLOW DEGRADATION
MASTER PLAN
CITY OF SUNNYVALE

6.2.2 Biogas Production from Food Waste and Fats, Oils, and Grease (FOG)

The Kennedy Jenks Fats, Oils, and Grease Report (dated July 2012) identified the ability of area surrounding the WPCP to contribute up to 100 tons of FOG to a new receiving facility. This facility would serve as a revenue stream (from tipping fees), but long term would be a significant contributor to the PGF power capabilities. The total amount of gas available from a FOG receiving facility would be approximately 54,000 cfd (assuming 13 cf per pound volatile solids destroyed).

While a FOG facility was identified as desirable, the window on the short-term payback profitability of such an investment may be shrinking. Other agencies in the Bay Area are constructing similar projects which are rapidly decreasing the supply of available FOG. Tipping fees, which currently are favorable, could decrease or disappear in the future. It is recommended that any FOG facility be built soon to take advantage of the current market. A FOG receiving facility is not part of this predesign. In the next few years, the diversion of organics to landfills will most likely be banned. This may open up the whole market of organics for co-digestion.

The Kennedy report identified approximately 15 tons per day of food waste that can be received at the treatment plant. This amount of waste has the potential to produce approximately 75,000 cfd of biogas. Food waste that has not been preprocessed should not be considered for the WPCP due to operational challenges such as high labor requirements and odor potential. However, if the waste is prescreened and in liquid form, it can be considered a viable feedstock for the digesters. While the biogas quantities discussed within this document do not account for food waste, this alternative could be reevaluated by the future gas optimization design team.

6.2.3 Total Biogas Production

The total biogas available to the PGF in the future is summarized in Table 6.2 below.

For perspective, 525,000 cfd of biogas can generate approximately 1,300 kW at 38 percent electrical efficiency, while the plant will consume approximately 1,800 kW in the year 2025 (assuming activated sludge is installed for secondary treatment).

Split treatment may have a minor impact on secondary biosolids generated. Moreover, biogas production from digestion of secondary biosolids is not anticipated to be nearly as significant as production from primary solids. Therefore, split treatment is not anticipated to significantly impact the biogas totals shown in Table 6.2. The CHP designer should consider this in the future.

Table 6.2 Total Biogas Production (cfd)
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Year	AAF or MMF	Biosolids (550 BTU)	Landfill Gas (415 BTU)	FOG (550 BTU)	Total
2025	AAF	196,000	301,000	54,000	551,000
	MMF	237,000	301,000	54,000	592,000
2035	AAF	209,000	246,000	58,000	513,000
	MMF	254,000	246,000	58,000	558,000

6.3 POWER GENERATION

Engine generators for the updated PGF will replace the existing Caterpillar 3516 engines. These new engines will be similar in size in order to align with the biogas production and natural gas blending, while providing sufficient heat for digester operation and supporting electrical demands at the facility. Sizing for engines is targeted for approximately 800 to 900 kW per engine. Engines under consideration are Jenbacher 412, Caterpillar 3516, or equal. Efficiencies for these are in the range of 35 percent to 41 percent depending on set up and specific models. For the purpose of this basis of design, all evaluations and cost were based on the Jenbacher 412 due to its high efficiency.

The new engines will need to comply with Bay Area Air Quality Management District (BAAQMD) Best Available Control Technology (BACT). For internal combustion engines, this includes lean burn engines with after treatment control. BACT limits for NOx is currently .15 g/bhp-hr and includes after treatment control with Selective Catalytic Reduction to lower NOx emissions to below BAAQMD limits. BACT limits for Carbon Monoxide (CO) is currently .89 g/bhp-hr and includes after treatment control with oxidation catalysts to reduce CO emissions to below BAAQMD limits. Other criteria pollutants must be addressed with biogas pretreatment technologies, which would be implemented to protect the engines and catalysts regardless. The proposed Jenbacher 412 engines come complete with a selective catalytic reduction system.

6.3.1 Project Elements

The engine generator upgrades would include the following major project elements.

- New 850 kW engine generators (and associated equipment)
- New electrical equipment

6.3.2 Design Criteria and Redundancy

The design criteria for the proposed engine generator upgrade are summarized in Table 6.3. Redundancy is not a consideration for this design, as the City does not desire to be a net energy producer. If an engine does go down for maintenance or due to failure, the WPCP will purchase the difference from Pacific Gas and Electric (PG&E).

Table 6.3 Design Criteria – Engine Generator Replacement WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale		
Parameter	**Units**	**Value**
Gas Capacity (2035)		
Biosolids	cfd	209,000
Landfill Gas	cfd	246,000
Total Gas Capacity	cfd	455,000
Gas Quality	BTU/cf	476
Engine Characteristics (Based on GE Jenbacher)		
Rated Engine Power	bhp	1,180
Rated Engine Output (100%)	kW	852
Rated Engine Output (75%)	kW	636
Rated Engine Output (50%)	kW	420
Engine Efficiency at 100% Output	%	41.2
Exhaust Gas Mass Flow Rate, dry	lbs/hr	9,956
Maximum Exhaust Back Pressure (After Engine)	Inches w.c.	24
Dimension (Length)	in	240
Dimension (Width)	in	80
Dimension (Height)	in	90
Discharge Voltage	kV	12.4

6.4 GAS CONDITIONING

6.4.1 Project Elements

The biogas conditioning upgrades would include the following major project elements.

- New hydrogen sulfide (H2S) removal equipment.
- New moisture removal equipment.
- New glycol chiller.
- New siloxane removal equipment.

6.4.2 Design Criteria and Redundancy

The design criteria for the proposed engine generator upgrade are summarized in Table 6.4. Redundancy will not be provided for the hydrogen sulfide and moisture removal. The siloxane removal equipment should have two vessels so as to maintain some level of treatment in the event of a vessel failure. If the H2S or moisture removal systems are taken offline for any reason, the engines should be removed from service until repairs are made.

6.4.3 Gas Treatment Technologies

Digester gas treatment systems are typically designed to have three treatment phases, illustrated in Figure 6.2. In the first phase hydrogen sulfide is removed from the wet gas. Gas is then compressed and sent to a moisture removal unit where the relative humidity is reduced. Siloxanes are then removed, and in some cases the gas passes through a filter for the removal of particulate matter, before the gas is sent to the point of use.

This section provides descriptions of various treatment technologies available.

6.4.3.1 Hydrogen Sulfide Removal

Hydrogen sulfide may be removed from digester gas by one or more of the following methods: adsorption, biological removal, chemical gas scrubbing, and ferric pretreatment. The majority of treatment processes for hydrogen sulfide removal are commercially available, and selection will be heavily dependent on operations and maintenance costs.

***Adsorption*:** This technology uses filter beds packed with an activated carbon media or other proprietary media. It is best suited for relatively low hydrogen sulfide concentrations or as a final polishing step because high loading rates will decrease the breakthrough time of the column (Bagreev et al 2004), and frequent replacement of media may be required if breakthrough occurs too quickly.

Table 6.4 Design Criteria – Gas Conditioning
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

Parameter	Units	Value
Site Conditions		
Minimum Ambient Temperature	DegF	15
Maximum Ambient Temperature	DegF	105
System Requirements		
Minimum Gas Flow	scfm	0
Maximum Gas Flow	scfm	400
Untreated Gas Conditions		
Minimum Inlet Gas Pressure	In. H2O	4
Maximum Inlet Gas Pressure	In. H2O	12
Hydrogen Sulfide Concentration	ppmv	600
Siloxane Concentration	mg/m^3	40
Treated Gas Conditions		
Discharge Gas Pressure	psig	5
Maximum Hydrogen Sulfide Concentration	ppmv	<25
Maximum Siloxane Concentration	Mg/m^3	<10

***Iron sponge adsorption**:* This is the oldest (developed for the gas industry almost 100 years ago), most widely used technology for the removal of hydrogen sulfide from digester gas and uses iron oxide to precipitate hydrogen sulfide into ferric sulfide. In the typical design configuration, gas is passed through a packed bed of iron oxide-coated media, typically wood chips which increase porosity and decrease pressure drop across the bed. This technology is simple, has proven successful in a large number of digester gas projects in the United States, and is commercially available through multiple vendors. Drawbacks to this treatment method include the reoccurring costs for media regeneration and replacement, and the potential for spontaneous combustion if media is not kept moist during replacement. Additionally, iron sponge replacement can be burdensome and performance diminish if the media is left in the reactor for an extended period time as the wood chips begin to degrade and the iron oxides agglomerate to a hardened mass that may be difficult to remove from the vessel.

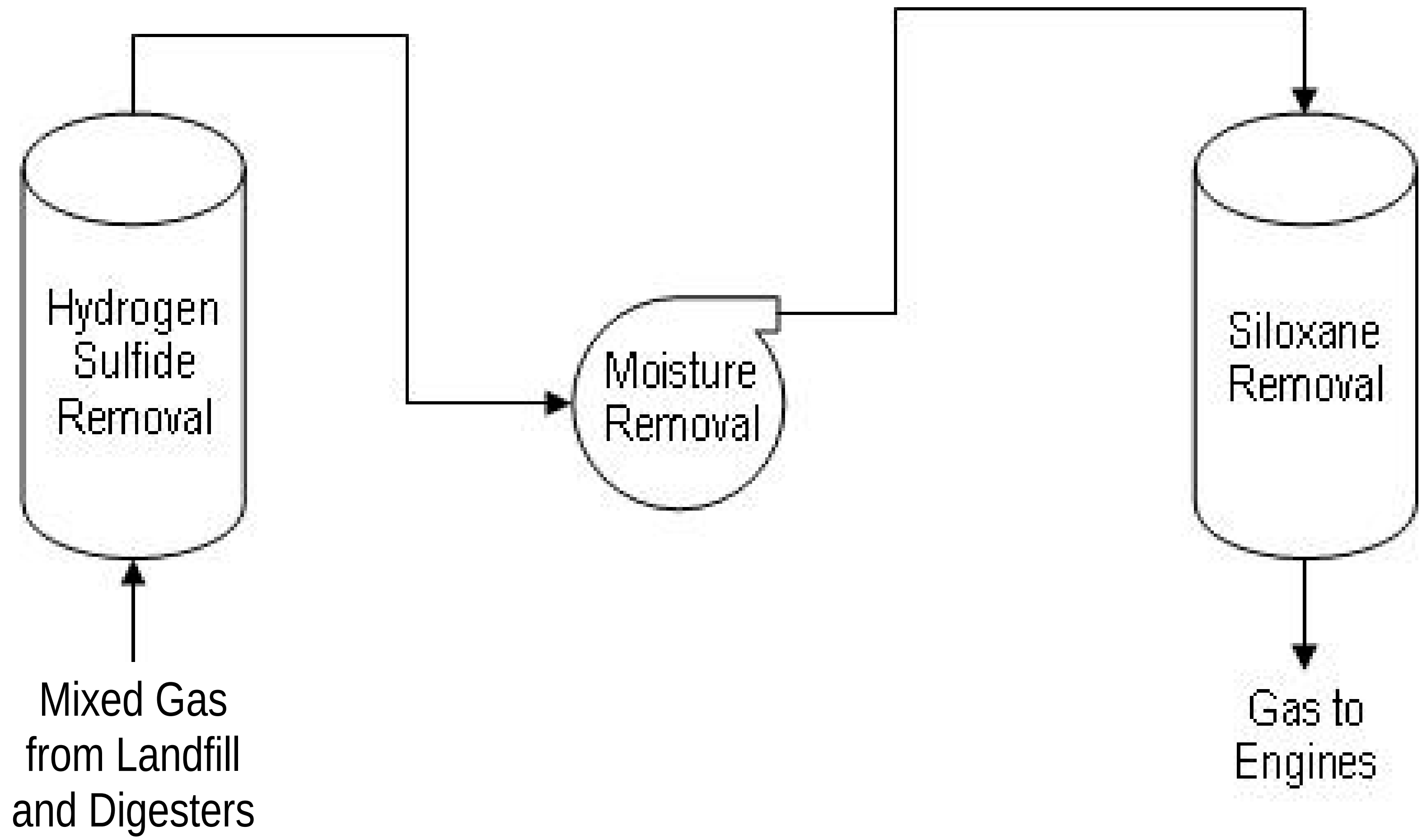

Figure 6.2
TYPICAL DIGESTER GAS TREATMENT PROCESS
MASTER PLAN
CITY OF SUNNYVALE

Engineered Media Adsorption: The use of a proprietary engineered media such as SulfaTreat^{TM} is an alternative to the iron sponge. External process components and configuration are similar to an iron sponge. However, the engineered media maintains its shape over time, is less susceptible to degradation in the filter bed, does not pose a fire hazard during replacement operations, and in general is easier to replace than iron sponge media. The biggest disadvantage of engineered media is that the media itself typically costs considerably more than iron sponge media.

Biological filter: A biofilm of sulfur-oxidizing bacteria is cultivated on media in a packed tower bio-trickling filter; where bacteria are able to metabolize the hydrogen sulfide into elemental sulfur and sulfate compounds which are washed from the system and recovered. The drawback to this technology is that it requires the addition of small quantity of oxygen to facilitate aerobic biological growth, and an additional treatment step may be required to separate sulfur from the liquid waste stream. Single stage bio-trickling filters for hydrogen sulfide removal are an established technology in odor control applications but should be considered as an emerging technology for digester gas applications. This technology could be an established technology by the time the CHP is designed and constructed.

Chemical scrubbing: This is a widely used technology in which the digester gas stream is mixed with a chemical scrubbing agent such as sulfuric acid (needed for ammonium or free ammonia removal), sodium hydroxide/hypochlorite or other proprietary chemical (Osorio & Torres 2009). Advantages of this configuration include less pressure loss through the system and no media replacement requirements. Disadvantages of this design include the relatively high cost for use and disposal of highly acidic or caustic chemicals and highly-instrumented control systems. Operating costs can be reduced if chemical regeneration technologies are utilized.

Chemical scrubbing with regeneration: This technology is a two-step process that uses a scrubbing solution, typically a solution of sodium hydroxide and in some cases a proprietary chemical additive, to oxidize and remove hydrogen sulfide from the gas stream. The clean gas exits the vessel and is sent to the next downstream treatment process. The sulfur-containing liquid stream is sent to a recovery reactor where sulfur is chemically or biologically converted to elemental sulfur and the scrubbing solution is regenerated. The regenerated scrubbing solution is returned to the scrubbing tower and the sulfur-containing liquid stream is either wasted or further processed using a filter press to produce a sulfur cake. In the biological treatment approach, the recovery reactor is typically a fixed-film aerobic reactor. In the chemical treatment approach, the proprietary catalyst used for hydrogen sulfide absorption is regenerated by oxidation reactions using atmospheric oxygen.

Ferric pretreatment: The precipitation of hydrogen sulfide to iron sulfide upstream of the digesters with chemical addition of iron sulfate or iron chloride is often used for odor control. Additionally ferric salts are used for chemically enhanced primary treatment (CEPT).

6.4.3.2 Moisture Removal

The most common methods of moisture removal in digester gas treatment systems are refrigeration and desiccant drying beds.

Refrigeration*:* Warm digester gas is cooled to a dew point of 40 DegF in gas-to-liquid glycol heat exchangers to remove moisture via condensation. This dew point temperature is selected because it has been shown to reduce the relative humidity of the gas to 35 percent or less. Additional moisture can be removed if the gas is chilled below freezing; however, this requires a significant increase in energy and capital cost. After the moisture is removed, the gas flows through a gas to gas heat exchanger where it is reheated to 80 DegF.

Desiccant Beds*:* Desiccant drying beds contain a solid media used for absorbing water molecules; common materials include activated alumina, molecular sieves, silica gels or proprietary deliquescent desiccant tablets. Media including activated alumina and silica gel may be regenerated in lag-lead configurations, but may not offer optimal moisture removal. In contrast, proprietary desiccant tablets may offer better moisture removal, but the media must be replaced on a consistent basis.

6.4.3.3 Siloxane Removal

Siloxanes may be removed from digester gas by one or more of the following methods: adsorption to porous media, absorption with liquids, biological degradation, and membrane separation.

Adsorption: The most widely used technology for siloxane removal is through adsorption to carbon media, silica gel, alumina media or other proprietary media in a packed bed. Configuration usually consists of at least two beds operating in parallel in a lead-lag configuration such that one bed is active while the other is being regenerated or replaced. Replacement of media is required when adsorption capacity has been met and is contingent upon contaminant loading and gas flow rates. In carbon-based media the competitive adsorption of non-volatile, sulfur containing or halogenated compounds will reduce the capacity of the media (Bagreev et al 2005), as will gas humidity above 60 percent (Shin et all 2002, Schweigkofler M, Niessner R. 2001). Each siloxane species also has a unique breakthrough curve which may reduce or expand operating capacity of the media. Design of adsorption beds must take into consideration the maximum and minimum gas flows and allowable pressure drop through the media bed to ensure optimal gas treatment and minimize friction losses through the media.

Absorption*:* Absorption is a chemical process whereby siloxanes are removed from the bulk gas by strong acids or bases. Research has indicated that nitric and sulfuric acids are the best options. The drawbacks to this method of siloxane removal include the stripping of trace amounts of sulfuric acid which increases corrosion in combustion engines and safety and disposal of strong acids (Ajhar et al.2010).

Biological Degradation: This technology involves the use of an anaerobic or aerobic biotrickling filter to biologically degrade siloxanes and has been documented solely in bench scales studies. To date pilot scale studies have not been conducted most likely due to the long empty bed retention time and mass transfer and biodegradation potential limitations on the bench scale (Popat & Deshusses 2008).

Membrane Separation: Removal of siloxanes may also be achieved by selective permeation/diffusion of gas solution through a dense polymeric membrane material. Removal efficiencies of up to 80 percent have been documented, however due to high capital costs and moderate power requirements to establish a high pressure gradient across the membrane there are currently no commercially available systems (Ajhar et al 2010).

6.4.3.4 Integrated Processes

In addition to the individual unit processes described above, two technologies for removing hydrogen sulfide, moisture and siloxanes in a single, integrated process – pressure swing adsorption and advanced refrigeration – have been used for digester and other types of biogas treatment.

Pressure Swing Adsorption (PSA): This technology separates gases based on their absorbance to solids at higher pressures, and is typically used to remove carbon dioxide and other contaminants in natural gas or biogas to produce a pipeline-quality gas (gas having a minimum methane content of 97 percent). Feed gas is first compressed, typically to 100 psig or more, and fed into a media-filled reactor for the separation step. Clean, pressurized gas exits the reactor ready for use. The reactor is then depressurized and a vacuum created, releasing the contaminants from the media, and the contaminate-laden "tail gas" removed from the reactor. The tail gas, which retains about 10 percent of the methane in the feed gas and has a typical BTU content of less than 150 BTU/ft^3, is typically sent to a waste gas flare. PSA systems typically use a carbon media and require upstream hydrogen sulfide and moisture removal to prevent contamination of the media. However, the MolecularGate^{TM} technology developed by the Englehard Corporation employs a molecular sieve that can remove hydrogen sulfide, moisture, siloxanes and carbon dioxide in a single process. PSA technology has proven successful in natural gas and landfill gas applications, but with very limited application to digester gas. PSA technology is more mechanically complex than other processes described above and has relatively high power demands (approximately 300 kW for a 600 scfm system) due to the elevated operating pressures and vacuum swing pumps. The loss of 10 percent or more of the feed gas methane to the wasted tail gas coupled with the high parasitic power demand significantly reduces the power production potential and resulting savings in purchased power, compared to other gas treatment alternatives.

Advanced Refrigeration: Deep chilling of biogas to low temperatures (less than or equal to 50 DegC) and high pressures has been proven to remove up to 99 percent of all types of siloxanes, whereas chilling to 5 DegC has been shown to reduce siloxanes by only 10 percent (Schweigkofler M, Niessner R. 2001). Commercially available products typically do not chill gas below -20 DegC and include a final carbon polishing filter for complete siloxane removal. Advanced refrigeration systems can be prone to operational problems due to icing, are mechanically complex with several stages of cooling and reheating heat exchangers, and have relatively high energy requirements for gas cooling. Application of advanced refrigeration for digester gas treatment appears to be quite limited to date.

6.4.3.5 Ranking of Gas Treatment Technologies

Gas treatment processes were evaluated and ranked according to a number of qualitative criteria related to demonstrated performance in biogas and digester gas applications, process complexity, operations and maintenance requirements and operational flexibility. Based on the outcome of the evaluation, the highest ranked alternatives will be recommended for further evaluation and possibly pilot scale testing.

6.4.3.6 Evaluation and Ranking Criteria

Treatment technologies were evaluated and compared using a comparative plus/neutral/minus ranking system described as follows.

Demonstrated Performance/Experience

+ The technology has proven successful in multiple digester gas treatment systems, including large and small projects with varied concentrations of containments.

0 The technology has been successfully documented for treatment of natural gas, landfill gas, agricultural digester gas, or industrial gas but has limited experience in municipal wastewater digester gas treatment.

- The technology has been discussed in scientific journals and tested at the bench or pilot scale level but there are few successful full-scale applications documented.

Complexity of Design

+ This technology is not complex in process design, with no recirculation of chemicals, recycle of gas, or additional process required for complete treatment. It does not need additional instrumentation for pH or temperature control.

0 Process design requires some instrumentation and recirculation of liquid or gas streams

- Contaminant - removal with this design requires complex instrumentation and extensive recirculation of liquid or gas streams, requires additional steps for by-product processing, or involves multiple intermediate process steps.

Maintenance Requirements

+ This technology does not require media replacement or costly disposal of by-products. It does not need specialized technicians for routine maintenance.

0 This technology requires additional maintenance by qualified technician, and occasional media replacement and disposal.

- This technology requires frequent replacement of media, disposal of spent media, and disposal of hazardous by-products or chemicals. This technology has equipment that operates under high temperature or pressures, the equipment may deteriorate quickly if not well maintained.

Energy Requirements

+ This technology has minimal energy requirements to keep system in operation.

0 This technology requires additional pumping of chemicals, and some additional pressure requirement.

- This technology requires high pressure or extreme temperatures.

Operational Flexibility

+ This system has the flexibility to operate under different contaminant loading conditions and will maintain required containment removal concentration regardless of upstream treatment.

0 Upstream treatments will not affect this systems removal performance, but increased loading will require more frequent maintenance such as media replacement.

- Adequate contaminant removal by this system is dependent on upstream processes, and maintenance or replacement cost will increase substantially if loading rate increases.

6.4.3.7 Evaluation and Ranking Results

Results of the preliminary evaluation and ranking of gas treatment processes is summarized below. Any technology with a ranking above '0' is considered viable. Note that advanced refrigeration and PSA processes are compared to individual unit processes to facilitate the comparison of integrated and individual unit processes.

Hydrogen Sulfide Removal: Scoring for the individual hydrogen sulfide removal technologies (Table 6.5) indicates that proprietary adsorption, iron sponge media, and biological treatment are suitable treatment alternatives for application at the WPCP. Media adsorption has an extensive history in hydrogen sulfide removal and simple design but has relatively high operations and maintenance costs for routine media replacement and disposal. Biological treatment is well-established for odor control while relatively new to digester gas applications, but has the potential to significantly reduce operations and maintenance costs compared to traditional media adsorption processes. Similarly, chemical scrubbing/regeneration technologies are newer to the market but also offer a significant reduction in operations and maintenance costs. These technologies will be evaluated further in the next section of this memorandum by comparing process complexity and projected operations and maintenance costs.

Table 6.5 Scoring Matrix – Hydrogen Sulfide Removal Technologies
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale

	Adsorption on Proprietary Media	Iron sponge	Biological Removal	Chemical scrubbing	Chemical scrubbing w/ biological regeneration	Chemical scrubbing w/ reagent regeneration	Ferric pretreatment	Pressure Swing Adsorption	Advanced Refrigeration
Demonstrated Performance/Experience	+	+	-	+	0	0	+	0	-
Complexity of Design	+	+	0	0	-	-	0	-	-
Operations Cost & Maintenance	-	-	+	-	+	+	-	-	-
Energy Requirements	+	+	0	0	0	0	+	-	-
Operational Flexibility	0	0	+	0	+	+	-	+	+
Total	**+2**	**+2**	**+1**	**0**	**+1**	**+1**	**0**	**-2**	**-3**

Moisture Removal: Refrigeration using heat exchangers is a well-established, proven technology for removing moisture from digester gas. As indicated in Table 6.6, refrigeration is the recommended technology for the moisture removal component of the digester gas treatment system particularly because of its demonstrated performance and operational flexibility.

Table 6.6	**Scoring Matrix – Moisture Removal Technologies WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale**			
	Refrigeration	**Desiccant Beds**	**Pressure Swing Adsorption**	**Advanced Refrigeration**
Demonstrated Performance/Experience	+	-	0	0
Complexity of Design	0	+	-	-
Maintenance Requirements	0	-	-	-
Energy Requirements	0	+	-	-
Operational Flexibility	+	-	+	+
Total	**+2**	**-1**	**-2**	**-2**

Siloxane Removal: As indicated in the alternative scoring matrix (Table 6.7) adsorption would be the recommended technology for siloxane removal. Media adsorption is the most common technology available, and it offers predictable removal efficiencies, relatively simple design, and lower energy requirements than other alternatives.

Table 6.7	**Scoring Matrix – Siloxane Removal Technologies WPCP Master Plan and Primary Treatment Facilities City of Sunnyvale**					
	Adsorption	**Absorption**	**Biological Degradation**	**Membrane Separation**	**Pressure Swing Adsorption**	**Advanced Refrigeration**
Demonstrated Performance/Experience	+	0	-	-	+	-
Complexity of Design	+	0	0	-	-	-
Maintenance Requirements	-	-	-	-	-	-
Energy Requirements	+	+	+	-	-	-
Operational Flexibility	-	-	-	0	+	+
Total	**+1**	**-1**	**-2**	**-4**	**-1**	**-3**

Special Consideration for Pressure Swing Adsorption: A PSA system is not recommended for routine use of digester gas in an engine generator CHP system. This is mainly due to its high parasitic power demands and wasting with the tail gas a portion of the useful BTUs in the digester gas. The major advantage of a PSA system is that it can produce pipeline quality gas, which provides flexibility to explore other potentially high-value uses for the cleaned biogas such as powering vehicles designed to run on compressed natural gas or sale to the regional gas utility. Should the City be interested in exploring other potential uses of WPCP digester gas, a PSA system for gas treatment should be re-evaluated.

6.4.4 Gas Treatment Recommendation

The City's objectives for the gas treatment system can be summarized as providing a robust system with proven technology while reducing routine annual costs for items such as media replacement. Based on those objectives, and considering the costs and operating experience of the hydrogen sulfide removal processes considered in this evaluation, the following configuration for the WPCP digester gas treatment system is recommended:

- Provide a traditional digester gas treatment train comprising of a proprietary media (such as Sulfatreat) adsorption media process for hydrogen sulfide removal, gas cooling to 40 DegF for moisture removal to a 40 percent relative humidity, activated carbon for siloxane removal, and a final particulate filter for removal of matter larger than three microns in size. Biological hydrogen sulfide removal should be considered if it becomes a mainstream technology by the time gas treatment is implemented.

6.5 HEAT RECOVERY

Replacement of the engine driven raw sewage pumps with electric driven pumps has reduced the availability of heat for plant use and therefore additional heat recovery is required. As part of the Primary Facilities project, the existing engines will have exhaust heat recovery provided to augment the heat supplied around the plant. The engines considered for the future system are similar in size to the existing ones and the associated exhaust flow rates are close enough to consider reusing the new heat recovery silencer. It is assumed however that the existing auxiliary silencer and exhaust piping will have to be reconfigured with the new engines because there will be added pressure losses associated with the SCR and Oxidation Catalyst after treatment systems. The existing Caterpillar engines have a back pressure limit of 27 inches of water column. The Jenbacher engines (which form the basis of design) have a back pressure limit of 24 inches of water column. Previous analysis of the exhaust system for the installation of heat recovery silencers indicate that the exhaust system will have about 20 inches of loss as currently configured, with over half that loss (12 inches) from the existing auxiliary silencer.

6.6 CIVIL/SITE CONSIDERATIONS

All facilities will be designed and implemented in accordance with the Design Standards developed as part of the Master Plan.

6.6.1 Piping Layout

The following major process and utility pipes would be routed to the gas conditioning system:

- Utility Water (3W) from the No. 3 Water System.
- Mixed Gas (MG) from the Air Blended Natural Gas, Landfill Gas, and Biogas Sources.

The following major process and utility pipes would be routed from the gas conditioning system:

- Treated Mixed Gas (MG).

6.6.2 Support Utilities

The only major support utilities for the gas conditioning system consist of Plant Utility Water (3W) to all hose bibbs in the area.

6.7 ELECTRICAL CONSIDERATIONS

All facilities would be designed and implemented in accordance with the Electrical Design Standards developed as part of the Master Plan.

All facilities would be designed and implemented in accordance with the Instrumentation and Control Design Standards developed as part of the Master Plan.

6.7.1 Electrical Distribution/Standby

The only standby power at the WPCP is an 80 kW engine driven generator. It is used to provide power for auxiliary systems for the PSTs and allows the influent pump engines and related equipment to be operational during power outages. The standby generator can also be used to start the PGF facility after a power outage occurs. However the generator does not have capability to provide power to the start the PGF facility and support the influent pump engines and their support equipment simultaneously.

The PGF has been used to provide plant power during power outages. It is not as reliable as dedicated stand by generators and not capable of bringing on significant block loads. Also, use of a cogeneration facility (with no backup) is not considered as a reliable source of standby power. For these reasons, the first phase of separate diesel powered standby power is being installed under the Primary Facilities project.

The existing cogeneration facility is connected to the existing 4160 volt bus. A new 12-kV distribution system is being installed as part of other plant improvements. The new cogeneration system will be connected to the 12-kV distribution system. The generators will produce power at the 12-kV level and have dedicated cogen 12-kV switchgear installed in the same location as the existing switchgear. Conductors will be installed in new ductbank to the plant’s main 12-kV switchgear where it will connect to the main bus thru a 12-kV circuit breaker.

The generator controls will be installed as part of the Cogen 12-kV switchgear and will control the paralleling operation of the generators. The Cogen 12-kV switchgear will also control (such as synchronization) the connection to the plant main 12-kV system. The system will taken offline in case of PG&E service failure and only operate when PG&E service is available. When the plant is operating on standby power, the Cogen system will stay off line.

6.8 MAJOR O&M CONSIDERATIONS

The major operations and maintenance (O&M) considerations for the gas conditioning system and engine generator upgrade are summarized in the Tables 6.8 and 6.9.

**Table 6.8 Operations and Maintenance Considerations – Engine Generator
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Equipment	O&M Consideration
Engine Generator	• Maintain clear access around the engine for daily maintenance • Provide ability to remove and maintain all major engine components • Provide adequate pressure/temperature transmitter so as to effectively communicate engine operational status
Jacket Water Heat Exchanger	• Maintain clear access around the engine for daily maintenance • Provide adequate pressure/temperature transmitter so as to effectively communicate engine operational status

**Table 6.9 Operations and Maintenance Considerations – Gas Conditioning
WPCP Master Plan and Primary Treatment Facilities
City of Sunnyvale**

Equipment	O&M Consideration
Hydrogen Sulfide Removal System	• Maintain clear access around the vessel for daily maintenance • Provide adequate access for media replacement activities
Moisture Removal System	• Maintain clear access around the moisture removal system for daily maintenance
Siloxane Removal System	• Maintain clear access around the vessel for daily maintenance • Provide adequate access for media replacement activities

6.9 LAYOUT DRAWINGS

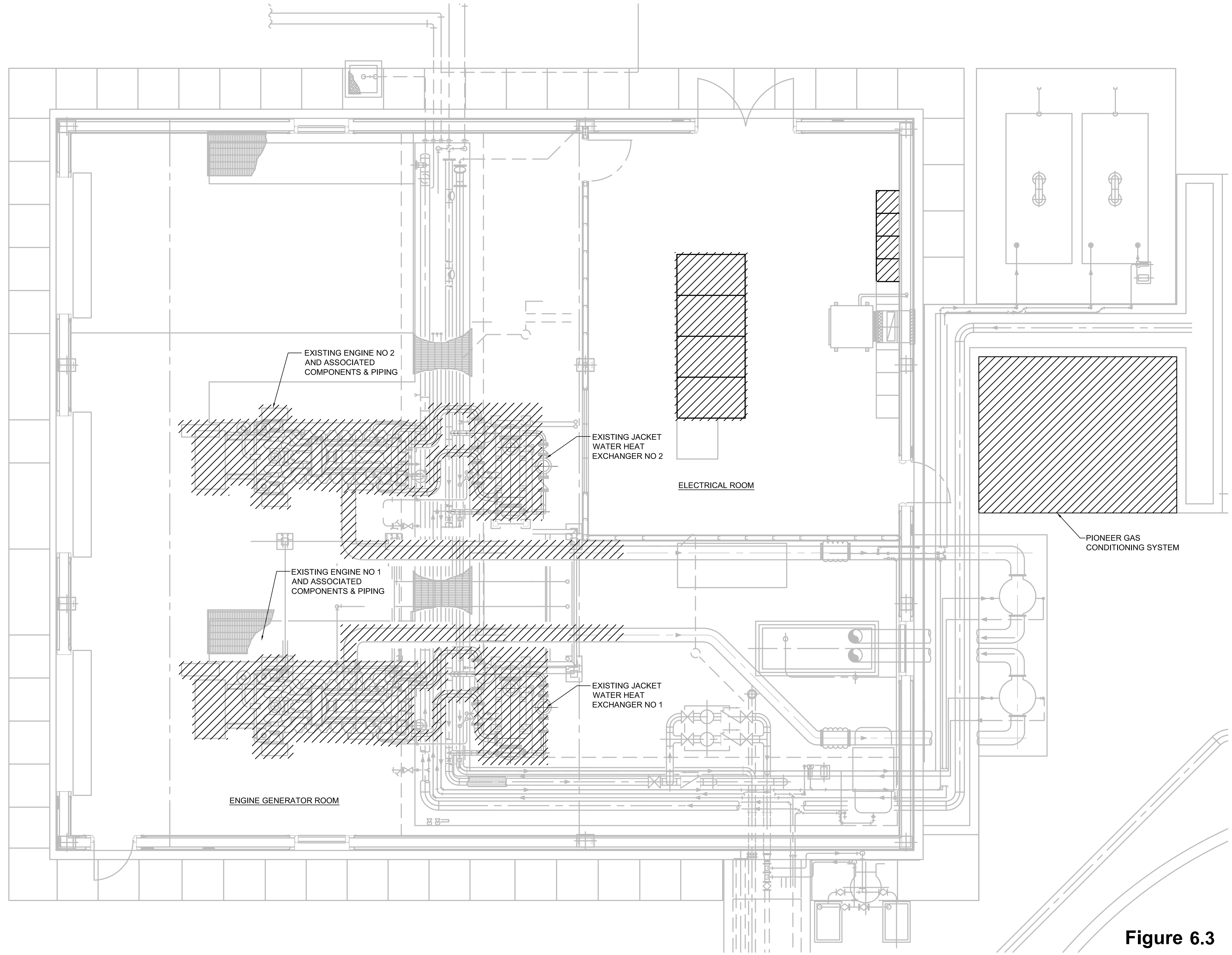

Figure 6.3

POWER GENERATIONS FACILITY

DEMO PLAN

PRIMARY TREATMENT DESIGN

CITY OF SUNNYVALE

SCALE: 1/8"=1'-0"

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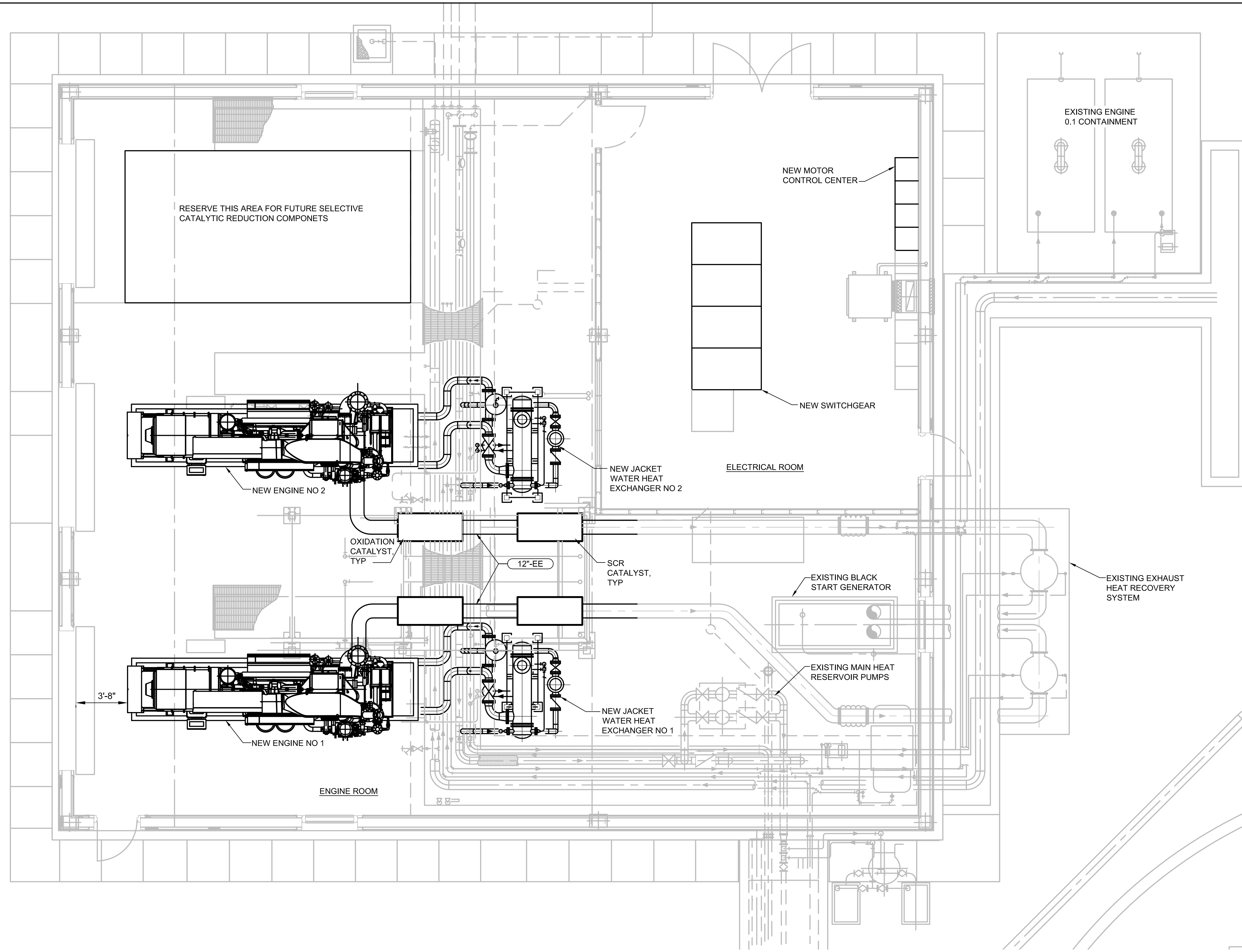

Figure 6.4

POWER GENERATIONS FACILITY

BUILDING PLAN

PRIMARY TREATMENT DESIGN

CITY OF SUNNYVALE

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SCALE: 1/8"=1'-0"

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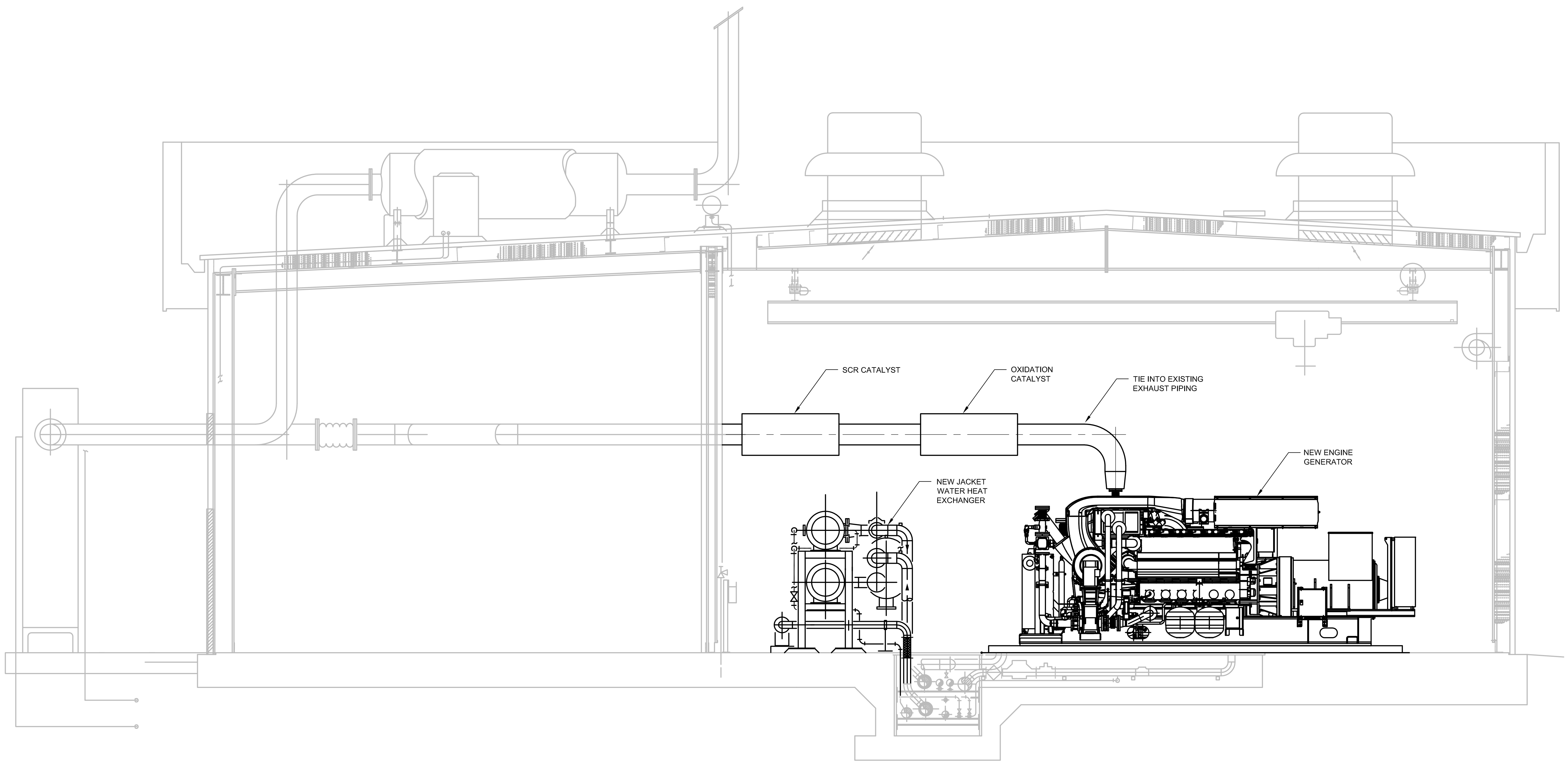

Figure 6.5
POWER GENERATION FACILITY SECTIONS

PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

SCALE: 3/16"=1'-0"

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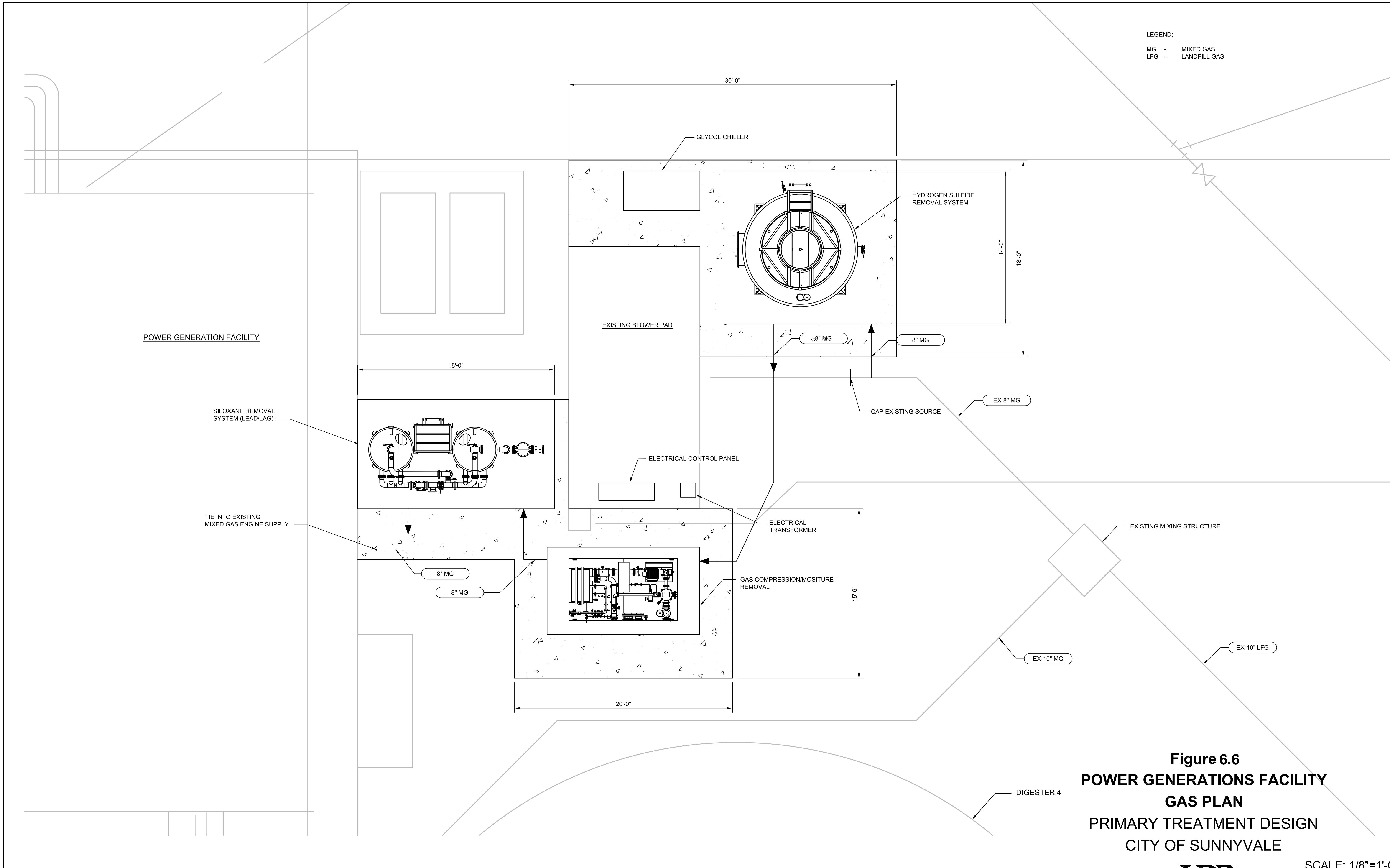

Figure 6.6
POWER GENERATIONS FACILITY GAS PLAN
PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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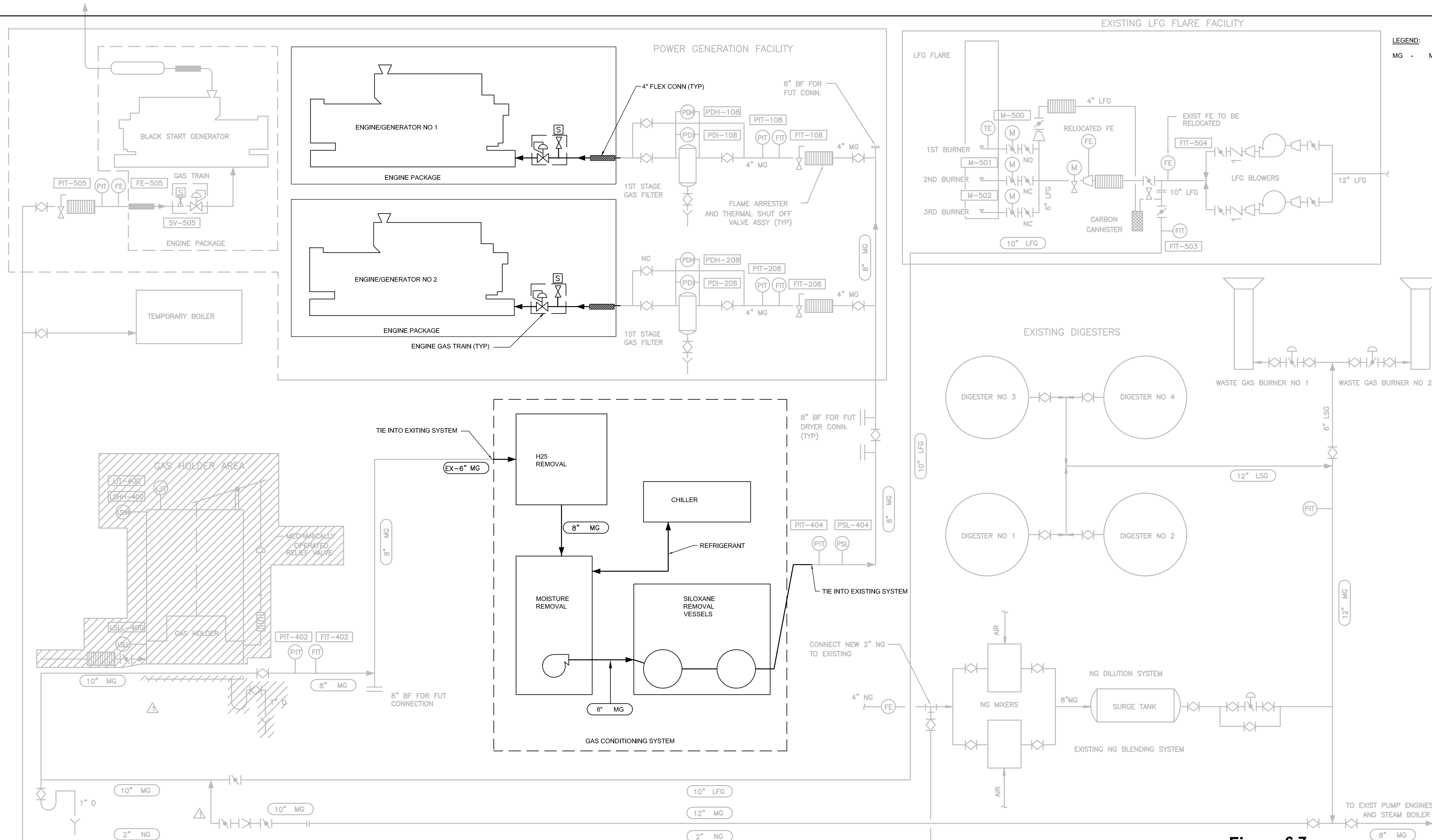

Figure 6.7
POWER GENERATIONS FACILITY
GAS FLOW SCHEMATIC
PRIMARY TREATMENT DESIGN
CITY OF SUNNYVALE

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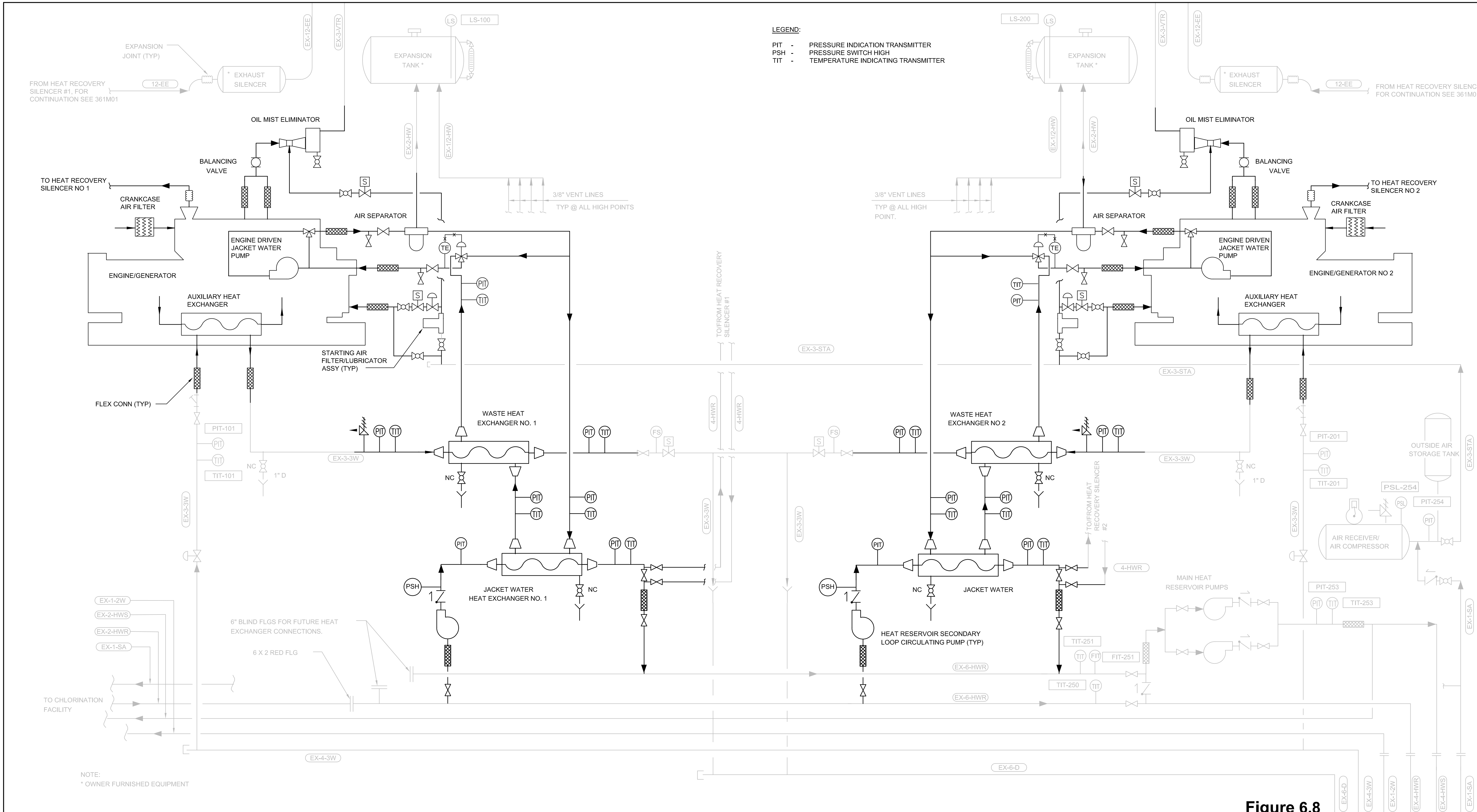

C:\pwworking\sac\d0620170\Fig 5-8 HOT WATER HEAT RECOVERY SCHEMATIC.dwg 02/13/2015 08:50 rsnider

Figure 6.8

POWER GENERATIONS FACILITY

HOT WATER HEAT RECOVERY SCHEMATIC

PRIMARY TREATMENT DESIGN

CITY OF SUNNYVALE

HDR

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SUPPORT FACILITIES

7.1 BACKGROUND

The purpose of this section is to provide the basis of design for new Administration-Operations-Lab and Maintenance buildings at the Donald M. Somers Water Pollution Control Plant (WPCP). This section includes an overview of the building program, conceptual building layout plans showing the approximate location and critical adjacencies for each building and identifies sustainability goals and key regulatory requirements to be addressed in the subsequent design development phases of these buildings.

This Basis of Design is based on the key findings and recommendations of the Master Plan. The proposed conceptual plans are based upon the space requirements and constraints outlined in the Master Plan Building Programming Technical Memorandum (TM). The Programming TM identifies approximate sizes and critical relationships for all distinct spaces within both buildings, and is the result of a process that included a survey of the existing WPCP facilities, workshops with staff, site observations, and documentation of existing and projected staff capacity. Refer to the Building Programming TM for more detailed information.

The Master Plan Site Layout Considerations TM identified the preferred location for each building within the site, in addition to related parking and landscaped areas. The preferred building sites were selected after the evaluation of various potential building locations and configurations. See the Site Layout Considerations TM for additional information.

The draft conceptual plans for both buildings were reviewed by the City in July 2014. Based upon this review, revised conceptual plans were presented to the City at a September 2014 workshop, along with proposed material options for exterior treatment of the Administration-Operations-Lab building. The final conceptual plans and materials descriptions included herein incorporate comments from the workshop as well as subsequent City feedback.

7.2 ADMINISTRATION BUILDING

7.2.1 Overview

The approximately 22,000 square foot (SF), two-story Administration-Operations-Lab building is proposed to be located at the southern edge of the WPCP on Carl Road at the former site of the existing household hazards waste storage area. The site is bordered on the east, west and south by a gradually sloping, grassy hill formed by the adjacent closed landfill. The building is oriented along the east-west axis, allowing for the longer elevations to take advantage of south and north facing solar geometry.

Programmatically, the building houses WPCP administration offices, primarily on the second floor, along with laboratory, operations, and staff support spaces on the first floor. The building program also includes a large meeting space for staff and public outreach events, an observation deck, and an informal outdoor gathering space. Critical programmatic constraints include providing vehicle access for laboratory sample receiving and outreach storage materials as well as to facilitate access to the main process facilities for the plant staff. Additionally, the building functions should be configured to allow public access to the Main Entry from parking areas outside of the main security gate.

7.2.2 Building Code Compliance

7.2.2.1 Preliminary Code Analysis

The buildings will be designed to comply with the most current codes and regulations in effect at time the projects are permitted. The preliminary code analysis is per the 2013 California Building Code (CBC).

- Construction Type: VB, with fire protection and suppression system.
- Occupancy Type: B – Business Group.
- Max allowed area: 9,000 SF per story, per CBC Table 503. Allowable area is increased to 33,750 SF per story with 30 foot frontage width and automatic sprinkler system protection per CBC section 506.
- Max allowable building height is two stories per CBC Table 503. Two stories are proposed.
- Exterior wall rating: Rated exterior walls are not required with fire separation distance greater than 30 feet per CBC Table 602.

7.2.2.2 Accessibility

All public and staff spaces shall comply with current CBC, ADAAG, or local regulatory authority accessibility code, including requirements for path of travel, exiting, fixtures, hardware, and signage. An accessible path of travel shall be provided from parking to public entry, public restrooms, and outreach meeting space. The second floor observation deck shall be accessible for visitor groups to view the plant processes in lieu of walking tours. Typical clearances and accessory mounting heights as required by code shall be provided at all doors, counters, showers, and restrooms. All code required accessible features would be provided at vertical circulation components, including stair handrails and elevator controls.

7.2.3 Sustainability

- Building energy performance shall be designed to meet requirements of current California Energy Code, Title 24 Part 6; and California Green Building Standards Code, Title 24 Part 11.
- The Administration building shall be designed to meet USGBC LEED Gold rating requirements, although the City may not pursue certification. Documentation should be kept for required design phase meetings and credits in the event the City decides to pursue certification during the construction phase. All pre-requisite credits should be incorporated into specifications where appropriate.
- Materials should be selected to meet LEED credit requirements for recycled content, locally sourced materials, and low-emitting materials.
- Office, laboratory and control spaces should be designed to optimize occupant comfort and productivity, including meeting LEED air quality, thermal comfort and access to views and daylight.
- Building systems performance should be designed to maximize energy performance and minimize water use per associated LEED credit requirements.
- Construction waste should be diverted to meet LEED credit requirements.

7.2.4 Conceptual Layout

See Figures 7.1 and 7.2 in Section 7.6 for the first and second floor conceptual layout plans of the proposed Administration-Operations-Lab building. The conceptual layouts show the following critical programmatic relationships and constraints:

- Operations/Control room is located on north side of building to facilitate operator access to the Plant. Plant vehicle parking, electric cart parking and charging station, and Mudroom/locker room access are adjacent to the Control Room and Plant Entry.

The Operations/Control room is fully enclosed and provides operator workstations, a group meeting space, the Control desk and related storage and support functions.

- The Mudroom at the building's north side serves as the Staff Entry from the Plant. Both men's and women's locker rooms have direct access off of mudroom, along with space for uniform storage, emergency equipment and wet weather gear storage. Plant vehicle parking is located near the Staff Entry.

- An internal stair is located adjacent to the Staff Entry and Laboratory to facilitate staff access between the Plant, Operations and Lab and the second floor office area.

- The Sample receiving space for the Laboratory is located at the building's west side, and provides direct access to the Laboratory. The Compliance Inspection lab has a separate entry. Dedicated vehicle parking for Lab pick-up and receiving and Environmental Compliance vehicles is located immediately adjacent to these spaces.

- The Laboratory has direct access to lab offices and sample receiving. The Compliance Inspection Lab is a separate, adjacent space with access to Sample Receiving. Lab office workstations take advantage of exterior walls for daylighting and views, with shared support space located at the interior.

- Access to the Laboratory should include pairs of doors sufficiently large to accommodate movement of equipment.

- The Outreach/Sustainability Storage, located on the building's west side, requires direct access to parking for staging and loading of materials for events.

- The public entry is located near accessible and visitor parking at the northeast corner of the building, and includes an exterior entry plaza. The first floor Lobby is minimally sized, providing stair and elevator access up to the main reception area on the second floor. Public restrooms are located off of the first floor Lobby.

- The second floor main reception area is sized to accommodate small tour groups and provides direct access to the Public Outreach Meeting space and exterior observation deck. The deck is located to provide views of the Plant and facilitate visual 'tours' of the facility.

- The administrative spaces on the second floor are organized to maximize daylight and views for all workspaces. A mix of open office work stations and four senior staff private offices wrap the building perimeter, with the interior core reserved for small meeting rooms, office support space, and ancillary building spaces including mechanical rooms, storage, stair, and restrooms. Daylighting into the interior spaces should be provided through the use of tubular skylights.

- The Compliance Inspection group is located in an open office area at the northwest corner of the second floor. This location is adjacent to the internal stair to facilitate access to the Compliance Inspection Lab on the first floor.
- Staff support spaces including kitchen, dayroom and restrooms, are located in the southwest corner. The kitchen has direct access to the dayroom, but can also be entered from the hall when the dayroom is in use. The dayroom opens to an exterior roof deck from which staff can access an outdoor gathering space at ground level via an external stair.

7.2.5 Building Envelope

- Exterior materials should be durable and low-maintenance, and should not facilitate the establishment of pest habitat.
- Exterior cladding system is to be a factory finished, concealed fastener metal panel siding. Cast-in-place concrete or CMU may be used as exterior accent wall at the entry areas.
- Fenestration treatment should be incorporate high performance glazing systems as appropriate for each functional area and in compliance with current energy code. External sunshading and/or internal light shelves should be provided to minimize heat gain and glare and maximize daylighting.
- Storefront or curtain wall glazing should be designed for bird collision deterrence per City regulation.
- Roof should be primarily flat with a membrane and/or vegetated roofing system. Some areas of pitched roof with metal roofing system may be incorporated where appropriate. Roof should be designed to support photovoltaic panels and mechanical equipment and a roof access stair or ladder should be provided.
- Building appearance should reflect modern, minimalist architectural design and be compatible with office building types in the vicinity.

7.2.6 Building Systems

- See Appendix B for an Outline Specification of building materials and system assumptions.

7.3 MAINTENANCE BUILDING

7.3.1 Overview

The approximately 8,000 SF, one-story maintenance building is proposed to be located within the WPCP at the southern perimeter, near the site of the existing Administration building. The building is located across Carl Road from the proposed Administration-Operations-Lab building, allowing for visual connection and staff movement between the two buildings. Similar to the proposed Administration building, the Maintenance building is oriented along the east-west axis, with longer north and south elevations.

Programmatically, the building houses maintenance shop and office space, an operations shop, instrumentation shop, warehouse storage and office space, staff gym, and storage for parts and equipment. Critical programmatic constraints include providing vehicle access for the Maintenance and Operations shops, warehouse, and storage areas and maintaining direct access between specific shop, storage, and office spaces.

7.3.2 Code Compliance

7.3.2.1 Preliminary Code Analysis

The buildings will be designed to comply with the most current codes and regulations in effect at time the project is permitted. The Preliminary Code analysis is per the 2013 California Building Code (CBC).

- Construction Type: IIB, with fire protection and suppression system.
- Occupancy Types:

Office areas	B – Business Group,
Haz Mat / Lube	H-2 – High Hazard Group
Shop / Warehouse	S-1 - Moderate Hazard Storage Group*
Instrumentation	S-1 Moderate Hazard Storage Group

**Assumes quantities of welding gases is less than the maximum allowable before classification*

- Max allowed area: Sum of the ratio of actual areas of separated occupancies divided by the allowable building area of each separated occupancy shall not exceed 1.
- Allowable area increase: Allowable area may be increased due to 30 foot frontage width and automatic sprinkler system protection per CBC section 506.
- Exterior wall rating: Not required with fire separation distance greater than 30 feet per CBC Table 602.

7.3.2.2 Accessibility

All office, workstations, and shared support spaces including the gym and restroom shall be made accessible per current CBC, ADA, or local regulatory authority accessibility code. Shops and plant vehicle parking spaces do not need to be made accessible, as per code. An accessible path of travel shall be provided from the Administration building to the Maintenance building staff entry. Accessible gate hardware shall be provided along the path of travel at the perimeter fence. Typical clearances, accessory mounting heights, and signage as required by code shall be provided at all doors, counters, and restrooms.

7.3.3 Sustainability

- Building energy performance shall be designed to meet requirements of current California Energy code, Title 24 Part 6; and California Green Building Standards Code, Title 24 Part 11.

- The Maintenance building does not have to meet USGBC LEED rating requirements and will not be certified. However, recycled and local materials should be used where possible. Office spaces should be designed to optimize occupant comfort and productivity, including maximizing daylighting and views, using low VOC interior finishes and performing flush out before occupancy.

7.3.4 Conceptual Layout

See Figure 7.3 in Section 7.6 for the conceptual layout plan of the proposed Maintenance building. The conceptual layout shows the following critical programmatic relationships and constraints:

- Location of staff entry at building's West side facilitates access to the administration building. Plant vehicle parking is located near a small outdoor entry area. Support spaces including the gym and staff restroom are located directly off of the entry to facilitate shared use with Administration building staff.

- The Operations Shop is located at the west side of the building to facilitate operator movement between the Operations/Control room at the proposed Administration building, the shop and the Plant. Vehicle access is provided on the north side along the proposed access road.

- The Maintenance Shop should be approximately twenty (20) feet in height to allow use of a bridge crane and would likely be taller than adjacent office, warehouse, instrumentation and operations shop spaces. Minimum height for all spaces from floor to roof is fifteen (15) feet. The Maintenance Shop is adjacent to the Warehouse and exterior storage area to allow for movement of materials between these spaces. Vehicle access is provided at the shop's north side along the proposed access road.

- The covered, exterior equipment storage is sized for long pipes and metal stock and configured to allow direct access to the Shop. It is located at the northeast corner to provide vehicle access from two sides. Adjacent uncovered exterior space can be used for staging and storage of additional, unsecured equipment and materials.

- The combined warehouse and parts / equipment and materials storage space is located at the southeast corner of the building near the access gate. The Warehouse office space should have a line of sight to the gate.

- Vehicle access is provided at the east side of the building for parts/equipment and materials storage. Direct access is provided to the shop to allow for the transfer of equipment and parts.

- Hazardous material and lubrication storage is located at the building's north side for vehicle drop-off and loading. This area does not require direct connection with any other program within the building, but should be located near both Shop spaces.

- The maintenance office has direct access to the Shop and includes an area for map and plan storage. Senior staff workstations, group office area and computer work stations should have access to daylight and exterior views. Senior staff workstations should also have a direct view into the Maintenance shop.

- The Instrumentation shop is a conditioned space located directly off of the maintenance shop at the building's north side. This space may be daylighted and have views to the exterior.

7.3.5 Building Envelope

- Exterior building materials should be similar to materials selected for the process buildings within the plant, including cast-in-place concrete or CMU. Refer to the Architectural Design Standards for additional information about process building materials.

- Exterior materials should be durable and low-maintenance, and should not facilitate the establishment of pest habitat.

- The Maintenance building is located at the Plant's southern perimeter, and will be visible from Borregas Avenue and the Plant entry. Accordingly, architectural consideration should be given to prominent building elements, including the south façade and west entry area.

- The design of the building exterior should be cohesive with both the Plant process buildings and new Administration-Lab-Operations building. Exterior building materials used on the Administration building should be incorporated into the Maintenance building office and gym areas where visible and functionally appropriate.

7.4 CIVIL/SITE CONSIDERATIONS

7.4.1 Overview

The Administration and Maintenance building improvements will be completed in conjunction with related site improvements at the WPCP. Those site improvements include upgrades to the WPCP's electrical distribution, construction of a buried utilidor system to convey support utilities (i.e., potable water, fiber optics, power, etc.), parking for staff and public and related landscaping elements. Specific site considerations are addressed in the following sections.

7.4.2 Administration Building Construction

The proposed location for the Administration building is on the former site of the Household Hazards Waste Disposal Facility. This location is sited on a closed landfill and as a result, special provisions are required to re-purpose its use for the Administration building.

A geotechnical site investigation was performed in late 2014, which included four soil borings. The results of that investigation are included in the Geotechnical Study for the Master Plan and Facilities Upgrade Project. The primary impact of using this location is that all the waste material below the proposed building site must be removed to a permitted landfill and proper fill material imported before foundation work can begin. This construction would also trigger the need to prepare an amendment to the closure/post closure plan for the landfill.

Due to the proximity to the existing landfill site, the building would also be required to comply with Title 27 requirements for a subsurface gas barrier, continuous gas monitoring and alarm systems.

7.4.3 Building Flood Protection

The proposed Maintenance building will be located within the confines of the floodwall to be constructed along the perimeter of the WPCP. However the Administration building would be located outside of the protected area of the floodwall. Therefore, special provisions must be developed be to provide 100-year tidal flood protection for the Administration Building.

Layout Considerations TM. It is intended that these parking concepts are further refined and implemented as part of the Administration and Maintenance building project improvements.

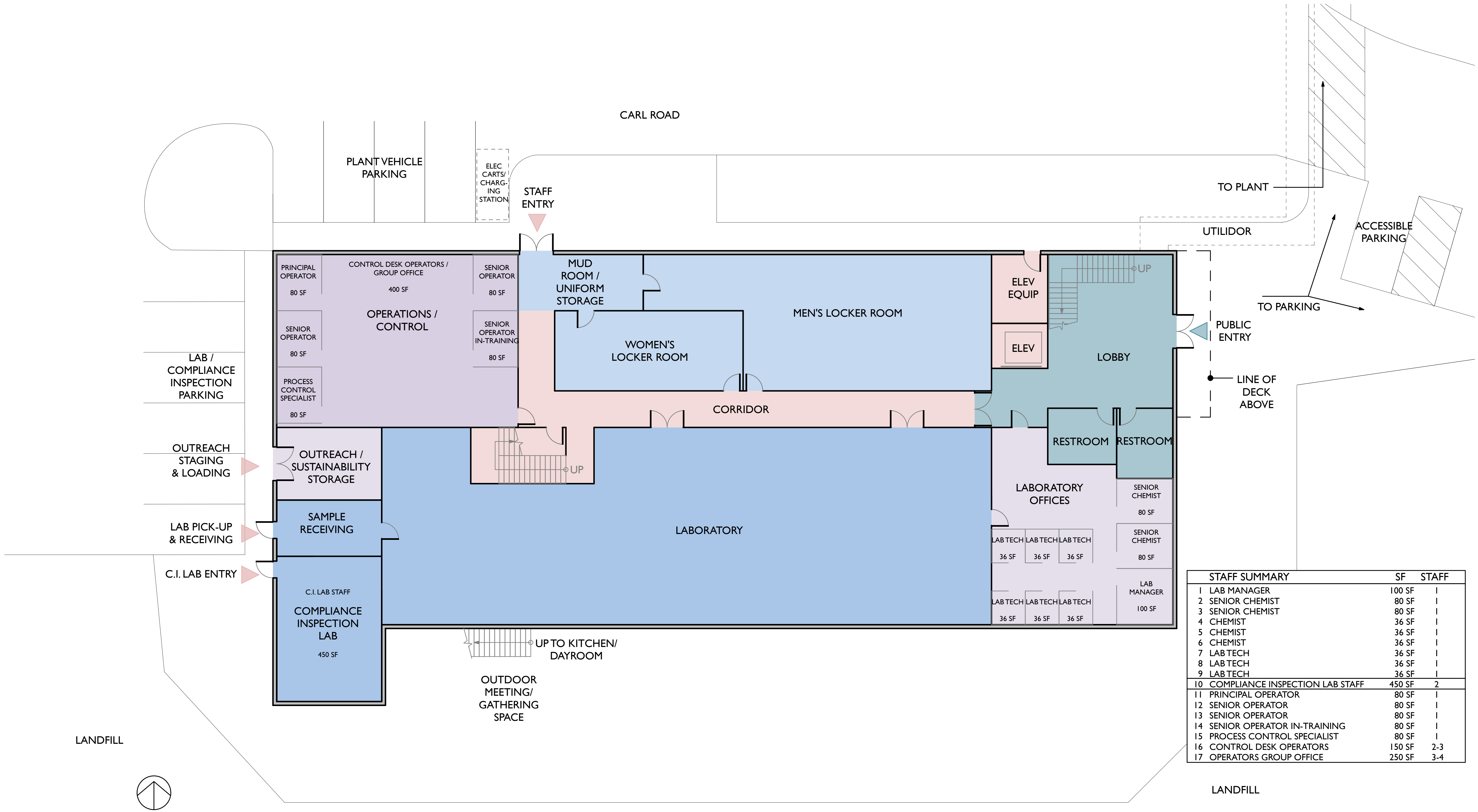
7.5 ELECTRICAL CONSIDERATIONS

7.5.1 Power Supply

Based on the Master Planning recommendations, the WPCP electrical distribution backbone will be upgraded from the existing 4,160-V system to a 12-kilovolt (kV) system. The first phase of that upgrade is occurring with the Primary Treatment Improvements project. The new 12-kV service will be distributed in ductbanks to a number of 480 volt transformers and switchgear locations around the WPCP site.

One of those new 480-V transformer and switchgear locations will be sited just west of the proposed Maintenance building. The 480-V power will then be distributed to the Administration and Maintenance buildings where additional transformers will be used to supply the necessary building power needs.

7.6 LAYOUT DRAWINGS



	STAFF SUMMARY	SF	STAFF
1	LAB MANAGER	100 SF	1
2	SENIOR CHEMIST	80 SF	1
3	SENIOR CHEMIST	80 SF	1
4	CHEMIST	36 SF	1
5	CHEMIST	36 SF	1
6	CHEMIST	36 SF	1
7	LAB TECH	36 SF	1
8	LAB TECH	36 SF	1
9	LAB TECH	36 SF	1
10	COMPLIANCE INSPECTION LAB STAFF	450 SF	2
11	PRINCIPAL OPERATOR	80 SF	1
12	SENIOR OPERATOR	80 SF	1
13	SENIOR OPERATOR	80 SF	1
14	SENIOR OPERATOR IN-TRAINING	80 SF	1
15	PROCESS CONTROL SPECIALIST	80 SF	1
16	CONTROL DESK OPERATORS	150 SF	2-3
17	OPERATORS GROUP OFFICE	250 SF	3-4

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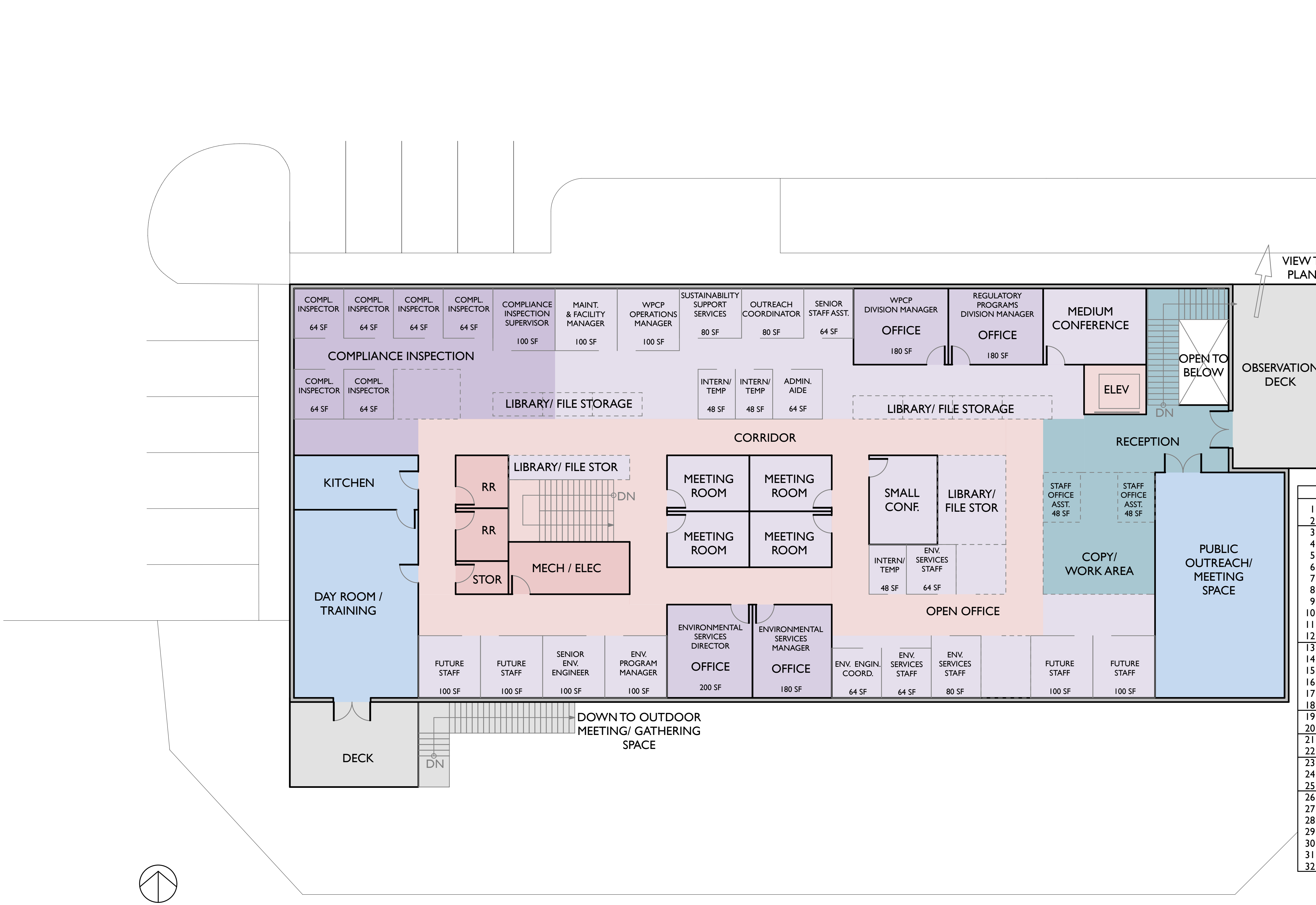
Concept Plan FINAL- Administration / Operations / Lab Building - 1st Floor

City of Sunnyvale WPCP Master Plan

Concept Design
date: February 2015
scale: 1/16" = 1'-0"



	STAFF SUMMARY	SF	STAFF
1	STAFF OFFICE ASSISTANT	48 SF	1
2	STAFF OFFICE ASSISTANT	48 SF	1
3	WPCP DIVISION MANAGER	180 SF	1
4	REGULATORY PROGRAMS DIVIS. MANAGER	180 SF	1
5	ENVIRONMENTAL PROGRAM MANAGER	100 SF	1
6	SENIOR ENVIRONMENTAL ENGINEER	100 SF	1
7	WPCP OPERATIONS MANAGER	100 SF	1
8	MAINTENANCE & FACILITY MANAGER	100 SF	1
9	FUTURE STAFF	100 SF	1
10	FUTURE STAFF	100 SF	1
11	FUTURE STAFF	100 SF	1
12	FUTURE STAFF	100 SF	1
13	ENVIR. ENGINEERING COORDINATOR	64 SF	1
14	ADMINISTRATIVE AIDE	64 SF	1
15	SENIOR STAFF ASSISTANT	64 SF	1
16	INTERN / TEMP	48 SF	1
17	INTERN / TEMP	48 SF	1
18	INTERN / TEMP	48 SF	1
19	OUTREACH COORDINATOR	80 SF	1
20	SUSTAINABILITY SUPPORT SERVICE	80 SF	1
21	ENVIRONMENTAL SERVICES DIRECTOR	200 SF	1
22	ENVIRONMENTAL SERVICES MANAGER	180 SF	1
23	ENVIRONMENTAL SERVICES STAFF	80 SF	1
24	ENVIRONMENTAL SERVICES STAFF	64 SF	1
25	ENVIRONMENTAL SERVICES STAFF	64 SF	1
26	COMPLIANCE INSPECTOR SUPERVISOR	100 SF	1
27	COMPLIANCE INSPECTOR	64 SF	1
28	COMPLIANCE INSPECTOR	64 SF	1
29	COMPLIANCE INSPECTOR	64 SF	1
30	COMPLIANCE INSPECTOR	64 SF	1
31	COMPLIANCE INSPECTOR	64 SF	1
32	COMPLIANCE INSPECTOR	64 SF	1

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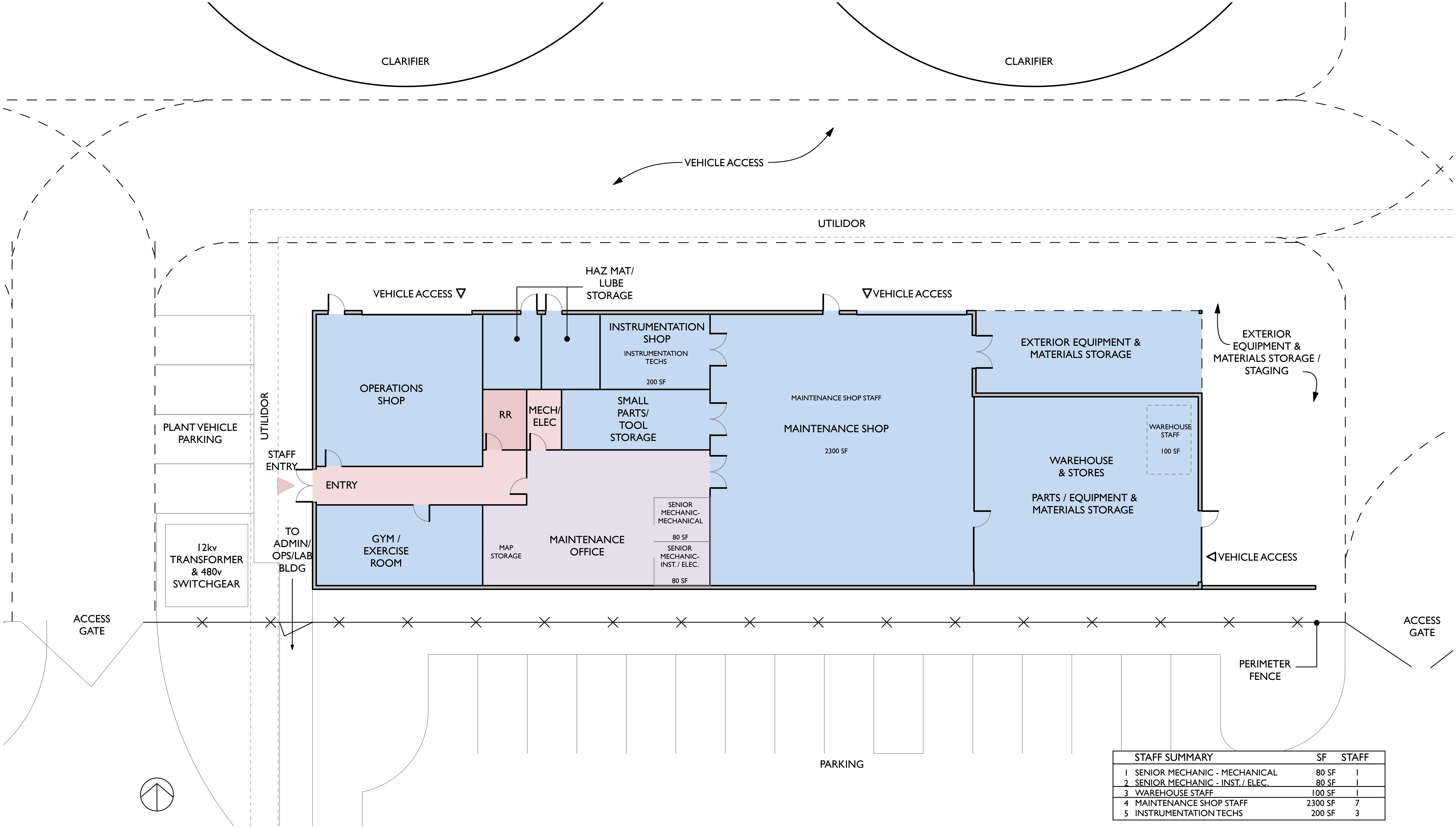
Concept Plan FINAL - Administration / Operations / Lab Building - 2nd Floor

City of Sunnyvale WPCP Master Plan

Concept Design
date: February 2015
scale: 1/16" = 1'-0"



	STAFF SUMMARY	SF	STAFF
1	SENIOR MECHANIC - MECHANICAL	80 SF	1
2	SENIOR MECHANIC - INST. / ELEC.	80 SF	1
3	WAREHOUSE STAFF	100 SF	1
4	MAINTENANCE SHOP STAFF	2300 SF	7
5	INSTRUMENTATION TECHS	200 SF	3

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Concept Plan FINAL- Maintenance Warehouse Building

City of Sunnyvale WPCP Master Plan

Concept Design
date: February 2015
scale: 1/16" = 1'-0"

7.7 REFERENCES

The following WPCP documents may be useful in the design of WPCP process buildings and structures:

- WPCP Master Plan Site Layout TM.
- WPCP Programming TM.
- WPCP Structural Design Standards.
- WPCP Civil Design Standards.
- WPCP Architectural Design Standards.
- WPCP Landscape Design Standards.

All architectural design and construction will be performed in accordance with the most current version of the following codes and standards. The most stringent code or standard requirement has priority:

- City of Sunnyvale Standard Details and Specifications http://sunnyvale.ca.gov/Departments/PublicWorks/CityStandardDetailsandSpecifications.aspx
- City of Sunnyvale Municipal Code http://qcode.us/codes/sunnyvale/
- City of Sunnyvale Consolidated General Plan http://sunnyvale.ca.gov/CodesandPolicies/GeneralPlan.aspx
- City of Sunnyvale Citywide Design Guidelines (SDG) http://sunnyvale.ca.gov/Portals/0/Sunnyvale/CDD/Non-Residential/CityWideDesignGuidelines.pdf
- California Building Code with California amendments and errata, Part 2, California Building Standards Code, Title 24, California Code of Regulations http://www.bsc.ca.gov/Home/Current2013Codes.aspx
- California Green Building Standards Code with California amendments and errata, Part 11, California Building Standards Code, Title 24, California Code of Regulations http://www.bsc.ca.gov/Home/Current2013Codes.aspx

- State of California Occupational Safety and Health Administration (CAL/OSHA) http://www.dir.ca.gov/dosh/
- ADA Accessibility Guidelines for Buildings and Facilities United States Access Board http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag
- Federal Occupational Safety and Health Administration (OSHA) https://www.osha.gov/
- American National Standards Institute (ANSI) http://www.ansi.org/
- American Society for Testing and Materials (ASTM) http://www.astm.org/
- Green Seal http://www.greenseal.org/
- United States Green Building Council LEED Reference Guide for Building Design and Construction http://www.usgbc.org/credits/new-construction/v4

APPENDIX A - PROCESS CRITICALITY ASSESSMENT

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Headworks														
Subsystems:														
Screening														
Bar Screens	4	1	15	PHF	20 mgd each; 3/8" clear opening	1 standby screen, 1 bypass channel	Yes	FM	45	45	Yes	45	60	Screen blinding, drive failure.
Screenings Conveyor	1	0	15	PHF		1 dedicated to all 4 screens; Provide diverter chute when conveyor offline	Yes	FM	15	15	Yes	15	15	Drive failure
Screenings Washer/Compactor	2	0	3	PHF		No standby	No	n/a	n/a	n/a	No	6	6	Motor failure, blinding/plugging
Pumping														
Inlet Gates	4	0	2	PHF		PHF can pass through 2 gates?	Yes	FM	8	8	Yes	8	8	Motor failure
Wetwell	2			PHF		Divider gate between wetwells	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Influent Pumps	6	1	275	PHF	4 pumps 12 mgd each, 2 pumps 6 mgd each (6 12 mgd pumps at buildout)	1 standby (largest pump)	Yes	FM	1375	1375	Yes	1375	1650	Overheating, clogging, motor failure, impeller wear
Flow Meters	1?			PHF		Meter bypass?	No	n/a	n/a	n/a	Yes	1	1	
Mag meter isolation valves	2	0	1	PHF		No standby	No	n/a	n/a	n/a	Yes	2	2	Assume in-line flow metering with magnetic meter. Only isolation valves required to divert flow for access to meter.
Grit Removal														
HeadCell	3	1		PDF	60 mgd hydraulic capacity; 40 mgd treatment capacity	1 standby	No	n/a	n/a	n/a	n/a	n/a	n/a	
Inlet Gates	3	0	4	PHF		1 per HeadCell Unit; No standby	No	n/a	n/a	n/a	Yes	12	12	Motor failure
Grit Pumps	6	3	50	PHF		2 per HeadCell Unit; 1 standby per HeadCell unit	No	n/a	n/a	n/a	Yes	150	300	Overheating, clogging, motor failure, shaft wear
Grit Pump Station Sump Pump	2	1	3	n/a	Drain wet well in 4 hours	1 standby	No	n/a	n/a	n/a	Yes	3	6	Motor failure
Grit Washing Unit	2	1	5	n/a		1 standby	No	n/a	n/a	n/a	Yes	5	10	Horsepower estimated. 1 Coanda unit requires about 2 hp (estimated 5 hp to be conservative).
Recycle Stream Pump Station									n/a	n/a				
Inlet Gates	2	1	5	n/a		1 standby	No	n/a	n/a	n/a	Yes	5	5	Motor failure
Recycle Pumps	2	1	25	n/a		1 standby	Yes	FM	25	25	Yes	25	50	Horsepower roughly estimated
Recycle Wet Well Sump Pumps	2	1	5	n/a	Drain wet well in 4 hours	1 standby	No	n/a	n/a	n/a	Yes	5	10	Motor failure

Process Criticality Assessment
Sunnyvale Master Plan

3/11/2015

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
HVAC System	1 System (multiple fans)		25	n/a	Building area and occupancy, 12 air changes per hour	multiple fans; half duty, half standby	Yes	HH	25	25	Yes	25	50	Fan failure
Odor Control System (for Headworks and Primaries)														
Exhaust Fan (Biotower Fan)	1	0	100	n/a	Building area and occupancy, 12 air changes per hour	No standby	No	n/a	n/a	n/a	Yes	100	100	
Scrubber Fan	1	0		n/a		No standby	No	n/a	n/a	n/a	Yes			
Odor Control Sump Pump	1	0		n/a		No standby	No	n/a	n/a	n/a	Yes			
Scrubber Recirculation Pump	1	0		n/a		No standby	No	n/a	n/a	n/a	Yes			
Total									**1493**	**1493**		**1782**	**2285**	

Abbreviation:

Standby Power Category
- HH - Human Health
- FM - Flow Management
- PP - Process Protection
- EP - Equipment Protection

Flow/Load
- PHF - Peak Hourly Flow
- PDF/L - Peak Daily Flow/Load
- MMF/L - Max Monthly Flow/Load
- ADF - Average Day Flow
- ADWF/L - Average Dry Weather Flow/Load

Process Criticality Assessment
Sunnyvale Master Plan

3/11/2015

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Primary Sed														
Subsystems:														
Primary Sed Tank	6			MMF	2000 gpd/sf	All tanks in service during max month; 115' long x 19' wide x 14' deep	n/a	n/a	n/a	n/a	Yes	n/a	n/a	n/a
Collector Mechanisms	6	0	2	MMF	Primary clarifier basin dimensions and water depth	No backup required; 1 sludge collector, flights and chains per tank	Yes	EP	12	12	Yes	12	12	Damaged collector, broken chains, debris and rags entangled around collector, sludge line plugged, drive failure
Cross Collector	6	0	1	MMF	Primary clarifier basin width, hopper size, and water depth	No backup required; 1 cross collector per tank	Yes	EP	6	6	Yes	6	6	Scraper worn or damaged, drive failure
Sludge Pumping	6	3	7.5	PDF/L	Pumping capacity	2 per 2 tanks; positive displacement, 40 gpm; 1 standby per 2 tanks	Yes	EP	22.5	22.5	Yes	22.5	45	Sludge line plugged, motor failure
Scum Pumping	4	2	5	PDF/L	Pumping capacity	2 per 3 tanks; positive displacement, 15 gpm; 1 standby per 3 tanks	Yes	EP	n/a	10	Yes	10	20	Scum line plugged, motor failure
Scum pipe/helical skimmer	6	0	0.75	n/a	Skimming capacity	No backup required; 1 per tank	Yes	EP	n/a	4.5	Yes	4.5	4.5	Buildups in scum pipe, motor failure
CEPT Facilities														
Iron Salt Feed Pumps	2	1	1	MMF & one tank offline	0.2 mg/L dose	1 standby	No	n/a	n/a	n/a	Yes	n/a	2	Motor failure, line leakage
Polymer Feed Pumps	2	1	1	MMF & one tank offline	20 mg/L dose	1 standby	No	n/a	n/a	n/a	Yes	n/a	2	Motor failure, line plugged or leakage
Polymer Blending Unit	1	0	1	n/a		No backup required	No	n/a	n/a	n/a	Yes	n/a	1	Motor failure, line plugged or leakage
Blower for Channel Aeration	2	1	25	MMF	Air requirements for channel aeration	1 standby	Yes	EP	n/a	25	Yes	25	50	Motor failure
Spray water booster pump	2	1	1.5	n/a	Any one pump to meet flow demand and pressure	1 standby	No	n/a	n/a	n/a	Yes	n/a	3	Motor failure
HVAC	1 System (multiple fans)		25	n/a	Building area and occupancy	multiple fans; half duty, half standby	Yes	HH	25	25	Yes	25	50	Fan failure
Total									**65.5**	**105**		**105**	**195.5**	

Abbreviation:
Standby Power Category
HH - Human Health
FM - Flow Management
PP - Process Protection
EP - Equipment Protection
Flow/Load
PHF - Peak Hourly Flow
PDF/L - Peak Daily Flow/Load
MMF/L - Max Monthly Flow/Load
ADF - Average Day Flow
ADWF/L - Average Dry Weather Flow/Load

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Diurnal EQ/ EQ Return Pump Station														
Subsystems:														
Storage Tanks	3 - 2.7 Mgal Tanks	0		Peaks Above 34.7 mgd	160 DIA x 25 SWD, prestressed concrete	No standby. Tanks used in sequence depending on needs.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Spillway into emergency storage basin OR pass flow through Plant.
EQ Return Pump Station	3	1	30	Variable	4 mgd, each @ 27 ft	1 standby	Yes	n/a	n/a	60	Yes	60	90	Motor Failure
Total									**0**	**60**		**60**	**90**	

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Flow/Load
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PDF/L - Peak Daily Flow/Load
MMF/L - Max Monthly Flow/Load
ADF - Average Day Flow
ADWF/L - Average Dry Weather Flow/Load

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Conv. Act. Sludge														
Subsystems:														
Aeration Basins	4 - 2.6 MG basins			MMF/MML	Aerobic SRT = 7 day	1 basin out of service for ADWF/ADWL (either aeration basin OR secondary clarifier)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Secondary Clarifiers	6 - 95 ft diameter clarifiers			MMF/PDF	SVI = 150 mL/g	1 clarifier out of service for ADWF/ADWL (either a clarifier OR an aeration basin)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS pumps	9 - 25 hp pumps			Peak RAS flow in 2035	50% of peak flow	3 standby	Yes	PP	n/a	150	Yes	150	225	Motor failure
WAS pumps	6 x 7.5 hp			Peak WAS flow in 2035	peak WAS flow = 0.6 mgd, RAS = 10,000 mg/L, 8 hour/day operation	3 standby	Yes	PP	n/a	30	Yes	30	45	Motor failure
IR pump	4 x 50 hp pumps			MMF	290% of MMF	1 aeration basin or secondary clarifier out of service for ADWF	Yes	PP	n/a	200	Yes	200	200	Motor failure
Mixers	12 - 15 hp; 4 - 7.5 hp; 6 - 25 hp submersible mixers			MMF	40 hp/Mgal	1 aeration basin or secondary clarifier out of service for ADWF	Yes	PP	n/a	360	Yes	360	360	Motor failure
Aeration blowers	5	1	300	Peak aeration demand 2035	DO of 2 mg/L at MMFs, peak of 1.3 x MMF	1 standby	Yes	PP	n/a	300	Yes	1200	1500	Plan on needing backup power to 1 of 4 blowers. NOTE: This assumes that can violate the max day limit
Total									**0**	**1040**		**1940**	**2330**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
MBR														
Subsystems:														
Fine Screens	3	1	5	PDF	peak flow 2035	1mm screens; 1 standby	Yes	PP	n/a	10	Yes	10	15	
Fine Screen Washer Compactors	3	0	3	n/a			No	n/a	n/a	9	Yes	9	9	
Aeration basin	4			MMF/MML	Aerobic SRT = 7 days	0.9 MG basins; 1 aeration basin out of service for ADWF/ADWL	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS Step Screens	4	1	5	PDF	peak flow 2035	3mm screens; 1 standby, both screens operated regularly	Yes	PP	n/a	15	Yes	15	20	
Step Screenings Conveyor	1	0	5	n/a		1 compactor; No standby	No	n/a	n/a	5	Yes	5	5	
Membrane Tanks	7			MMF	MMF flux = 16 gfd	275,000 sf of membranes; 1 membrane tank out of service for MMF, PDF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS pumps	6	1	200	MMF	4Q at MMF	1 standby	Yes	PP	n/a	750	Yes	1000	1200	
WAS pumps	3	1	15	Peak WAS flow	Peak WAS flow in 2035	1 standby	Yes	PP	n/a	30	Yes	30	45	
Permeate pumps	7	0	40	PDF	peak flow 2035	1 pump per MBR tank; No standby	Yes	PP	n/a	280	Yes	280	280	
Mixers	20	0	5	MMF	0.5kwh/kcf	1 mixer per un-aerated zone; No standby (9 duty per basin); 1 aeration basin out of service for ADWF	Yes	PP	n/a	100	Yes	100	100	
Aeration blowers (aeration basin)	6	1	300	Peak aeration demand	DO of 2 mg/L at MMFs, peak of 1.3 x MMF	1 standby	Yes	PP	n/a	300	Yes	1500	1800	Plan on needing backup power to 1 of 5 blowers. NOTE: this assumes can violate max day ammonia limit.
Membrane air scour blowers	4	1	250	MMF		1 standby	Yes	PP	n/a	500	Yes	750	1000	Plan on providing standby power to 2/3 of the blowers.
Membrane drain pumps		1	30	n/a		1 standby	Yes	PP	30	30	Yes	0	0	
Membrane CIP pump			30				Yes	PP	30	30	Yes	0	0	
CIP Spent Storage Sump Pump														
MBR Pump Gallery Sump Pump	2		1				Yes	PP	2	2	Yes	0	0	
MBR Citric Acid Sump Pump	1		2				Yes	PP	2	2	Yes	0	0	
MBR Sodium Hypochlorite Sump Pur	1		2				Yes	PP	2	2	Yes	0	0	
Emergency bypass pumping (for flows in excess of 3-day emergency storage)														
Total									**66**	**2065**		**3699**	**4474**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Filtration														
Subsystems:														
Filter Polymer Pumps	2	1	1	5 ppm @ MMF		1 standby	No	n/a	n/a	n/a	No	1	2	Motor failure
Filters	4			MMF	match aeration basin capacity	32 length x 15 width; 1 standby during summer low flows, no standby during wet weather	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Filter blinding, backwash valve failure
Filtered Water Lift Pumps	5	1	40	MMF	8 mgd each @16 ft	1 standby at equalized PHF	Yes	FM	90	180	Yes	180	200	Motor failure, overheating, bearing failure
Backwash Pumps	3	1	50		8400 gpm @ 20 ft	1 standby	Yes	PP	n/a	10	Yes	10	150	Motor failure, overheating, bearing failure, Assume running 10% of the time per plant staff conversations that backwashing occurs for about 2 hours per filter and about 1 filter per day is backwashed.
Filter Backwash Air Blower	2	0	50	MMF	2,500 scfm max 1,500 scfm normal	0 standby	Yes	PP	n/a	10	Yes	10	150	
Total									**90**	**200**		**201**	**502**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Disinfection														
Subsystems:														
Current Planning Considerations:														
Chlorine Contact Tank	4	1		MMF	<60 min contact time for discharge, 120 min contact time for recycled water	1 standby during ADWF	n/a	n/a		n/a	n/a	n/a	n/a	
Sodium Hypochlorite System														
Sodium Hypochlorite Storage Tanks	3			ADF	1,050 gpd for effluent disinfection and 230 gpd for filter influent chlorination	each 6,000 gallons working volume (actual volume is 6,500 - 6,600 gallons); 10 ft diameter, 11 ft tall; one of three tanks will be kept full all the times.	No	FM	n/a	n/a	n/a	n/a	n/a	Overfill due to level transducer failure
Filter Influent Chlorination - Tote				ADF	Min one day storage, will be refilled from hypochlorite storage tanks	330 gallon tote	No	n/a	n/a	n/a	n/a	n/a	n/a	Overfill due to level transducer failure
Filter Influent Chlorination - Metering Pumps	2	1	0.33	ADF	To meet min and max day sodium hypochlorite demand	peristaltic pumps, each 2 - 100 gph discharge flow; 1 standby	No	n/a	n/a	n/a	yes	0.33	0.66	Motor failure, tube leakage
Sodium Hypochlorite Transfer Pumps	3	1	1.5	N/A	One pump to transfer hypochlorite between storage tanks and recirculate within the tank and one pump to refill filter influent chlorination tote	FRP centrifugal pump, each 100 gpm discharge flow; 1 standby	Yes	FM	n/a	1.5	yes	3	3	Motor failure
Filter Backwash Supply Chlorination - Metering Pumps	2	1	0.33	N/A	To meet min and max sodium hypochlorite demand	peristaltic pump, each 50 - 500 gph discharge flow; 1 standby	Yes	FM	n/a	n/a	yes	0.33	0.66	Motor failure, tube leakage
Effluent Disinfection Metering Pumps	2	1	0.33	ADF	To meet min and max day sodium hypochlorite demand	peristaltic pump, each 5 - 500 gph discharge flow; 1 standby	Yes	FM	0.660	0.660	yes	0.33	0.66	Motor failure, tube leakage
Induction Unit	2	1	7.5	N/A	N/A	1 standby	Yes	FM	15	15	Yes	7.5	15	Motor failure, feed connection failure
Sodium Bisulfite System														
Bisulfite Storage Tank	1	0				No standby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Chemical Induction Unit	1	0	15	MMF		No standby	Yes	PP	n/a	15	Yes	15	15	
Bisulfite Analyzer	2	1	1			1 standby	Yes	PP	n/a	1	Yes	1	2	
Bisulfite Injection Pump	2	1	1	MMF		1 standby	Yes	PP	n/a	1	Yes	1	2	
Vent Scrubber	1	0	1			No standby	Yes	PP	n/a	1	Yes	1	1	
Subtotal for Chlorination									**16**	**35**		**29**	**40**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Disinfection														
Future Planning Considerations:														
UV Channels	3	1		MMF	3 channels at 12.9 mgd per channel	1 standby channel at max month	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Some channels shut down during summer for maintenance
UV Lamps	384	0.33		MMF	64 lamps per bank, 2 banks per channel, 25 mJ/cm^2	1/3 of lamps on standby during MMF	Yes	PP	67	134	Yes	134	201	Multiple channels available
Subtotal for UV									**67**	**134**		**134**	**201**	
Aqueous Ammonia Chemical Metering Pump	2	1	2	MMF		1 standby	No	n/a	n/a	n/a	Yes	2	4	
Subtotal for Chloramination									**0**	**0**		**2**	**4**	
Ozone Generator	2	1	350	MMF	3 mg/L	1 unit standby	No	n/a	n/a	n/a	Yes	350	700	
Subtotal for Ozone									**0**	**0**		**350**	**700**	
Total - Sodium Hypochlorite + Ozone									**16**	**35**		**381**	**744**	
Total - UV + Ozone									**67**	**134**		**484**	**901**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Recycled Water System														
Subsystems:														
Recycled Water Pumps	5	1		Demand	2x150hp, 2x100hp, 1x75hp, 1x15hp, (5500 gpm @ 60 psi)	1 standby (largest pump)	No	n/a	n/a	n/a	No	286	590	If pumps fail, switch to potable water supply. Based on providing 3.6 mgd RW continuously.
Hypo Dosing Pumps	1			Demand	6 ppm	1 standby	No	n/a	n/a	n/a	No	2	4	
Total									**0**	**0**		**288**	**594**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Yes/No	Category	72-hr Hp±	24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Thickening														
Subsystems:														
WAS Storage														
Recirculation Pump	2	1	7.5	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Thickening														
Rotary Drum Thickeners	3	1	25	MML	400 gpm @ 1 % solids; 2,000 pph	1 standby	Yes	PP	n/a	25	Yes	50	75	
TWAS Pumps	3	1	25	MML		1 standby	Yes	PP	n/a	25	Yes	50	75	
Spray Water Booster Pumps	2	1	5	MML		1 standby	Yes	PP	n/a	5	Yes	5	10	
Thickening Polymer System									n/a					
Recirculation Pump	2	1	7.5	MML		1 standby	Yes	PP	n/a	7.5	Yes	7.5	15	
Polymer Blender Units	4	1	0.5	MML		1 standby	Yes	PP	n/a	1.5	Yes	1.5	2	
HVAC System (for Thickening and Dewatering)	1 System (multiple fans)		25	n/a	Building area and occupancy, 12 air changes per hour	multiple fans; half duty, half standby	Yes	HH	25	25	Yes	25	50	Fan failure
Odor Control System (for Thickening and Dewatering)														
Exhaust Fan (Biotower Fan)	1	0	40	n/a	Building area and occupancy, 12 air changes per hour	No standby	No	n/a	n/a	n/a	Yes	40	40	
Scrubber Fan	1			n/a			No	n/a	n/a	n/a	Yes			
Odor Control Sump Pump	1			n/a			No	n/a	n/a	n/a	Yes			
Scrubber Recirculation Pump	1			n/a			No	n/a	n/a	n/a	Yes			
Total									**25**	**89**		**187**	**282**	

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Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Digestion														
Subsystems:														
Digesters	2 - 82,300 CF digesters 3 - 120,100 CF digester			MML	15 day SRT at max month load; 0.12 lb/cf-day VSS loading rate	1 standby (largest digester tank)	No	n/a	n/a	0	Yes	0	0	
Mixing System														
Digester Mixing Pumps	3 (1 - 30 hp pump for Dig. 3; 1 - 40 hp pump for Dig. 4, and 5)			MML		No standby (1 per digester)	Yes	n/a	40	110	Yes	110	110	During power outage, mix one digester at a time (rotate).
Heating System														
Heat Exchanger	5			MML		No standby (1 per digester)	Yes	n/a	0	0	Yes	0	0	
Digester Sludge Recirculating Pumps	7 - 15 hp pumps (6 pumps for Dig. 1 - 4; 1 pump for Dig. 5)			MML		No standby (1 per digester)	Yes	n/a	30	105	Yes	105	105	
Digester Hot Water Recirculating Pumps	7 - 1 hp pumps (6 pumps for Dig. 1 - 4; 1 pump for Dig. 5)			MML		No standby (1 per digester)	Yes	n/a	2	7	Yes	7	7	
Raw Sludge Hot Water Pump	1	0	7.5	MML		No standby	Yes	n/a	7.5	7.5	Yes	7.5	7.5	
Sludge Pumping														
Supernatant Pumps	3	1	5	MML		1 standby (assuming pumps operated intermittently)	No	n/a	n/a	10	Yes	10	15	
Transfer Sludge Pumps	2	1	7.5	MML		1 standby (assuming pumps operated intermittently)	No	n/a	n/a	7.5	Yes	7.5	15	Assume pumps run 50 percent of the time.
Digester Drain Pump	1			n/a		No standby	No	n/a	n/a	5	Yes	5	50	Assume pumps run 50 percent of the time.
Influent Sludge Grinders	4	0	5	MML		4 - 5 hp grinders (1 for Dig. 2 - 5); No standby	No	n/a	n/a	20	Yes	20	20	
Gas Management														
Digester Gas Flare	1			MML		No standby	No	n/a	n/a	0	Yes	0	0	
FOG Feed Facility														
Rock Trap/Grinder	1	0	7.5	MML		No standby	No	n/a	n/a	7.5	Yes	7.5	7.5	
Unloading/Mixing Pump	2	1	10	MML		2 chopper pumps; 1 standby	No	n/a	n/a	10	Yes	10	20	
Digester Feed Pump	2	0	10	MML		2 progressive cavity pump; No standby	No	n/a	n/a	20	Yes	20	20	
Heat Tracing	1	0	10	MML		No standby	No	n/a	n/a	10	Yes	10	10	
Total									**79.5**	**320**		**320**	**387**	

Notes:

(1) Assume during a 24-hour power outage WAS needs to be wasted to the digesters. Assume WAS will be sent to two of the large digesters. Assume those digesters need heating if receiving new (i.e., cold) sludge. Assume other digesters do not need heating during 24-hour power outage. Assume all digesters need mixing during power outage.

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Dewatering (Screw Presses)														
Subsystems:														
Digester Sludge Storage														
Digester Sludge Storage Tank	1			MML		No standby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Recirculation Pump (Mixing)	2	1	7.5	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Feed Pumping														
Feed Pumps	4	1	40	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Inline Grinder	4	1	5	MML		1 standby	No	n/a	n/a	n/a	Yes	15	20	
Dewatering														
Screw Press	4	1	10	MML		1 standby	No	n/a	n/a	n/a	Yes	30	40	
Bridge Crane	1	0	20	n/a		No standby	No	n/a	n/a	n/a	No	20	20	
Dewatering Polymer System														
Recirculation Pump	2	1	7.5	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Polymer Blender Units	2	1	5	MML		1 standby	No	n/a	n/a	n/a	Yes	5	10	
Polymer Solution Feed Pumps	5	1	10	MML		1 standby	No	n/a	n/a	n/a	Yes	40	50	
Potable Water Booster Pumps	2	1	20	MML		1 standby	No	n/a	n/a	n/a	Yes	20	40	
Cake Pumping														
Cake Pump	4	1	40	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Cake Hopper Discharge Gates	2	1	1	n/a		Bypass pipeline for direct truck loading	No	n/a	n/a	n/a	Yes	1	2	
Truck Loading Conveyor	1	0	15	MML		No standby	No	n/a	n/a	n/a	Yes	15	15	
HVAC System (included in Thickening)														
Total									**0**	**0**		**401**	**547**	

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							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Dewatering (Centrifuges)														
Subsystems:														
Digester Sludge Storage														
Digester Sludge Storage Tank	1			MML		No standby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Recirculation Pump (Mixing)	2	1	7.5	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Feed Pumping														
Feed Pumps	4	1	40	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Inline Grinder	4	1	5	MML		1 standby	No	n/a	n/a	n/a	Yes	15	20	
Dewatering														
Centrifuge	3	1	300	MML		1 standby	No	n/a	n/a	n/a	Yes	600	900	
Bridge Crane	1	0	20	n/a		No standby	No	n/a	n/a	n/a	No	20	20	
Dewatering Polymer System														
Recirculation Pump	2	1	7.5	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Polymer Blender Units	2	1	5	MML		1 standby	No	n/a	n/a	n/a	Yes	5	10	
Polymer Solution Feed Pumps	5	1	10	MML		1 standby	No	n/a	n/a	n/a	Yes	40	50	
Potable Water Booster Pumps	2	1	20	MML		1 standby	No	n/a	n/a	n/a	Yes	20	40	
Cake Pumping														
Cake Pump	4	1	40	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Cake Hopper Discharge Gates	2	1	1	n/a		Bypass pipeline for direct truck loading	No	n/a	n/a	n/a	Yes	1	2	
Truck Loading Conveyor	1	0	15	MML		No standby	No	n/a	n/a	n/a	Yes	15	15	
HVAC System (included in Thickening)														
Total									**0**	**0**		**971**	**1407**	

Abbreviation:
Standby Power Category
HH - Human Health
FM - Flow Management
PP - Process Protection
EP - Equipment Protection
Flow/Load
PHF - Peak Hourly Flow
PDF/L - Peak Daily Flow/Load
MMF/L - Max Monthly Flow/Load
ADF - Average Day Flow
ADWF/L - Average Dry Weather Flow/Load

Process Criticality Assessment
Sunnyvale Master Plan

3/11/2015

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
							Yes/No	Category	72-hr Hp±	24-hr Hp±				
Biosolids Post Processing														
Subsystems:														
Paddle Dryer System							No	n/a	n/a	n/a	Yes	200	300	
Total									**0**	**0**		**200**	**300**	

Abbreviation:
Standby Power Category
HH - Human Health
FM - Flow Management
PP - Process Protection
EP - Equipment Protection
Flow/Load
PHF - Peak Hourly Flow
PDF/L - Peak Daily Flow/Load
MMF/L - Max Monthly Flow/Load
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ADWF/L - Average Dry Weather Flow/Load

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Support Facilities (Admin., etc.)														
Subsystems:														
Support Facilities (Admin., etc.)	20,000 SF			n/a	7.5 VA per SF		Yes	FM	50	101	n/a	201	251	
Total									**50**	**101**		**201**	**251**	

Abbreviation:
Standby Power Category
HH - Human Health
FM - Flow Management
PP - Process Protection
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Flow/Load
PHF - Peak Hourly Flow
PDF/L - Peak Daily Flow/Load
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ADWF/L - Average Dry Weather Flow/Load

Process Criticality Assessment
Sunnyvale Master Plan

3/11/2015

Process/Equipment	Proposed No. of Units	Proposed No. of Standby Units	Duty Load per Unit Hp±	Flow & Load Condition	Design Criteria	Duty/Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Filter Backwash Storage and Pump Station														
Subsystems:														
Storage Tanks	1					0.9 Mgal Tank; No standby. Tank partitioned by baffle walls into three section. Each section used in sequence depending on needs.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Spillway into emergency storage basin OR pass flow through Plant.
Backwash Pumps	3	1	20	Variable	2 mgd, each @ 30 ft	1 standby	Yes	PP	n/a	40	Yes	40	60	Motor Failure
AFT Pump Station (for pond/CAS treatment)														
AFT Pumps	3	1	20	Variable	2 mgd, each @ 30 ft	1 standby	No	n/a	n/a	n/a	Yes	40	60	Motor Failure
Total									**0**	**40**		**80**	**120**	

Abbreviation:
Standby Power Category
HH - Human Health
FM - Flow Management
PP - Process Protection
EP - Equipment Protection
Flow/Load
PHF - Peak Hourly Flow
PDF/L - Peak Daily Flow/Load
MMF/L - Max Monthly Flow/Load
ADF - Average Day Flow
ADWF/L - Average Dry Weather Flow/Load

Electrical Load Summary

Updated 8/26/2014

Item	Qty		Output Rating (hp)		Drive	Volts	Duty Load (kW)	Total Load (kW)	Electrical Room Assignment
	In-Use	Stand-By	hp	kW					
Microfiltration Feed Pumps	2	1	60	44.8	VFD	460	89.52	134.28	
Microfiltration Backwash Pumps	1	1	45	33.6	VFD	460	33.57	67.14	
Microfiltration Prescreen Motors	1	1	1	0.4	VFD	460	0.373	0.746	
Microfiltration Air Scour Blowers	1	1	10	7.5	VFD	460	7.46	14.92	
MF CIP Recirculation Pump	1	1	20	14.9	VFD	460	14.92	29.84	
MF CIP Hot Water Tank Heater	1	0		100	N/A	460	100	100	
Waste washwater sump pumps	1	1	5	3.7	CS	460	3.73	7.46	
Plant Air Compressors (Valves, Integrity Test)	1	1	5	3.7	CS	460	3.73	7.46	
Metering Pumps:							0	0	
Sodium Hypochlorite - MF Pretreatment	1	1	0.25	0.2	NA	115	0.1865	0.373	
Aqua Ammonia - MF Pretreatment	1	1	0.25	0.2	NA	115	0.1865	0.373	
Sodium Hypochlorite - MF CIP	1	1	0.25	0.2	NA	115	0.1865	0.373	
Citric Acid- MF CIP	1	1	0.25	0.2	NA	115	0.1865	0.373	
Caustic Soda- MF CIP	1	1	0.25	0.2	NA	115	0.1865	0.373	
Sodium Bi-Sulfite- MF CIP	1	1	0.25	0.2	NA	115	0.1865	0.373	

Duty Power (kW)	Total Power (kW)
254	364

Duty Power (hp)	Total Power (hp)
341	488

RO/UV/AOP Facilties Estimated Load 3/11/2015

Year	2026	2035	
	10 MGD	Additional load for 15 MGD	Total
Duty (HP)	3925	2267	6192
Standby (HP)	682	1	683
Total (HP)	4607	2268	6875

CONFERENCE MEMORANDUM

Project:	Master Plan and Primary Treatment Design	**Conf. Date:**	October 22, 2013
Client:	City of Sunnyvale	**Issue Date:**	December 17, 2013
Location:	West Conference Room		

Attendees:

City:
Bryan Berdeen
Dan Hammons
Pat Lenor
Craig Mobeck
Bhavani Yerrapotu
Jeff Sorensen
Tanner McGuiness

Carollo/HDR/Subconsultants:
Jamel Demir
Jim Hagstrom
Katy Rogers
Alex Ekster

Purpose: Process Criticality Review

Distribution: 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. **Meeting Goals**
   a. Address process reliability/redundancy criteria for:
      1) Systems and equipment.
      2) Standby power.

2. **Diversion of Flows**
   a. In previous meetings, it was decided there would be no diversion of raw sewage.
   b. There may be two types of diversion for primary effluent:
      1) Daily equalization (8 MG) to shave peaks
      2) Emergency storage to accommodate any flows in excess of the EQ basin volume that can not be handled by the treatment process
   c. City staff stated the WPCP is required to meet the requirements of the NPDES permit for at least 72 hours no matter what (e.g., power failure). NPDES permit includes backup equipment requirements, but they are vague.
   d. City staff stated the WPCP did have a 25-hour power outage during a three-day period. PGE was out for 12 hours, then 5, then 3…etc. The power outage was intermittent. The City diverted to the ponds over that entire period.

e. **Decision: We need to plan for diversion of off-spec tertiary water (either to the head of the plant or emergency storage).**

f. **Action Item: Need to determine how much emergency storage should be provided and the associated cost.**

g. It is important to establish the emergency storage and diversion of flows. It will affect how much reliability and redundancy is provided for other process areas.

   1) As a minimum, if recycled water effluent does not meet Title 22 requirements it could be diverted to the Bay discharge if it is adequately disinfected.

   2) The major events that would cause tertiary effluent to be “off-spec” for Bay discharge include losing a clarifier or blinding the filters.

   3) When you have built in systems for diversion, maintenance is much easier. At San Jose, staff typically had to get all maintenance done in an 8-hour period, but they also had all the resources they needed to do that. We need to be realistic about how much time we might take to do maintenance or need facilities offline at Sunnyvale.

h. Four criticality categories were established. <*These were subsequently revised as part of the ECHP Workshop.*> They include:

   1) Human Health (HH) – protect human health

   2) Flow Management (FM) – prevent flooding

   3) Process Protection (PP) – protect the process from catastrophically failing

   4) Equipment Protection (EP) – protect equipment from damage

i. Carollo/HDR to establish standby power period(s) (24 hour and/or 72 hour). <*Subsequent to the meeting, Carollo/HDR established two standby power periods:*

   1) *Normal Standby (24-hour period) – standby power provided to facilities that require continuous operation to maintain the process for minimum treatment of influent.*

   2) *Critical Standby (72-hour period) – standby power provided to facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity.*>

j. Draft criticality tables were presented that summarize the recommended equipment, level of redundancy and standby power for each treatment process.

   1) Standby equipment is recommended for most equipment (e.g., standby pumps, blowers, screens, etc.) to improve process reliability. The level of redundancy is defined for each piece of equipment in the criticality tables.

k. Carollo to provide updated version of the process criticality tables. <*The criticality tables were subsequently updated for the ECHP workshop and will be included the ECHP Plan TM.*>

3. **Berm Construction**

   a. If split flow treatment is implemented, the existing system will remain in service and the ponds can be used for emergency storage. If a conventional plant is implemented, the ponds will be abandoned and EQ storage will be needed.

b. If the ponds are used for permanent EQ storage or emergency storage, the elevation of the berms would need to be raised to comply with dam construction requirements.

c. The City has had berm failures already. Berm construction will be expensive whether you need to meet dam safety requirements or not. Need to consider this carefully when deciding how much storage to have.

d. Timeline Review

1) 2018 – New Headworks and Primary Treatment Facility

(1) Redundancy and reliability is the same as existing:

(a) Secondary treatment in the ponds

(b) Emergency generators to provided standby power to headworks and primary treatment process

b) 2023 – Secondary Treatment Improvements

(1) Split flow (no berm upgrades required, but maintenance required)

(2) Full secondary with EQ basins for diurnal flow equalization and provisions for sufficient power reliability during extended power outages

(3) Full secondary with EQ basins for diurnal flow equalization and earthen emergency basin (this could require less power reliability)

2) 2034 – Secondary Treatment Improvements

a) The same as 2023, except for the split flow alternative will now require extra power reliability or earthen emergency basin.

3) **Action Item: Ask H.T. Harvey if they have any further information on the timing associated with upgrading the berms for sea level rise.**

4. **Headworks**

a. Overview

1) The headworks must be operational at all times.

2) Provide standby equipment to provide flow management reliability. The following headworks equipment should have standby units:

a) Screens – one standby screen and one bypass channel

b) Pumps – one standby pump (largest pump)

c) HeadCell Units – one standby to pass peak hourly flow

d) HVAC system fans

3) The headworks process should have partial standby power for flow management and to protect human health (i.e., provide adequate ventilation).

b. Discussion - Screens

1) The screens have two levels of redundancy:

a) First level of redundancy – use standby screen

b) Second level of redundancy – use bypass channel that would route flow around the screens to the influent pump station.

2) The City stated there is a level of comfort with using newer screen technology, because the new screens are easier to clear when there are blinding issues.

3) When power is out, the conveyor and washer compactor would be down and a bin would be provided to collect screenings.

c. <u>Discussion - Pumping</u>

1) There will be a gate dividing the wet wells. 99±% of the time, this gate will be open so you can operate the influent pump station with one wetwell rather than two.

2) The inlet gates need to exercised regularly so they work when needed. The gate operator also needs to match the gate size so they are not oversized.

d. <u>Discussion – Grit Removal</u>

1) There would be two levels of reliability for grit removal: 1) hydraulic reliability and 2) treatment reliability. There would be enough hydraulic capacity to pass the peak hourly flow with one HeadCell unit out of service. As a result, flow would not need to bypass the grit removal system. There would be enough treatment capacity to treat the maximum day flow with all units in service. If the treatment capacity is exceeded, grit performance would decrease, but is not expected to have a significant negative impact on the process.

2) A bypass channel could be added later depending on cost, for an extra level of redundancy.

3) If necessary, it would be good to have provisions to flush certain areas with air, so we do not have to worry about solids build up as much.

4) Carollo to look into need to provide air scour in grit basins to flush solids that may accumulate during a power outage. (To be addressed as part of the Primary Treatment Facility Design.

e. <u>Discussion – HVAC and Odor Control</u>

1) The current plan is to implement one odor control system for the headworks and primaries.

2) **Decision: HVAC at the headworks and primary treatment facilities is critical to remain operational at all times. Odor control at the headworks and primary treatment facilities would not be considered critical.**

5. **Primary Treatment**

a. <u>Overview</u>

1) The primary treatment process should have enough capacity to take one primary sedimentation tank (PST) offline during average dry weather flow (ADWF).

a) This provides flexibility to do maintenance in the summer.

b) This could be done by providing a redundant PST or providing CEPT. It is more conservative to provide one redundant PST.

2) Number and phasing of primary sedimentation tanks (PSTs) to be finalized as part of the Primary Treatment Alternatives Analysis TM. <*Subsequent to the meeting, the number of primary sedimentation tanks (PSTs) and phasing of the*

    PSTs was finalized in the Primary Treatment Alternatives Analysis TMs. The primary treatment process would include 6 PSTs. The PSTs would not be phased and would be sized to accommodate the 2035 maximum month flow. >

  3) The primary treatment process should have standby power to protect the equipment.

b. Discussion

  1) City staff noted if we have to bypass the screening facility and send rags and grit to the PSTs, then we should plan on probably losing one PST. It seems logical to have an extra PST.
  2) Staff prefers more tanks to fewer tanks (six seems like a right number).
  3) Agreed we should provide standby power to the sludge equipment. You need to keep your sludge equipment running, so you do not break your flights. If you stop pumping sludge you can develop a blanket that is 3-5 feet deep over night.
  4) To clarify, it makes sense for operational staff to use CEPT as a tool because the solids are amendable to CEPT. It is an additional tool, not relied on for capacity so it is not critical. The CEPT system would include storage tank, metering pump, controls, etc. At a minimum, we should reserve site space for a CEPT system.
  5) Most plants, use CEPT to try to improve removal when their flows start to increase. As the flows come up, staff may want to start using CEPT. CEPT may also be helpful to meet phosphorous limits if/when they occur.
  6) Caroll/HDR to look at using a central primary sludge and scum pump station as opposed to dedicated pumps for each PST. (To be addressed as part of the Primary Treatment Facility Design.)

6. **Equalization**

a. Overview

  1) One redundant storage tank at ADWF.
  2) No standby power should be provided. The return pump station and washdown pump station will be down during a power outage.

b. Discussion

  1) A flow meter should be provided to measure how much flow is sent to and returned from the EQ basins. At San Jose, staff used the level in the EQ basins to determine volume stored. Staff had to drive out there to check that the level readings were accurate.

7. **Bioreactors**

a. Overview

  1) Provide one standby bioreactor (aeration basin) during ADWF. For conventional activated sludge, all secondary clarifiers would need to be in service to take one bioreactor out of service during ADWF. For an MBR system, an aeration basin could be taken out of service if no more than one MBR train were out of service.
  2) Provide partial standby power to the bioreactors to protect the treatment process.

b. Discussion

1) This level of redundancy is typical of most plants.
2) There are factors of safety included in the design criteria (e.g., the design SRT). The process team agreed to these design criteria, but in a pinch you could potentially operate a little off the design criteria.
3) Carollo to check cost and process implications of constructing four smaller aeration basins instead of three to increase redundancy. <*Subsequent to the meeting it was determined it is optimum from a cost, site phasing and reliability standpoint to have four aeration basins.*>
4) Carollo to check how modifying the SRT may allow taking one aeration basin and one secondary clarifier offline at the same time (to be included in the Basis of Design if appropriate).

8. **Secondary Clarifiers**

a. Overview

1) Provide one standby clarifier during ADWF.
2) Provide partial standby power to protect the process.

9. **Membranes**

a. Overview

1) Provide one standby membrane bioreactor (MBR) during peak daily flow (PDF).
2) Provide one standby bioreactor (aeration basin) during ADWF.
3) Provide standby power to protect the process and the equipment. The MBR air scour blowers must remain partially operational to support the biological process and prevent damage to the membranes that can occur under septic conditions.

b. Discussion

1) Unlike secondary clarifiers, MBRs require N+1 because the failure mechanism is different (more catastrophic) and the cost to provide it is less. If an MBR goes down, you can not push flow through a membrane.

10. **Filtration**

a. Overview

1) Provide one standby filter during ADWF.
2) Provide no standby filters during maximum month flow (MMF). Note, recycled water can not be provided in this mode of operation.
3) Provide partial standby power for flow management and to protect the process.

b. Discussion

1) Filtration is required for bay discharge and recycled water, but the requirements are different. At the Treatment Alternatives Review Workshop, we discussed whether the existing filters could be operated under all flow conditions to meet Title 22.

2) With split flow treatment there would be additional complexity because it may make sense to build a dedicated filter for split flow.

3) Filter backwash EQ will not be available when the pond system is removed. EQ for filter backwash will need to be provided. At San Jose, they send it to the old primary tanks. The filter backwash is roughly 10 percent of the process flow. It will probably need to be treated with some chemicals. It may make sense to use the emergency overflow to equalize secondary effluent and pump constantly to filters (this is not optimal from hydraulic standpoint right now).

4) The City stated backwash system can not be down for more than 24 hours.

5) Carollo to look at recommendation to keep the existing dual media filters (DMFs) and run them to meet Title 22. Carollo to look at whether we can meet Title 22 at diurnal peaks or if we need to dedicate filters that run at a different rate for Title 22. *<Subsequent to the meeting, it was finalized in the Filtration Treatment Alternatives Analysis TM that the filters can handle various flows assuming a re-rating is performed and potable water is available for short-term peak flow conditions.*

11. **Disinfection**

a. <u>Overview</u>

1) Provide one standby chlorine contact tank (CCT) during ADWF.

2) Provide on standby chlorine contact tank (CCT) during MMF. Note, in this mode of operation, no recycle water can be provided.

3) Provide partial standby power for flow management and to protect the process.

b. <u>Discussion</u>

1) The City stated the sodium hypochlorite project provides full redundancy on all equipment except the recirculation pump.

2) *<Subsequent to the meeting, the reliability and redundancy criteria was established for an ozone system, which may be required to treat CECs.>*

12. **Recycled Water Pumping**

a. <u>Overview</u>

1) The level of redundancy needs to be determined based on the City's policy decisions to provide recycled water.

2) No standby power should be provided.

b. <u>Discussion</u>

1) **Action Item: Bhavani to set up a meeting with the City, SCVWD and Hydroscience to determine when SCVWD may need the water and how much they will need.**

2) Based on the Hydroscience Recycled Water Master Plan Report and the outcome of the City's meeting with SCWVD regarding when recycled water will be needed, Carollo/HDR to establish site space, utilities, and funds to support recycled water production on site.

3) The plant has not been producing any recycled water because it does not pay off. The City would have to pay twice to do so (pay to produce it and pay to use it). It is cheaper to use potable water.
4) With split stream treatment, algae will come back to the filters. We need to pilot test to know if we can meet recycle water with the existing filters under a split stream treatment scenario.

13. **Thickening**

a. Overview

1) Provide one standby rotary drum thickener (RDT) at maximum month load (MML).
2) No standby power provided to process. This assumes no sludge will be wasted from the secondary process during a power outage.
3) Provide partial standby power for the ventilation system only to protect human health.

b. Discussion

1) We need to think about primary sludge storage and if it is really needed to optimally feed sludge to the digesters. This will be addressed as part of the Solids Treatment Alternatives Analysis TMs.
2) The current plan is to implement one odor control system for the thickening and dewatering processes.
3) As part of the Master Plan, Carollo to look at side stream impacts and any associated issues that may impact the solids treatment process (e.g., struvite formation).

14. **Digestion**

a. Overview

1) The level of standby digesters provided during average dry weather load (ADWL) and MML will be finalized in the Solids Treatment Alternatives Analysis TMs.
2) Provide partial standby power to protect process.

b. Discussion

1) The City is currently operating with two digesters but it is not ideal. They can take a digester offline and not mix it for 24 hours.
2) Carollo/HDR to evaluate the need to add 1-2 more digesters depending on the upstream requirements. The tentative assessment is FOG and food can be added at any time without causing significant impact to digester capacity. This will be done as part of the Solids Treatment Alternatives Analysis TMs.

15. **Dewatering**

a. Overview

1) Provide one standby dewatering unit (centrifuge or screw press) at MML.

2) No standby power provided to process. This assumes no sludge will be wasted from the digesters during a power outage.
3) Provide partial standby power for the ventilation system only to protect human health.

b. Discussion

1) There was further discussion about the pros and cons of centrifuges and screw presses for dewatering.
2) **Decision: The Master Plan will be based on a screw press dewatering system. This option is more conservative for planning purposes because a screw press system will take up more space and have a higher life cycle cost**
3) Based on current layout, we can potentially preserve the drying beds.
4) There are two scenarios for solids dewatering:
   a) Keep using drying beds as you do now, and have Cynagro haul 15% solids offsite.
   b) Give Cynagro the liquid flow from the digesters. Cynagro dewaters it onsite and then takes it offsite.
5) The City's current contract with Cynagro is $39/wet ton to take it in any form. If the City starts giving them a liquid, they will likely need to pay the market rate.
6) Cynagro is currently working on dredging the small pond. The City is going to try to complete any solids management projects for the ponds before the headworks and primary treatment project starts.
7) City/Carollo to meet with Cynagro to discuss optimum interim operation of drying beds.
8) Carollo/HDR to consider coordination of Cynagro's current pond dredging and dewatering work with the future construction of headworks/primaries in the implementation plan.

16. **Action Items**

a. City/Carollo: Need to determine how much emergency storage should be provided (will be an agenda item at the next criticality discussion).
b. Carollo: Ask HT Harvey about timing for sea level rise (impact on berm reconstruction).
c. City: Meet with SCVWD to determine timing of their r needs.

17. **Decisions**

a. Need to plan for diversion of "off spec" tertiary water (either to the head of the plant or to emergency storage).
b. HVAC at the Headworks is considered critical (should be part of standby power considerations).
c. Screw presses will be considered as the selected technology for dewatering.

Prepared By:

K. Rogers

KR:kr

CONFERENCE MEMORANDUM

Project:	Master Plan and Primary Treatment Design	**Conf. Date:**	February 20, 2014
Client:	City of Sunnyvale	**Issue Date:**	March 28, 2014
Location:	WPCP Training Room		

Attendees:

City:
Luis Arribeno
Bryan Berdeen
Leo Carlino
Dan Hammons
Pat Lenoir
Tanner McGinnis
Craig Mobeck
Jeff Sorrick

Carollo:
Jamel Demir
Katy Rogers
Steve Walker

Purpose: Criticality Review Meeting #2

Distribution: Attendees, B.Yerrapotu, J. Wickstrom **File:**

Discussion:
The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us. These are preferences and opinions that Carollo will look into more and verify that they are appropriate for the system that is being planned. Any items that conflict with the proposed plan need further discussion, or that Carollo has concerns with will be raised and resolved prior to furthering the plan.

1. Review Standby/Redundancy by Process Area (see attached summary)
   A. General
      1) Clarified the number and size of all headworks/primary equipment. Will be further refined during the final design process as part of the preparation of the Design Information Memorandum (DIMs).
      2) Pre-consolidation of the primary treatment facility site will take about 6 months and could start as early as one year from today.
      3) Prior to beginning Package #1 (demolition/pre-consolidation), the dewatering facility needs to be decommissioned and replaced with a contract dewatering process.
      4) Plant staff stated Synagro only wants to do contract dewatering if it is in conjunction with the pond project due to efficiency issues.
   B. Headworks - Screening
      1) Clarified the bypass channel should be sized to pass the peak hourly influent flow. The bypass channel provides passive bypass of process flow if the screens blind.
      2) Staff prefers continuous loading of screenings to the washer/compactor, not batch loading (which should not occur with the proposed screening technologies). Batch loading causes process issues

3) During the DIM process, Carollo will revisit whether a standby washer/compactor is required.

C. Headworks – Influent Pumping

1) Staff prefers to have one flow metering element, rather than two. If two meters are measuring the same flow, they have to decide which measured flow to use, to average them both, etc.
2) If one flow meter is provided, a bypass and space should be provided so an ultrasonic flow meter could be added to the line if the primary meter fails.

D. Headworks – Grit Removal and Handling

1) Clearing blockages within the HeadCells may be difficult. Providing adequate access for maintenance will be considered during design.

E. Side-Stream Recycled Flow Pump Station

1) The purpose of this pump station is to meter and sample all recycled streams in one common location, separate from the WPCP influent flow. Ideally, it would likely be located near the headworks. This location might change based on how recycle streams are currently be routed to the existing influent PS.
2) Plant staff stated there is an existing wetwell used for drainage of the tarmac. It is located near the existing headworks and may include submersible pumps. May want to evaluate using this as the Side Stream Pump Station. **Action Item: Carollo to consider using this pump station**

F. Extended Power Outage

1) City provided direction in previous meetings, that raw effluent should not be diverted to the ponds. During a power outage, the headworks and PSTs should remain in operation (supported by standby power) and primary effluent should be diverted to emergency storage in the existing pond area.
2) Plant staff does not want the tunnels to flood. It would take months to restore operation if the tunnels were flooded.
3) Staff felt that provisions to allow bypass of raw effluent to the ponds in the event of an extended power outage (72+ hours) to avoid site flooding should be evaluated during the DIM process. The Regional Board does not typically allow passive overflow of raw effluent. They typically require facilities need to make a conscious decision and action in order bypass raw effluent. **Action Item: Carollo to consider the potential for raw bypass in a long-term outage scenario as part of the DIM process.**

G. Primary Treatment

1) The number of sludge and scum pumps per primary clarifier will be re-visited during the DIM preparation based on peer reviewer feedback.
2) Clarified that the proposed sludge pumps will probably be operated more continuously than the existing primary sludge pumps.
3) Providing a standby blower for the influent channel to the primary sedimentation tanks may not be necessary. These blowers only provide mixing (not treatment). Carollo has seen these blowers go down and the primary treatment process continue to work just fine. **Action Item: Carollo to evaluate the need for a standby blower for channel mixing.**

H. EQ Pump Station

1) If these pumps are located remotely (by the ponds), they will be more difficult to access. Carollo will look at options to reduce the need to access this PS (make it more reliable). These options will be considered, when the cost for this pump station is estimated and added to the Program Implementation Plan.
2) This pump station is not required if split flow is implemented. It is only required when the ponds are completely replaced with a new secondary treatment process.
3) Staff stated the flow might stratify in the tanks. At San Jose, they saw stratification over distance and depending on where the flows occurred. We need to include flow disturbance elements to reduce stratification (to be identified as part of the Basis of Design documentation).
4) These tanks would include some sort of automated washdown system to minimize plant staff time for cleaning these tanks out (provisions for manual spray monitors would also be provided). Tank cleaning could be scheduled during low flow conditions, when these tanks are not needed (or only one tank is needed).

I. Conventional Activated Sludge/MBRs
   1) The secondary treatment process alternatives and recommendations may be reevaluated after the master plan, if there has been significant progress and changes to the available process alternatives.

J. Filtration
   1) When the ponds are abandoned, filter backwash will be equalized in an existing air floatation thickener (AFT) (converted for storage) and metered back to the headworks or primary treatment process. Until then filter backwash will continue to be diverted to the ponds.
   2) Carollo staff mentioned the option of using ballasted floc tank as part of the conventional activated sludge process design.

K. Disinfection – Conversion to hypo is currently in design.

L. Recycled Water (RW)
   1) Based on the RW demand projections, Carollo to determine as part of the Implementation plan what improvements are required to meet the demand (especially from a replacement standpoint).

M. Digestion
   1) Clarified the primary recommended improvement to the digesters is to replace the influent sludge feed piping. There will separated primary and secondary sludge feed piping with valves and meters to control sludge flow. Discussed the benefits of providing a small upstream blending tank (in lieu of separate feed lines). Tight site may make this tank difficult to implement. **Action Item: Carollo to consider providing flexibility to implement either feed approach as part of the master planning recommendations.**

N. Dewatering

   When implementation of a new dewatering facility becomes more imminent, the City should tour appropriate facilities (i.e., cake pumping/storage at Santa Rosa, screw presses at Petaluma, etc).

   1) Screw conveyors could also be considered for cake conveyance. Vallejo has a very extensive screw conveyor system that works well.

2. Review Emergency Storage Needs/Alternatives

A. The results of the Master Plan opportunities and constraints analysis will dictate whether it is advantageous to utilize either the Cargill Channel or Pond A4 for equalization or emergency storage. Currently proposing a three day emergency storage basin (partitioned for ease of maintenance) adjacent to the diurnal EQ facilities.

B. Staff said all emergency planning documentation states we need to be able to operate under emergency conditions for at least 3-days.

C. Staff has regularly taken the plant down for a couple days for significant maintenance efforts. **Action Item: WPCP staff to check record data to determine how much flow they have diverted to the ponds**.

   1) DH: We usually coordinate a lot of maintenance efforts (e.g., we do our annual PMs on gates and manholes when a contractor needs to be doing work). Other issues are sodium hypochlorite improvements, PG&E outages, etc.

D. When the outfall was inspected, the intent was to determine if the outfall line could have an overflow structure installed in it with some sampling in case there was a hot hit. This would provide capture of non-spec effluent before it is released to the Bay. We should have several points of contingency – ability to divert primary influent and tertiary effluent to the emergency storage basin. From a regulation standpoint, this seems very favorable. Most plants do not have this level of redundancy.

   1) Staff prefers to implement a diversion from the existing outfall to the ponds. This would allow the plant to divert off-spec final effluent back to the ponds. Right now, once flow comes back from the ponds it goes out to the Bay. The existing PE line might be useful for this. This could potentially be included with the Primary Treatment Project because the project does include some major piping improvements

   2) Staff said the raw influent diversion system never worked. It has never diverted raw effluent to the ponds. The whole collection system would need to surcharge for the flow to get to the ponds by gravity. They installed surcharge plates in the collection system. It is uncertain how much the collection system has served as a reservoir. In 2013, a basement (not local) was flooded. Explained how the existing raw sewage would be diverted to the new headworks – need to develop the hydraulic grade line to ensure the new diversion box will not overflow. **Action Item: City to provide record of wet well levels (i.e., those that are used to trigger running the Auxiliary Pump Station). They can provide water levels in the channels upstream of the channel monsters.**

   3) Looking at the Collection System Master Plan it is difficult to reconcile how the wet well level changes during high flows (storms).

   4) Other plants typically can divert 1 days worth of influent flow during emergency periods.

      a) Denver Metro did not have any EQ. No violations over 18 year period. That said, Metro is a Special District,; there

      b) .fore can get the automation, controls, and facilities that they need to have reliable operation (more so than cities).

      c) Longmont has an EQ basin that holds 6 MG at the front end of the plant. That allows them to do unattended operation on a daily basis. During the Longmont flooding event last year, they were down for 24 hours, which resulted in flooded basements.

3. Next Steps:

A. Decision: Off-spec water diversion should be considered as an early execution project in the Master Plan.
B. Action Item: Carollo to consider using the existing tarmac pump station as the site waste pump station.
C. Action Item: Carollo to consider the potential for raw bypass in a long-term outage scenario.
D. Action Item: Carollo to evaluate the need for a standby blower for channel mixing.
E. Action Item: Carollo to consider providing flexibility to implement either digester feed approach as part of the master planning recommendations.
F. Action Item: City to provide a list of planned maintenance activities that are accomplished by diverting influent plant flow to the ponds.
G. Action Item: City to provide record of wet well levels (i.e., those that are used to trigger running the Auxiliary Pump Station). They can provide water levels in the channels upstream of the channel monsters.

Attachments

Process Criticality Assessment Tables – 2/18/2014

Prepared By:

Katy Rogers

Process Criticality Assessment
Sunnyvale Master Plan

2/18/2014

Process	Standby Load 72-hours	Standby Load 24-hours	Est. Peak Duty Load All duty units	Est. Connected All units (duty + standby)
Headworks	1,493	1,493	1,782	2,285
Primary Sed	66	105	105	196
EQ Emergency Storage	0	0	60	90
Conventional Activated Sludge	0	758	1,673	2,070
MBR	30	1,823	3,218	3,656
Filtration	100	350	351	467
Disinfection(1)	16	35	381	744
Recycled Water System	0	0	427	594
Thickening	25	89	187	282
Digestion	0	77	443	513
Dewatering	0	0	386	532
Support Facilities (Admin., etc.)	50	101	201	251
Total for AS	**1,749**	**3,007**	**5,995**	**8,023**
Total for MBR	**1,779**	**4,072**	**7,540**	**9,609**

Notes:
(1) The disinfection loads are based on a sodium hypochlorite + ozone process. In the far future, the process may change to a UV + ozone process. Refer to the disinfection tab for loads associated with this type of process to ensure the ultimate power distribution system can accommodate the UV + ozone process.

Process Criticality Assessment
Sunnyvale Master Plan

2/18/2014

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Headworks												
Subsystems:												
Screening												
Bar Screens	4	PHF	20 mgd each; 3/8" clear opening	1 standby screen, 1 bypass channel	Yes	FM	45	45	Yes	45	60	Screen blinding, drive failure.
Screenings Conveyor	1	PHF		1 dedicated to all 4 screens; Provide diverter chute when conveyor offline	Yes	FM	15	15	Yes	15	15	Drive failure
Screenings Washer/Compactor	2	PHF		No standby	No	n/a	n/a	n/a	No	6	6	Motor failure, blinding/plugging
Pumping												
Inlet Gates	4	PHF		PHF can pass through 2 gates?	Yes	FM	8	8	Yes	8	8	Motor failure
Wetwell	2	PHF		Divider gate between wetwells	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Influent Pumps	6	PHF	4 pumps 12 mgd each, 2 pumps 6 mgd each (6 12 mgd pumps at buildout)	1 standby (largest pump)	Yes	FM	1375	1375	Yes	1375	1650	Overheating, clogging, motor failure, impeller wear
Flow Meters	1?	PHF		Meter bypass?	No	n/a	n/a	n/a	Yes	1	1	
Mag meter isolation valves	2	PHF		No standby	No	n/a	n/a	n/a	Yes	2	2	Assume in-line flow metering with magnetic meter. Only isolation valves required to divert flow for access to meter.
Grit Removal												
HeadCell	3	PDF	60 mgd hydraulic capacity; 40 mgd treatment capacity	1 standby	No	n/a	n/a	n/a	n/a	n/a	n/a	
Inlet Gates	3 (1 per HeadCell Unit)	PHF		No standby	No	n/a	n/a	n/a	Yes	12	12	Motor failure
Grit Pumps	6 (2 per HeadCell Unit)	PHF		1 standby per HeadCell unit	No	n/a	n/a	n/a	Yes	150	300	Overheating, clogging, motor failure, shaft wear
Grit Pump Station Sump Pump	2	n/a	Drain wet well in 4 hours	1 standby	No	n/a	n/a	n/a	Yes	3	6	Motor failure
Grit Washing Unit	2	n/a		1 standby	No	n/a	n/a	n/a	Yes	5	10	Horsepower estimated. 1 Coanda unit requires about 2 hp (estimated 5 hp to be conservative).
Recycle Stream Pump Station							n/a	n/a				
Inlet Gates	2	n/a		1 standby	No	n/a	n/a	n/a	Yes	5	5	Motor failure
Recycle Pumps	2	n/a		1 standby	Yes	FM	25	25	Yes	25	50	Horsepower roughly estimated
Recycle Wet Well Sump Pumps	2	n/a	Drain wet well in 4 hours	1 standby	No	n/a	n/a	n/a	Yes	5	10	Motor failure

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
HVAC System	1 System (multiple fans)	n/a	Building area and occupancy, 12 air changes per hour	Standby fans	Yes	HH	25	25	Yes	25	50	Fan failure
Odor Control System (for Headworks and Primaries)												
Exhaust Fan (Biotower Fan)	1 - 100 hp fan	n/a	Building area and occupancy, 12 air changes per hour	No standby	No	n/a	n/a	n/a	Yes	100	100	
Scrubber Fan	1	n/a		No standby	No	n/a	n/a	n/a	Yes			
Odor Control Sump Pump	1	n/a		No standby	No	n/a	n/a	n/a	Yes			
Scrubber Recirculation Pump	1	n/a		No standby	No	n/a	n/a	n/a	Yes			
Total							**1493**	**1493**		**1782**	**2285**	

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Standby Power Category
- HH - Human Health
- FM - Flow Management
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Flow/Load
- PHF - Peak Hourly Flow
- PDF/L - Peak Daily Flow/Load
- MMF/L - Max Monthly Flow/Load
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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Primary Sed												
Subsystems:												
Primary Sed Tank	6 tanks - 115' long x 19' wide x 14' deep	MMF	2000 gpd/sf	All tanks in service during max month	n/a	n/a	n/a	n/a	Yes	n/a	n/a	n/a
Collector Mechanisms	6 (1 sludge collector, flights and chains per tank)	MMF	Primary clarifier basin dimensions and water depth	No backup required	Yes	EP	12	12	Yes	12	12	Damaged collector, broken chains, debris and rags entangled around collector, sludge line plugged, drive failure
Cross Collector	6 (1 cross collector per tank)	MMF	Primary clarifier basin width, hopper size, and water depth	No backup required	Yes	EP	6	6	Yes	6	6	Scraper worn or damaged, drive failure
Sludge Pumping	6 (2 per 2 tanks), positive displacement, 40 gpm	PDF/L	Pumping capacity	1 standby per 2 tanks	Yes	EP	22.5	22.5	Yes	22.5	45	Sludge line plugged, motor failure
Scum Pumping	4 (2 per 3 tanks), positive displacement, 15 gpm	PDF/L	Pumping capacity	1 standby per 3 tanks	Yes	EP	n/a	10	Yes	10	20	Scum line plugged, motor failure
Scum pipe/helical skimmer	6 (1 per tank)	n/a	Skimming capacity	No backup required	Yes	EP	n/a	4.5	Yes	4.5	4.5	Buildups in scum pipe, motor failure
CEPT Facilities												
Iron Salt Feed Pumps	2	MMF & one tank offline	0.2 mg/L dose	1 standby	No	n/a	n/a	n/a	Yes	n/a	2	Motor failure, line leakage
Polymer Feed Pumps	2	MMF & one tank offline	20 mg/L dose	1 standby	No	n/a	n/a	n/a	Yes	n/a	2	Motor failure, line plugged or leakage
Polymer Blending Unit	1	n/a		No backup required	No	n/a	n/a	n/a	Yes	n/a	1	Motor failure, line plugged or leakage
Blower for Channel Aeration	2	MMF	Air requirements for channel aeration	1 standby	Yes	EP	n/a	25	Yes	25	50	Motor failure
Spray water booster pump	2	n/a	Any one pump to meet flow demand and pressure	1 standby	No	n/a	n/a	n/a	Yes	n/a	3	Motor failure
HVAC	1 system (multiple fans)	n/a	Building area and occupancy		Yes	HH	25	25	Yes	25	50	Fan failure
Total							**65.5**	**105**		**105**	**195.5**	

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Diurnal EQ/ EQ Return Pump Station												
Subsystems:												
Storage Tanks	2 - 4 Mgal Tanks	Peaks Above 34.7 mgd	160 DIA x 25 SWD, prestressed concrete	No standby. Tanks used in sequence depending on needs.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Spillway into emergency storage basin OR pass flow through Plant.
EQ Return Pump Station	3	Variable	4 mgd, each @ 27 ft	1 standby	No	n/a	n/a	n/a	Yes	60	90	Motor Failure
Total							**0**	**0**		**60**	**90**	

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Conv. Act. Sludge												
Subsystems:												
Aeration Basins	3 - 3 MG basins	MMF/MML	Aerobic SRT = 7 day	1 basin out of service for ADWF/ADWL (either aeration basin OR secondary clarifier)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Secondary Clarifiers	7 - 5,260 sf basins	MMF/PDF	SVI = 150 mL/g	1 clarifier out of service for ADWF/ADWL (either a clarifier OR an aeration basin)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS pumps	6 - 2000 gpm pumps	Peak RAS flow in 2035	40% of peak flow	1 standby	Yes	PP	n/a	75	Yes	75	90	Motor failure
WAS pumps	6 - 7.5 hp	Peak WAS flow in 2035	peak WAS flow = 0.6 mgd, RAS = 10,000 mg/L, 8 hour/day operation	1 standby	Yes	PP	n/a	22.5	Yes	37.5	45	Motor failure
IR pump	4 - 17000 gpm pumps	MMF	290% of MMF	1 standby	Yes	PP	n/a	225	Yes	225	300	Motor failure
Mixers	9 - 15 hp submersible mixers	MMF	0.5kwh/kcf	1 aeration basin or secondary clarifier out of service for ADWF	Yes	PP	n/a	135	Yes	135	135	Motor failure
Aeration blowers	5 - 300 hp blowers	Peak aeration demand 2035	DO of 2 mg/L at MMFs, peak of 1.3 x MMF	1 standby	Yes	PP	n/a	300	Yes	1200	1500	Plan on needing backup power to 1 of 5 blowers. NOTE: This assumes that can violate the max day limit
Total							**0**	**758**		**1673**	**2070**	

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Process Criticality Assessment
Sunnyvale Master Plan

2/18/2014

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
MBR												
Subsystems:												
Fine Screens	6 - 1mm screens	PDF	peak flow 2035	1 standby	Yes	PP	25	25	Yes	25	30	
Fine Screen Washer Compactors	6 units	n/a			No	n/a	n/a	n/a	Yes	15	18	
Aeration basin	3 - 1.03 MG basins	MMF/MML	total SRT = 10 days	1 aeration basin out of service for ADWF/ADWL	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS Step Screens	2 - 3mm screens	PDF	peak flow 2035	1 standby, both screens operated regularly	Yes	PP	5	5	Yes	5	10	
Step Screenings Conveyor	1 compactor	n/a		No standby	No	n/a	n/a	n/a	Yes	5	5	
Membrane Tanks	6 - 287,000 sf of membranes	MMF	MMF flux = 18.3 gfd	1 membrane tank out of service for MMF, PDF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
RAS pumps	6 - 100 hp pumps	MMF	4Q at MMF	1 standby	Yes	PP	n/a	500	Yes	500	600	
WAS pumps	3 - 25 hp pumps	Peak WAS flow	Peak WAS flow in 2035	1 standby	Yes	PP	n/a	25	Yes	50	75	
Permeate pumps	6 - 75 hp pumps (1 per MBR tank)	PDF	peak flow 2035	No standby (1 per MBR tank)	Yes	PP	n/a	450	Yes	450	450	
Mixers	9 - 7.5 hp (1 per un-aerated zone)	MMF	0.5kwh/kcf	No standby (9 duty per basin). 1 aeration basin out of service for ADWF	Yes	PP	n/a	67.5	Yes	67.5	67.5	
Aeration blowers (aeration basin)	5 - 300 hp blowers	Peak aeration demand	DO of 2 mg/L at MMFs, peak of 1.3 x MMF	1 standby	Yes	PP	n/a	300	Yes	1200	1500	Plan on needing backup power to 1 of 5 blowers. NOTE: this assumes can violate max day ammonia limit.
Membrane air scour blowers	6 - 150 hp blowers	MMF		No standby (6 duty).	Yes	PP	n/a	450	Yes	900	900	Plan on providing standby power to 1/2 of the blowers.
Total							**30**	**1823**		**3218**	**3656**	

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Filtration												
Subsystems:												
Filter Polymer Pumps	2	5 ppm @ MMF		1 standby	No	n/a	n/a	n/a	No	1	2	Motor failure
Filters	4 duty, 32 length x 15 width	MMF	match aeration basin capacity	1 standby during summer low flows, no standby during wet weather	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Filter blinding, backwash valve failure
Filtered Water Lift Pumps	6	MMF	8 mgd each @16 ft	1 standby at equalized PHF	Yes	FM	100	200	Yes	200	240	Motor failure, overheating, bearing failure
Backwash Pumps	3		8400 gpm @ 20 ft	1 standby	Yes	PP	n/a	150	Yes	150	225	Motor failure, overheating, bearing failure
Total							**100**	**350**		**351**	**467**	

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Process Criticality Assessment
Sunnyvale Master Plan

2/18/2014

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Disinfection												
Subsystems:												
Current Planning Considerations:												
Chlorine Contact Tank	4	MMF	<60 min contact time for discharge, 120 min contact time for recycled water	1 standby during ADWF	n/a	n/a		n/a	n/a	n/a	n/a	
Sodium Hypochlorite System												
Sodium Hypochlorite Storage Tanks	3 - each 6,000 gallons working volume (actual volume is 6,500 - 6,600 gallons), 10 ft diameter, 11 ft tall	ADF	1,050 gpd for effluent disinfection and 230 gpd for filter influent chlorination	One of three tanks will be kept full all the times.	No	FM	n/a	n/a	n/a	n/a	n/a	Overfill due to level transducer failure
Filter Influent Chlorination - Tote	330 gallon tote	ADF	Min one day storage, will be refilled from hypochlorite storage tanks	n/a	No	n/a	n/a	n/a	n/a	n/a	n/a	Overfill due to level transducer failure
Filter Influent Chlorination - Metering Pumps	2 peristaltic pumps, each 2 - 100 gph discharge flow	ADF	To meet min and max day sodium hypochlorite demand	1 standby	No	n/a	n/a	n/a	yes	0.33	0.66	Motor failure, tube leakage
Sodium Hypochlorite Transfer Pumps	3 FRP centrifugal pump, each 100 gpm discharge flow	N/A	One pump to transfer hypochlorite between storage tanks and recirculate within the tank and one pump to refill filter influent chlorination tote	1 standby	Yes	FM	n/a	1.5	yes	3	3	Motor failure
Filter Backwash Supply Chlorination - Metering Pumps	2 peristaltic pump, each 50 - 500 gph discharge flow	N/A	To meet min and max sodium hypochlorite demand	1 standby	Yes	FM	n/a	n/a	yes	0.33	0.66	Motor failure, tube leakage
Effluent Disinfection Metering Pumps	2 peristaltic pump, each 5 - 500 gph discharge flow	ADF	To meet min and max day sodium hypochlorite demand	1 standby	Yes	FM	0.660	0.660	yes	0.33	0.66	Motor failure, tube leakage
Induction Unit	2	N/A	N/A	1 standby	Yes	FM	15	15	Yes	7.5	15	Motor failure, feed connection failure
Sodium Bisulfite System												
Bisulfite Storage Tank	1			No standby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Chemical Induction Unit	1	MMF		No standby	Yes	PP	n/a	15	Yes	15	15	
Bisulfite Analyzer	2			1 standby	Yes	PP	n/a	1	Yes	1	2	
Bisulfite Injection Pump	2	MMF		1 standby	Yes	PP	n/a	1	Yes	1	2	
Vent Scrubber	1			No standby	Yes	PP	n/a	1	Yes	1	1	
Subtotal for Chlorination							**16**	**35**		**29**	**40**	

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Disinfection												
Future Planning Considerations:												
UV Channels	3	MMF	3 channels at 12.9 mgd per channel	1 standby channel at max month	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Some channels shut down during summer for maintenance
UV Lamps	384	MMF	64 lamps per bank, 2 banks per channel, 25 mJ/cm^2	1/3 of lamps on standby during MMF	Yes	PP	67	134	Yes	134	201	Multiple channels available
Subtotal for UV							**67**	**134**		**134**	**201**	
Aqueous Ammonia Chemical Metering Pump	2	MMF		1 standby	No	n/a	n/a	n/a	Yes	2	4	
Subtotal for Chloramination							**0**	**0**		**2**	**4**	
Ozone Generator	2	MMF	3 mg/L	1 unit standby	No	n/a	n/a	n/a	Yes	350	700	
Subtotal for Ozone							**0**	**0**		**350**	**700**	
Total - Sodium Hypochlorite + Ozone							**16**	**35**		**381**	**744**	
Total - UV + Ozone							**67**	**134**		**484**	**901**	

Abbreviation:

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Flow/Load
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- MMF/L - Max Monthly Flow/Load
- ADF - Average Day Flow
- ADWF/L - Average Dry Weather Flow/Load

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Recycled Water System												
Subsystems:												
Recycled Water Pumps	5	Demand	2x150hp, 2x100hp, 1x75hp, 1x15hp, (5500 gpm @ 60 psi)	1 standby (largest pump)	No	n/a	n/a	n/a	No	425	590	If pumps fail, switch to potable water supply
Hypo Dosing Pumps	1	Demand	6 ppm	1 standby	No	n/a	n/a	n/a	No	2	4	
Total							**0**	**0**		**427**	**594**	

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- ADF - Average Day Flow
- ADWF/L - Average Dry Weather Flow/Load

Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Thickening												
Subsystems:												
WAS Storage												
Recirculation Pump	2	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Thickening												
Rotary Drum Thickeners	3	MML	400 gpm @ 1 % solids; 2,000 pph	1 standby	Yes	PP	n/a	25	Yes	50	75	
TWAS Pumps	3	MML		1 standby	Yes	PP	n/a	25	Yes	50	75	
Spray Water Booster Pumps	2	MML		1 standby	Yes	PP	n/a	5	Yes	5	10	
Thickening Polymer System							n/a					
Recirculation Pump	2	MML		1 standby	Yes	PP	n/a	7.5	Yes	7.5	15	
Polymer Blender Units	4	MML		1 standby	Yes	PP	n/a	1.5	Yes	1.5	2	
HVAC System (for Thickening and Dewatering)	1 System (multiple fans)	n/a	Building area and occupancy, 12 air changes per hour	Standby fans	Yes	HH	25	25	Yes	25	50	Fan failure
Odor Control System (for Thickening and Dewatering)												
Exhaust Fan (Biotower Fan)	1 - 40 hp fan	n/a	Building area and occupancy, 12 air changes per hour	No standby	No	n/a	n/a	n/a	Yes	40	40	
Scrubber Fan	1	n/a			No	n/a	n/a	n/a	Yes			
Odor Control Sump Pump	1	n/a			No	n/a	n/a	n/a	Yes			
Scrubber Recirculation Pump	1	n/a			No	n/a	n/a	n/a	Yes			
Total							**25**	**89**		**187**	**282**	

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Digestion												
Subsystems:												
Digesters	2 - 82,300 CF digesters 3 - 120,100 CF digester	MML	15 day SRT at max month load; 0.12 lb/cf-day VSS loading rate	1 standby (largest digester tank)	No	n/a	n/a	n/a	Yes	0	0	
Mixing System												
Digester Gas Recirculating Pumps	2 (2 - 30 hp pumps for Dig. 1 and 2)	MML		No standby (1 per digester)	No	n/a	n/a	n/a	Yes	60	60	
Digester Mixing Pumps	4 (1 - 30 hp pump for Dig. 3; 1 - 40 hp pump for Dig. 4, and 5)	MML		No standby (1 per digester)	Yes	n/a	n/a	40	Yes	110	110	During power outage, mix one digester at a time (rotate).
Heating System							n/a					
Heat Exchanger	5	MML		No standby (1 per digester)	Yes	n/a	n/a	0	Yes	0	0	
Digester Sludge Recirculating Pumps	5 - 15 hp pumps	MML		No standby (1 per digester)	Yes	n/a	n/a	30	Yes	75	75	
Digester Hot Water Recirculating Pumps	5 - 1 hp pumps	MML		No standby (1 per digester)	Yes	n/a	n/a	2	Yes	5	5	
Raw Sludge Hot Water Pump	1 - 5 hp pump	MML		No standby	Yes	n/a	n/a	5	Yes	5	5	
Sludge Pumping							n/a					
Supernatant Pumps	3 pumps	MML		1 standby (assuming pumps operated intermittently)	No	n/a	n/a	n/a	Yes	20	30	
Transfer Sludge Pumps	2 pumps	MML		1 standby (assuming pumps operated intermittently)	No	n/a	n/a	n/a	Yes	50	100	
Digester Drain Pump	1 pump	n/a		No standby	No	n/a	n/a	n/a	Yes	50	50	
Influent Sludge Grinders	4 - 5 hp grinders (1 for Dig. 2 - 5)	MML		No standby (1 per digester)	No	n/a	n/a	n/a	Yes	20	20	
Gas Management							n/a					
Digester Gas Flare	1	MML		No standby	No	n/a	n/a	n/a	Yes	0	0	
FOG Feed Facility							n/a					
Rock Trap/Grinder	1	MML		No standby	No	n/a	n/a	n/a	Yes	7.5	7.5	
Unloading/Mixing Pump	2 chopper pumps	MML		1 standby	No	n/a	n/a	n/a	Yes	10	20	
Digester Feed Pump	2 progressive cavity pump	MML		No standby	No	n/a	n/a	n/a	Yes	20	20	
Heat Tracing	1	MML		No standby	No	n/a	n/a	n/a	Yes	10	10	
Total							**0**	**77**		**443**	**513**	

Notes:

(1) Assume during a 24-hour power outage WAS needs to be wasted to the digesters. Assume WAS will be sent to two of the large digesters. Assume those digesters need heating if receiving new (i.e., cold) sludge. Assume other digesters do not need heating during 24-hour power outage. Assume all digesters need mixing during power outage.

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power Yes/No	Standby Power Category	Standby Power 72-hr Hp±	Standby Power 24-hr Hp±	Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
Dewatering												
Subsystems:												
Thickened Sludge Storage												
Thickened Sludge Storage Tank	1	MML		No standby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Recirculation Pump (Mixing)	2	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Feed Pumping												
Feed Pumps	4	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Inline Grinder	4	MML		1 standby	No	n/a	n/a	n/a	Yes	15	20	
Dewatering												
Screw Press	4	MML		1 standby	No	n/a	n/a	n/a	Yes	30	40	
Bridge Crane	1	n/a		No standby	No	n/a	n/a	n/a	No	20	20	
Dewatering Polymer System												
Recirculation Pump	2	MML		1 standby	No	n/a	n/a	n/a	Yes	7.5	15	
Polymer Blender Units	2	MML		1 standby	No	n/a	n/a	n/a	Yes	5	10	
Polymer Solution Feed Pumps	5	MML		1 standby	No	n/a	n/a	n/a	Yes	40	50	
Potable Water Booster Pumps	2	MML		1 standby	No	n/a	n/a	n/a	Yes	20	40	
Cake Pumping												
Cake Pump	4	MML		1 standby	No	n/a	n/a	n/a	Yes	120	160	
Cake Hopper Discharge Gates	2	n/a		Bypass pipeline for direct truck loading	No	n/a	n/a	n/a	Yes	1	2	
HVAC System (included in Thickening)												
Total							**0**	**0**		**386**	**532**	

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Process/Equipment	Proposed Facilities	Flow & Load Condition	Design Criteria	Standby Criteria	Standby Power				Segregated Power?	Est. Peak Duty All duty units Hp±	Est. Connected All units Hp±	Comments (Failure Modes)
					Yes/No	Category	72-hr Hp±	24-hr Hp±				
Support Facilities (Admin., etc.)												
Subsystems:												
Support Facilities (Admin., etc.)	20,000 SF	n/a	7.5 VA per SF		Yes	FM	50	101	n/a	201	251	
Total							**50**	**101**		**201**	**251**	

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APPENDIX B - OUTLINE SPECIFICATION OF BUILDING MATERIALS AND SYSTEM ASSUMPTIONS

ADMINISTRATION/LAB/OPS - CONCEPT DESIGN OUTLINE SPECIFICATIONS
5 May 2015

DIVISION 1 - GENERAL REQUIREMENTS

01100 Summary

Office Building - 22,000 sf – Two floors @ approximately 12,000 sf first floor 10,000 sf second floor, plus 730 sf of exterior deck. Building height - Assume 15' Floor to Floor and Floor to Roof plus 42" min. parapet at roof. Building will be designed to meet **Essential Services Building** standards. Building and systems will be designed to meet **USGBC LEED Gold rating requirements.**

Estimated Costs to include new building only. All site work, including hardscape areas adjacent to the building, all civil work, i.e. paving/drainage at parking area and yard around building/parking structures, and site utilities are not included in this estimate.

Furniture/Equipment – provide FF&E allowance for all furniture, office partition system, and misc. lab equipment. Assume majority of lab equipment to be relocated from existing building.

01352 LEED Requirements

The Project is to be designed to meet LEED certification at a minimum Gold level. Certification may be pursued.

01410 Regulatory Requirements

Applicable code requirements include the current edition of the California Building Code, Electrical Code, Mechanical Code, Plumbing Code, and Fire Code, with City of Sunnyvale amendments. Requirements of the Federal Americans with Disabilities Act (ADA) "Accessibility Guidelines for Buildings and Facilities" (ADAAG) also applies.

DIVISION 2 - SITE CONSTRUCTION

02300 Earthwork

Grading and preparation of site for the building foundation. **Over excavation of existing fill and compacted fill to be estimated by others.**

02621 Foundation Drainage System

Drain piping to collect and divert rain water away from building foundations.

(Civil and Landscaping work to be estimated by others)

DIVISION 3 - CONCRETE

03100 Concrete Formwork
Formwork requirements for cast-in-place concrete.

03200 Concrete Reinforcement
Meeting ASTM A615 Grade 60 or ASTM A706 Grade 60

03300 Cast-in-Place Concrete
Slab on grade, spread footing foundation: 4,000 psi, normal weight concrete.
Topping Slabs and Miscellaneous Concrete: 3,000 psi, normal weight concrete.
Possible concrete wall at Admin first floor entry/locker room north wall.

03357 Concrete Floor Sealer - Vapor Emission Control
Curing compound and sealer at slabs to receive an applied impervious finish material.

03360 Concrete Finishes
Includes stained and polished floor finish – First floor Lobby, corridor and mud room.
Second floor exterior deck.

DIVISION 4 - MASONRY

04220 Concrete Unit Masonry
Possible reinforced CMU masonry wall Admin first floor entry/locker room north wall.

DIVISION 5 - METALS

05120 Structural Steel
Building structural steel frame, including steel pipe columns, wide flange beams and shapes, channels, angles, plates, rods, tubing, and bolts.

051210 Buckling Restrained Braces

053100 Steel Decking
Concrete filled metal decking at second floor and roof.

05400 Cold Formed Metal Framing
Perimeter wall framing members, designed to withstand dead and live loads due to vertical and horizontal loads from wind, seismic, and exterior building materials.

05500 Metal Fabrications
Miscellaneous metal items include balcony railings, stair nosings, custom handrails, elevator sill angles, ladders, sump grates and steel support framing for wall and ceiling hung items.

05510 Metal Stairs
Concrete filled steel pan stairs at secondary stairwell; custom designed steel pan stairs and railing at main entry lobby.

05590 Custom Stainless Steel Fabrications
Stainless steel countertops and shelving at Compliance Inspection Lab.

DIVISION 6 - WOOD AND PLASTICS

06105 Miscellaneous Rough Carpentry
Wood and wood panel products for blocking, backing, and miscellaneous items. FSC certification of wood source.

06200 Finish Carpentry
Standing and running trim for miscellaneous interior wood items – chair rail at large Meeting Room, accent wall panels at lobby stair. FSC certification of wood source.

06400 Architectural Woodwork
Wood casework, plastic laminate countertops at office/control/copy areas, and shop fabricated woodwork. FSC certification of wood sources.

06615 Solid Surfacing Material
Countertops at Restrooms and Kitchen.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07210 Building Insulation
Thermal Wall Insulation: 6 inch thick fiberglass batts, minimum R-19, containing no urea formaldehyde binder plus 2-1/2" rigid insulation exterior to stud framing.
Acoustical Insulation: 4 inch thick fiberglass batts, containing no urea formaldehyde binder at restrooms, locker rooms, conference rooms and private offices.

07260 Vapor Retarders
Underslab vapor retarder to prevent migration of groundwater into slab-on-grade; minimum 15 mil polyethylene sheet meeting ASTM E1745, Class A.

07412 Preformed Metal Wall and Soffit Panels
Building envelope - Galvanized steel concealed fastener Kynar coated finish; Centria, Morin, system, or similar.

07542 TPO Thermoplastic Membrane Roofing
Fully adhered thermoplastic polyolefin membrane roofing over rigid insulation board. Membrane minimum 60 mils thick, white color, minimum 78 Solar Reflectance Index. Insulation board rigid polyisocyanurate meeting ASTM C1289 Type II, average R value of 30.

07600 Flashing and Sheet Metal
Typical 24-gage galvanized sheet metal at flashings, counterflashings, parapet caps, reglets, gutters and scuppers. Typical 60-mil thick reinforced rubberized asphalt at flexible flashings.

07840 Firestopping
Penetrations in fire-rated construction; top-of-wall firestopping at fire-rated partitions.

07900 Joint Sealers
Interior and exterior sealants for resistance to water, moisture, air, and sound. Sealants to comply with VOC emissions requirements of South Coast Air Quality Management District.

DIVISION 8 - DOORS AND WINDOWS

08110 Steel Doors and Frames
Exterior insulated hollow metal doors and frames at service doors, meeting ANSI/SDI A250.8, Level 2 - Heavy Duty.

08120 Aluminum Doors and Frames
Interior Room Doors: Aluminum frames, fire rated where required, clear anodized aluminum finish.

08210 Wood Doors
Flush solid core interior wood doors, 1-3/4 inch thick, natural hardwood veneer finish, FSC certified particleboard cores.

08310 Access Doors and Panels
Plumbing and mechanical access doors and panels in walls and ceilings to access plumbing valves and HVAC controls.

08420 Aluminum Windows, Entrances, and Storefronts
Perimeter Windows: Similar to Kawneer "Trifab VG451T", thermal break storefront framing system, 1-inch thick insulating glass, clear anodized finish with integrated sunshades at east, south and west walls, similar to Kawneer “ Versoleil Outrigger” system.
Two Story High Reception Lobby: Similar to Kawneer "1600 Wall System", curtainwall framing system, 1-inch thick insulating glass, clear anodized finish.
Entrance Doors: Similar to Kawneer "AA 425 – Thermal entrance doors.

08620 Unit Skylights
Tubular skylights at second floor interior office areas – Solatube 750-DS-O 21 or similar.

08710 Door Hardware
Builders hardware for doors to include hinges, locksets, exit devices, closers, openers, stops, gasketing, thresholds, and door protection. Building to meet current California Building Code requirements for life safety, fire and smoke protection, and accessibility;

main entry door to have ADA-accessible automatic door openers. Assume card reader system and electronic door monitoring system at exterior entry doors.

08800 Glazing
Window, storefront, and curtainwall glazing to be 1 inch thick high performance insulating glass units with low-e coating on #2 face. Doors and sidelites to be clear tempered safety glass.

DIVISION 9 - FINISHES

09100 Metal Support Systems
Light gage interior steel framing systems, consisting of 20-gage punched cee studs, shaftwall studs, ceiling joists, furring channels, backing plates, and suspended ceiling grillage for gypsum board.

09250 Gypsum Board
Typical Interior Walls and Ceilings: 5/8-inch thick gypsum board, Type X.
Exterior Walls Behind Metal Wall Panels: 1/2-inch thick exterior sheathing.
Shaft Walls: 1-inch thick gypsum shaft liner board.
Behind Tile Wainscoting: 5/8-inch thick cementitious backer board.

09300 Tile Work
Public Toilet Rooms: Ceramic tile at floor and walls, thinset.
Staff Toilet/Locker Rooms: Ceramic tile at floor and walls, thinset; waterproof membrane under floor tile at second floor.
Locker Room Showers: Ceramic tile at floor and walls, mortar bed; waterproof membrane under tile.

09510 Acoustical Ceilings
Lay-in acoustical ceilings to be provided at lobby, offices, operations, meeting rooms, lab, day room.
Panels: 24 x 24 or 24 x 48 inches, performance characteristics to be determined.
Suspended Grid: 9/16 inch flat bottom tee, meeting ASTM C635 Intermediate Duty, seismic bracing meeting CBC requirements.

09650 Resilient Flooring
Laboratory/Compliance Inspection/Receiving: 3 mm thick homogeneous sheet vinyl; Nora-Noraplan "Envirocare", heat welded seams, integral cove base, or similar.
Operations/Control, first floor corridor, dayroom, kitchen, storage rooms: Linoleum sheet or linoleum tile.
Rubber Topset Base: At linoleum floors, carpet tile floors, and concrete floors where gypsum board meets floor.

09681 Carpet Tile

At Office areas, second floor reception and Meeting Rooms; 20 x 20 inches, tufted textured loop, soil/stain protected and antimicrobial treated; Shaw Contract Group or Interface, meeting CRI "Green Label Plus" certification program.

09699 Water Vapor Emission Control Testing
Testing of concrete floor substrates to verify whether slabs are fully cured to accept impervious finish material. When floors fail testing, provide remedial floor sealer system.

09910 Paints
Interior and exterior paints, stains, and coatings. Primarily acrylic latex, meeting VOC requirements of South Coast Air Quality Management District.

DIVISION 10 - SPECIALTIES

10100 Visual Display Boards
Items include marker boards and tackboards, in Operation/control, day room, and all Meeting/conference Rooms.

10210 Metal Wall Louvers
Extruded aluminum or hollow metal wall louvers for ventilation or air intake/exhaust, including bird screens or insect screens.

10240 Exterior Grilles and Screens
Visual screens around outdoor roof mounted mechanical equipment.

10260 Wall and Corner Guards
Includes corner guards and/or wall protection in hallways subject to bumping and scraping from carts, etc.

10440 Signage
Interior wall mounted signs identifying rooms, ADA accessibility signs, exit signs, and occupancy load signs.
Exterior building identification sign.
Parking signage by others.

10500 Lockers
Metal lockers and wood locker benches for staff locker rooms .

10520 Fire Protection Specialties
Fire extinguishers, fire extinguisher cabinets, extinguisher mounting brackets, and fireman's Knox box.

10650 Operable Partitions
Potential room divider partition at Public Outreach/Meeting Room to allow simultaneous meetings.

10800 Toilet and Bath Accessories
Stainless steel accessories for toilet rooms, shower rooms, janitorial room, and sinks in kitchen.

10900 Wardrobe and Closet Specialties
Coat and boot racks for Mud room.

DIVISION 11 - EQUIPMENT

11132 Projection Screens
Motorized projection screen, recessed in ceiling of Public Outreach/Meeting Room and Day Room.

11450 Residential Equipment
Kitchen: Refrigerator, range, dishwasher, two microwave ovens.

11620 Laboratory Fume Hoods
SS Canopy hoods at Wet Chemistry 1 – 60”, Dishwashing - 1 – 48” and Metals Lab - 2 – 48”
Fume Hoods
Wet Chemistry – 6 – 60” fume hoods
Microbiology – two biological safety hoods
Organics – 1 – 48” fume hood
Metals – 1 – 48” fume hood

DIVISION 12 - FURNISHINGS

12346 Laboratory Countertops
Standard lab epoxy resin countertops, black, 6” splash

12349 Laboratory Service Fittings
Swivel goose neck faucets with vacuum breakers.
Deionized faucets.
Gas, air, vacuum fittings.

12352 Laboratory Wood Casework
Kewaunee Flush Overlay laboratory fixed wood casework, or similar.

12484 Floor Mats and Frames
Recessed floor mats and frames at entry doors in Reception Lobby, Lab Sample Receiving and Mud room.

12491 Horizontal Louver Blinds
Window blinds at offices, lounge, meeting room, and other windows subject to glare from direct sunlight entering building.

DIVISION 13 - SPECIAL CONSTRUCTION

13930 Fire Protection – Automatic Sprinkler System

City requirement to provide automatic sprinkler system. Clean agent fire extinguishing system in Server and Electrical Room.

DIVISION 14 - CONVEYING SYSTEMS

14240 Hydraulic Elevators

Minimum 3,500 pound capacity oil-hydraulic passenger elevator, accessible.
Entrance Doors and Frames: Brushed stainless steel.
Elevator Cab Door, Walls and Ceiling Finishes: Brushed or decorative stainless steel.
Elevator Cab Floor: Sheet linoleum, rubber, or similar durable material.
Floor level call "Kick" buttons at each entrance landing and in cab.

DIVISION 15 - MECHANICAL

Assume high efficiency, multi-zone HVAC system. Natural gas is available on site. Roof mounted HVAC equipment. Separate system for Laboratory and Environmental Compliance Lab – 100% outside air. Fume hood and canopy exhaust systems extend through chase at second floor up to roof.

DIVISION 16 - ELECTRICAL

High efficiency lighting, occupancy sensors, etc. to meet CEC.
Data network, security system.

MAINTENANCE - CONCEPT DESIGN OUTLINE SPECIFICATIONS
5 May 2015

DIVISION 1 - GENERAL REQUIREMENTS

01100 Summary

Maintenance Shop Building 8,000 sf – Single story including covered exterior storage area. Building Height – Assume 20’ Floor to Roof at Shop and Warehouse spaces, 15’ min. at Office, Gym, Small Parts Storage and accessory spaces. Building will be designed to meet **Essential Services Building** standards. Building and systems will be designed to meet **CalGreen Building Standards.**

Estimated Costs to include new building only. All site work, including hardscape areas adjacent to the building, all civil work, i.e. paving/drainage at parking area and yard around building/parking structures, and site utilities are not included in this estimate.

Furniture/Equipment – provide FF&E allowance for all furniture and office partition system at Mtce. and Warehouse Offices, warehouse shelving system and small parts storage shelving system. Assume Mtce. and Operators Shop equipment to be relocated from existing buildings. Assume Gym equipment to be relocated from existing gym.

01410 Regulatory Requirements

Applicable code requirements include the current edition of the California Building Code, Electrical Code, Mechanical Code, Plumbing Code, and Fire Code, with City of Sunnyvale amendments. Requirements of the Federal Americans with Disabilities Act (ADA) "Accessibility Guidelines for Buildings and Facilities" (ADAAG) also applies.

DIVISION 2 - SITE CONSTRUCTION

02300 Earthwork

Grading and preparation of site for the building pad and site grading.

02621 Foundation Drainage System

Drain piping to collect and divert rain water away from building foundations.

(Civil and Landscaping work beyond building perimeter to be estimated by others)

DIVISION 3 - CONCRETE

03100 Concrete Formwork

Formwork requirements for cast-in-place concrete.

03200 Concrete Reinforcement

Meeting ASTM A615 Grade 60 or ASTM A706 Grade 60

03300 **Cast-in-Place Concrete**
Slab on grade, spread footing foundation: 4,000 psi, normal weight concrete.
Miscellaneous Concrete: 3,000 psi, normal weight concrete.

03357 **Concrete Floor Sealer - Vapor Emission Control**
Curing compound and sealer at slabs to receive an applied impervious finish material.

03360 **Concrete Finishes**
Includes stained and polished floor finish at Entry hall. Sealed concrete at Operations shop, Mtce. Shop, HazMat Storage, Small Parts Storage and Warehouse storage.

<u>DIVISION 4 - MASONRY</u>

04220 **Concrete Unit Masonry**
CMU masonry exterior bearing walls. Shotblast face CMU field with 4” split face accent bands.

<u>DIVISION 5 - METALS</u>

05120 **Structural Steel**
Structural steel framing at roof and interior walls, including steel pipe columns, wide flange beams and shapes, channels, angles, plates, rods, tubing, and bolts. Steel roof framing and decking exposed at Operations Shop , Mtce. Shop, Warehouse, HazMat Storage and small parts storage.

053100 **Steel Decking**
At roof, with concrete fill.

05400 **Cold Formed Metal Framing**
NA

05500 **Metal Fabrications**
Miscellaneous metal items include roof access ladder, sump grates and steel support framing for wall and ceiling hung items.

<u>DIVISION 6 - WOOD AND PLASTICS</u>

06105 **Miscellaneous Rough Carpentry**
Wood and wood panel products for blocking, backing, and miscellaneous items. FSC certification of wood source.

06400 **Architectural Woodwork**

Clear finished wood casework, plastic laminate countertops, and shop fabricated woodwork. FSC certification of wood sources. Minimal casework at Mtce. Office - Map Storage counter and cabinets.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07210 Building Insulation
Thermal Wall Insulation at Conditioned Space (Mtce. & Ops Shop space unconditioned): 2-1/2" thick rigid polyiso against exterior CMU walls.
Acoustical Insulation: 4 inch thick fiberglass batts, containing no urea formaldehyde binder at restrooms and Shop walls.

07260 Vapor Retarders
Underslab vapor retarder to prevent migration of groundwater into slab-on-grade; minimum 15 mil polyethylene sheet meeting ASTM E1745, Class A.

07412 Preformed Metal Wall and Soffit Panels
Soffit at Exterior Equipment Storage areas - Galvanized steel concealed fastener Kynar coated low-e finish;Centria, Morin, system, or similar.

07542 TPO Thermoplastic Membrane Roofing
Fully adhered thermoplastic polyolefin membrane roofing over rigid insulation board. Membrane minimum 60 mils thick, white color, minimum 78 Solar Reflectance Index. Insulation board rigid polyisocyanurate meeting ASTM C1289 Type II, average R value of 30.

07600 Flashing and Sheet Metal
Typical 24-gage galvanized sheet metal at flashings, counterflashings, parapet caps, reglets, gutters and scuppers. Typical 60-mil thick reinforced rubberized asphalt at flexible flashings.

07840 Firestopping
Penetrations in fire-rated construction; top-of-wall firestopping at fire-rated partitions.

07900 Joint Sealers
Interior and exterior sealants for resistance to water, moisture, air, and sound. Sealants to comply with VOC emissions requirements of South Coast Air Quality Management District.

DIVISION 8 - DOORS AND WINDOWS

08110 Steel Doors and Frames
Exterior and interior insulated hollow metal doors and frames, except in locations noted in 08120 & 08420, meeting ANSI/SDI A250.8, Level 2 - Heavy Duty.

08120 Aluminum Doors and Frames
Interior Room Doors at Gym, Restroom, Mtce, Office: Aluminum frames.

08210 Wood Doors
Flush solid core interior wood doors at Aluminum Frame locations, 1-3/4 inch thick, natural hardwood veneer finish, FSC certified particleboard cores.

08310 Access Doors and Panels
Plumbing and mechanical access doors and panels in walls and ceilings to access plumbing valves and HVAC controls.

08332 Overhead Coiling Doors
Motorized, insulated steel coiling doors, factory finished at Mtce. Shop, Operations Shop and Warehouse.

08420 Aluminum Windows, Entrances, and Storefronts
Exterior Windows at Mtce. Office, Gym & Warehouse Staff office: Similar to Kawneer "Trifab VG451T", thermal break storefront framing system, 1-inch thick insulating glass, clear anodized finish with integrated sunshades at east, south and west walls, similar to Kawneer " Versoleil Outrigger" system.
Entrance Doors at Staff Entry: Similar to Kawneer "AA 425 – Thermal entrance doors.

08620 Unit Skylights
Tubular skylights at Restroom, Small Parts Storage, Shop & Warehouse – Solatube 750-DS-O 21 or similar.

08710 Door Hardware
Builders hardware for doors to include hinges, locksets, exit devices, closers, openers, stops, gasketing, thresholds, and door protection. Building to meet current California Building Code requirements for life safety, fire and smoke protection, and accessibility; main entry door to have ADA-accessible automatic door openers. Assume card reader system and electronic door monitoring system.

08800 Glazing
Windows and storefront glazing to be 1 inch thick high performance insulating glass units with low-e coating on #2 face. Doors and sidelites to be clear tempered safety glass.

DIVISION 9 - FINISHES

09100 Metal Support Systems
Light gage interior steel framing systems, consisting of 20-gage punched cee studs, ceiling joists, furring channels, backing plates, and suspended ceiling grillage for gypsum board. 2-1/2" deep stud furring at exterior insulated walls.

09250 Gypsum Board
Typical Interior Walls and Ceilings: 5/8-inch thick gypsum board, Type X.
Behind Tile Wainscoting: 5/8-inch thick cementitious backer board.

09300 Tile Work
Restroom: Ceramic tile at floor and walls, thinset.

09510 Acoustical Ceilings
Lay-in acoustical ceilings to be provided at Entry, office, gym, instrumentation shop.
Panels: 24 x 24 or 24 x 48 inches, performance characteristics to be determined.
Suspended Grid: 9/16 inch flat bottom tee, meeting ASTM C635 Intermediate Duty, seismic bracing meeting CBC requirements.

09650 Resilient Flooring
Mtce. & Warehouse Staff Office, Instrumentation Shop: Linoleum sheet or linoleum tile.
Rubber flooring at Gym.
Rubber Topset Base: At linoleum, rubber flooring and concrete floors where gypsum board meets floor.

09699 Water Vapor Emission Control Testing
Testing of concrete floor substrates to verify whether slabs are fully cured to accept impervious finish material. When floors fail testing, provide remedial floor sealer system.

09910 Paints
Interior and exterior paints, stains, and coatings. Primarily acrylic latex, meeting VOC requirements of South Coast Air Quality Management District. High performance coatings at hollow metal doors and frames, exposed steel structure and decking.

DIVISION 10 - SPECIALTIES

10100 Visual Display Boards
Items include marker boards and tackboards, potentially in Mtce. Office & Warehouse Office.

10210 Metal Wall Louvers
Extruded aluminum or hollow metal wall louvers for ventilation or air intake/exhaust, including bird screens or insect screens.

10240 Exterior Grilles and Screens
Visual screens around outdoor roof mounted mechanical equipment.

10260 Wall and Corner Guards
Includes corner guards and/or wall protection in hallways subject to bumping and scraping from carts, etc.

10440 Signage
Interior wall mounted signs identifying rooms, ADA accessibility signs, exit signs, and occupancy load signs.
Exterior building identification sign.

Parking signage by others.

10520 **Fire Protection Specialties**
Fire extinguishers, fire extinguisher cabinets and extinguisher mounting brackets.

10800 **Toilet and Bath Accessories**
Stainless steel accessories for rest room and Mtce. Shop service sink.

DIVISION 11 - EQUIPMENT

DIVISION 12 - FURNISHINGS

12484 **Floor Mats and Frames**
Recessed floor mats and frames at Entry door.

12491 **Horizontal Louver Blinds**
Window blinds at offices, gym and instrumentation shop.

DIVISION 13 - SPECIAL CONSTRUCTION

13930 **Fire Protection – Automatic Sprinkler System**
City requirement to provide automatic sprinkler system. Clean agent fire extinguishing system in Electrical Room.

DIVISION 14 - CONVEYING SYSTEMS

14633 **Top Running Bridge Crane**
Top running single girder traveling bridge crane in Mtce. Shop.

DIVISION 15 - MECHANICAL

Assume high efficiency, multi-zone HVAC system. Natural gas is available on site.
Exhaust system in Mtce. Shop for Welding (snorkel vent system)

DIVISION 16 - ELECTRICAL

High efficiency lighting, occupancy sensors, etc. to meet CEC. 220V in Shop spaces.
Data network, security system.