DRAFT BASIS OF DESIGN MEMORANDUM

Morro Bay WRF

B&V PROJECT NO. 400530

PREPARED FOR

City of Morro Bay, California

2 MAY 2019

JOINT VENTURE

FILANC BLACK & VEATCH

Table of Contents

LIST OF TABLES

LIST OF FIGURES

0 Executive Summary

0.1 PROJECT SCOPE

This Basis of Design Report and the corresponding 30% Drawings were produced to meet the requirements of Exhibit B of the Design-Build contract while incorporating feedback and input from the City gathered in the series of design collaboration meetings held in November, December, and January.

0.1.1 Scope Order of Precedence

Effort has been taken to make sure the BDR and 30% drawings match in scope. The Exhibit B document will be marked up to conform to the BDR and 30% drawings after they have been approved.

Where there is a disagreement in the depicted project scope, the following order of precedence currently applies, with 1 taking precedence over 2 and so forth:

1. Process, Instrumentation, and Control Drawings
2. General Drawings
3. Civil Mechanical Drawings
4. Other Drawings
5. Basis of Design Report tables
6. Basis of Design Report text
7. Exhibit B of the Design-Build Contract

Exhibit B would normally take precedence at the top of this list. However, there are a number of pending changes that have been incorporated into this BDR and the accompanying 30% drawings which have not yet been contractually added to project by executed change order. Exhibit B will be revised to incorporate these changes and be amended to the contract with that executed change order. When that is done, Exhibit B would return to the top of the scope order of precedence list.

0.1.2 Pending Adjustments to Exhibit B

This BDR and the corresponding 30% Drawings reflect the current understood project scope, including changes which are currently in the process of Potential Change Order (PCO) development and approval. These elements are not in the project scope until the PCOs are approved.

PCO	NAME	SUMMARY OF CHANGES
01	New Sodium Hypochlorite Feed for Plant Water	The Plant Recycled Water Pump Station was relocated to the RO Feed Tanks area based on City input to ensure plant water supply is not dependent on operation of the IPR system. The pump station was moved at no added cost. A NaOCL feed point had to be added to this pump station because the new water source (MBR Filtrate) is not yet disinfected whereas the old source (IPR Product Water) was. Without this modification, potable water usage at the facility would increase when the IRP system is not in operation. *Improved operational flexibility. Project cost increase.*

PCO	NAME	SUMMARY OF CHANGES
02	Operations Building Modifications	The Operations Building was simplified and optimized to better fit the City's operational needs. The clearstory was removed from the building and replaced with ventilation pergolas and solar-tube skylights. The building was extended a few feet and internal spaces were reconfigured. *Improved operational function. Project cost decrease.*
03	Modify Stormwater Management Design	To meet best-practices for stream and estuary water quality protection, the plant site storm drainage scheme was modified to allow collection of first-flush rain events in the North Process Area so they can be pumped to the headworks for treatment. To make this work, hillside drainage is now separated from in-plant drainage and routed under the site via culverts to the dry-creek. Swales, catch basins, culverts, and a stormwater control and pump station were added. These modifications will also eliminate the requirements for additional permits from the Regional Water Quality Control Board (RWQCB) and United States Army Corps of Engineers (USACE). *Improved stormwater quality protection flexibility. Project cost increase.*
04	Headworks Odor Control	Odor control was extended to include the SAFE Diversion Box and Fine Screens in order to minimize the potential for odors and corrosion. Odor control for these facility was not specifically required as part of the Request for Proposals (RFP). *Improved operational function. Project cost increase.*
05	Remove Canopy over MBR Tanks	The canopy and monorails over the MBR Tanks were removed. A crane (not included in project) will be used to remove the membrane cassettes. *Value engineering change. Project cost decrease.*
06	MBR Tank Size	On Hold. Depending on the MBR Supplier selected, the tank size needed for their equipment may vary. The BDR and 30% Drawings were revised to reflect the MBR tank quantity and size which was included in the proposal.
07	Enclose Chemical Systems Outside RO Building	Canceled. These chemical systems were moved to the Chemical Facility. See PCO 09.
08	TOC Meters	On Hold. No changes were made to incorporate this PCO into the BDR or 30% Drawings.

PCO	NAME	SUMMARY OF CHANGES
09	Consolidate Chemical Facilities	The chemical facilities outside the RO/UV Building and at the MBR Area were incorporated into the Chemical Facility. The Chemical Facility was enlarged and moved to make this function properly. These modifications were made to improve operator safety and site security. Chemical facilities located in multiple locations throughout the facility would also require a more complex hazardous materials management plan. Space and spares for a future Liquid Ammonium Sulfate feed system were also added to this facility per City request. A Sulfuric Acid feed system was also added, refer to PCO 32. *Improved operational flexibility. Project cost increase.*
10	Chemical Piping	The chemical piping was changed from double-contained rigid piping to flexible tubes in concrete-encased PVC ductbanks. *Value engineering change. Project cost decrease.*
11	Enclose Dewatering Equipment	PCO Canceled. See PCO 28.
12	Move Vactor Washdown Area	The Vactor Washdown Area was moved. *Improved operations. No cost change.*
13	Wind Protection at Headworks	PCO Canceled. See PCO 25.
14	Bypass Line for UV Off-Spec Water	PCO Canceled. An automated bypass was added at no cost to allow shunting of off-spec UV effluent to the Outfall Pump Station, rather than stop process flow as originally included.
15	Remove Solids Dumpster Lid	The solids dumpster enclosing lid and curtains were removed and replaced with an extension of the Dewatering Area Canopy. The modification was made to reduce operational complexity and maintenance requirements. *Simplified operations. Project cost increase.*
16	Modify Outfall Pump Station	On hold. A fourth Outfall Pump was added to provide a spare pump at peak flow conditions per design review comment. Currently this PCO is on hold and the pumping configuration will be finalized as design develops on the Outfall Transmission Pipeline.

PCO	NAME	SUMMARY OF CHANGES
17	SAFE Equalization Tank	An equalization and sedimentation tank was added upstream of the SAFE system to absorb minor peak flows without requiring use of the SAFE Filter during periods of dry weather. This system was also designed to provide settling of water routed to the SAFE Filter for improved performance. The improvements were added to improve system performance, reduce maintenance costs, and reduce the operational complexity of the SAFE system. Without the addition of the equalization tank, the SAFE system would operate more frequently, leading to higher long-term operations and maintenance costs. *Improved operations and operational flexibility. Project cost increase.*
18	Instrumentation & Control Changes	The Control System Block Diagram and BDR text reflect the various changes necessary to coordinate with the new SCADA Master Plan and City preferences issued after proposal submittal. *Improved control system coordination. Project cost increase.*
19	Product Water Tank	On Hold. No changes were made to incorporate this PCO into the BDR or 30% Drawings.
20	Change Architectural Layout of the Ops Building	PCO Canceled. See PCO 02.
21	Revise Maintenance Building Layout and Size	The Maintenance Building was enlarged and the layout was modified to meet clarified space and function requirements. The modifications result in an area that is consistent with the City's existing maintenance and consistent with the needs assessment in the Draft Facilities Master Plan. The RFP did not require a specific square footage and the proposal design included space for maintenance of the WRF only. The City will maintain the WRF and the water and wastewater systems from this facility. Without these improvements, the facility would not be adequate to maintain the City's current level of service. *Improved operational effectiveness to replace facility being lost at current WWTP. Project cost increase.*
22	Influent Piping and Metering	The influent pipe was changed to dual pipes and flow meters to coordinate with updated offsite pipelines design development. Dual pipes were selected for system operational needs. *Meet updated overall system operational needs. Improved operational flexibility. Project cost increase.*

PCO	NAME	SUMMARY OF CHANGES
23	Install Outdoor-Rated PD Blowers at BNR Facility	The BNR Aeration Blowers were changed to dry-screw blowers to address concerns with dust in the seals of the turbo blowers required by the RFP. *Improved equipment reliability. Project cost decrease.*
24	Remove Bypass of Coarse Screens	The bypass around the Packaged Headworks Units (coarse screens and grit removal) was removed. *Value engineering change. Project cost decrease.*
25	Add Bagging Sleeves at Headworks	Specialized weighted protection sleeves were added to prevent wind from blowing and pulling out waste bagging sleeves. *Improved maintenance. No cost change.*
26	SAFE Diversion Box Additions	A removable cover that can be walked on, access ladder, and handrailing were added to the SAFE Diversion Box to facilitate odor control (added by PCO 04) and provide for inspection/servicing of the diversion box while covered. *Improved operations. Project cost increase.*
27	Relocate SAFE Facility	PCO Canceled. The SAFE Filter was moved. This PCO was canceled and any costs associated with moving the SAFE Filter were incorporated into PCO 17.
28	Size Dewatering Area for Future Enclosure	The Dewatering Area was reconfigured to facilitate future enclosure of the area without causing issues with equipment access, etc. The area was rearranged to optimize operation. Note: The canopy structure and foundation are not designed for walls to be added to it. *Improved long term flexibility. Improved operation. Project cost increase.*
29	10k CY of Additional Spoils Disposal	On Hold. The spoils disposal area was enlarged to accommodate up to 10,000 cubic-yards of suitable offsite spoils generated by the conveyance project. The area shown herein is conceptual, requires modification of the plant parcel limits, and will require design workshop discussion to determine a final configuration.
30	Match Sludge Blowers to BNR Blowers	On Hold. No changes were made to incorporate this PCO into the BDR or 30% Drawings.

PCO	NAME	SUMMARY OF CHANGES
31	Stairs at Headworks (total of 4)	Stairs, instead of ladders, will be used for access to the coarse screens and grit chambers on the package headworks units in order to facilitate maintenance. The 30% drawings do not reflect the necessary changes. *Improved operational ease of access. Project cost increase.*
32	Sulfuric Acid System	A sulfuric acid feed system as added with feed points to RO Feed and UV Influent. This was added for improved operational flexibility and process control, especially in variable influent water quality conditions. Water quality testing to confirm design requirements for this system was not received in time to be analyzed and incorporated into this design. Estimated demands were used to size this system for now. It was determined including this facility into the conceptual design of the newly centralized Chemical Facility at this stage was required to properly configure and locate that facility. *Improved operational flexibility. Project cost increase.*
33	Match Solids Pump to MBR Supplier	On Hold. No changes were made to incorporate this PCO into the BDR or 30% Drawings.
34	Upsize Computer/Monitors in Control Room	PCO Canceled. The monitors were upsized per City request as shown on the Control Block Diagram in the 30% Drawings at no added cost.

0.2 DESIGN FOCUS OF THE BDR AND 30% DRAWINGS SUBMITTAL

The focus of design effort on the BDR and 30% Drawings Submittal achieves the following objectives:

- Clearly define the project scope inclusive of City feedback, input, and requested changes gained in the series of Design Workshops held in November and December 2018.
- Advance plant design integration to assure no significant hydraulic or configuration changes will be needed beyond this submittal to make the plant function properly as a cohesive facility.
- Prepare for early earthworks start in June 2019 by focusing on refining the site plan and facility arrangement.
- Prepare for early procurement of the Headworks and MBR equipment packages to start immediately after the 30% submittal by advancing design of those components.
- Integrate design features to support early start construction efforts. For example, the BNR Tanks are identified as the first construction work to start in August 2019, but they were connected to the MBR System which may not have submittals available in time to support this effort. The design was modified so the BNR tanks can be constructed independent of the MBR system configuration to decouple those items in the construction schedule.
- Advance the P&IDs to be highly accurate of the scope and features included in the project scope.

0.3 DESIGN DEVELOPMENT EFFORTS IN PROGRESS

0.3.1 Anticipated Corrections for Next Submittal

The following issues with this set are known and will be addressed prior to the next submittal:

- The legends and abbreviations in the General Drawings have not be conformed to the drawings.
- The drawing list font is too small.
- The Operations Building outline shown on the Civil Drawings does not quite match the current layout as shown on the Architectural Drawings.
- The MBR Tanks location in the MBR Area shown on the Civil Drawings does not match the revised location as shown correction on the Civil-Mechanical Drawings. The BNR/MBR Footprint is accurate on the Civil Drawings.
- The 3D Renderings of some facilities show large spread footings. Foundations have not yet been designed and these footings will be revised in 60% design.
- The legends for the P&IDs have not been conformed to the Drawings, but the process codes and pipe codes have been.
- Analyzers: Care was taken to make sure the required analyzers are included in the correct locations, however, the depiction of the analyzer mounting type (submersible probe, insertion probe, or flow-thru instrument) is not consistently accurately shown. Analyzer panels may be collected differently and furnished appurtenances such as valves, rotameters, and flow-by lines are not consistently shown accurately.

0.3.2 Design Efforts on Hold

The following design efforts are on hold for the reasons stated below:

- The Outfall Pump Station design is on hold pending further design coordination with the Outfall Transmission Pipeline designer.
- The IPR Product Water Pump Station design is on hold pending further design coordination with the IPR Transmission Pipeline designer and design/function requirements development for the IPR Wellfield Injection system by that designer.
- The IPR Product Water Storage Tank design is on hold pending further development of the IPR Wellfield Injection systems volume and operational requirements by that designer.
- The design of the spoils area is on hold pending design workshop discussion on impacts of accommodating off-site spoils and options for placement, including potential modifications to plant parcel limits.
- Sulfuric Acid Feed System design is on hold pending receipt and analysis of additional water quality data and design workshop discussion on the results of that analysis.
- Vactor Unloading Area design is on hold pending receipt of pictures of facilities the City would like to emulate.
- Design advancement of the Operations and Maintenance Buildings beyond what is included in the 30% Drawings is on hold pending City review and direction.

0.3.3 Design Efforts in Progress

Beyond normal design progression of the project, the following items are noted as requiring further design development:

- The plant Recycled Water System design will be further developed and refined in detailed design as specific water demands and scenarios are identified.
- The plant Sewer System and Lift Stations will be further developed and refined in detailed design as specific water and drainage flow volumes and scenarios are identified.
- The detailed stormwater calculations and system design are currently in progress. Facilities shown in this submittal are conceptual.
- Design workshop effort focusing on the design of the Water Vehicles Equipment Storage, Collection Vehicles Equipment Storage, Water Supply Storage, Collection Supply Storage, and Outdoor Storage Aisles will be performed.

Design layout of the Dechlorination Station will be developed and reviewed in a design review workshop.

1 Project Overview

1.1 PROJECT BACKGROUND AND DRIVERS

In January 2013, the California Coastal Commission (CCC) voted to deny the Coastal Development Permit (CDP) for construction of upgrading the Morro Bay-Cayucos Wastewater Treatment Plant (WWTP) at its existing location. The basis for denial included inconsistency with the Local Coastal Plan's zoning provisions, failure to avoid coastal hazards, failure to include a sizable reclaimed water component and project location within an LCP-designated sensitive view area.

One of the drivers for replacing the existing WWTP is the need for a major upgrade in order to meet the regulatory requirements of the Federal Clean Water Act (CWA) and additional requirements defined by the State of California Regional Water Quality Control Board (RWQCB). The other key driver is the California Coastal Commission's January 2013 direction to relocate the facility to a more inland area that is consistent with Coastal Act policies.

The CWA defines the quality of treated wastewater that can be released to the environment. In the case of the City, its treated wastewater is discharged to the Pacific Ocean, offshore and north of Morro Rock. The existing plant cannot meet state and federal requirements for discharge to the ocean without significant upgrades. Regional Water Quality Control Board has required the City of Morro Bay to develop a new treatment facility by 2021.

The City has decided to move forward with construction of a new Water Reclamation Facility (WRF) that will turn the City's wastewater into a new, sustainable water source. By expanding its water supply portfolio to include locally-generated recycled water, the WRF will ultimately improve the City's water supply reliability and make the City less reliant on expensive and potentially uncertain imported water.

1.2 PROJECT DESCRIPTION

The City of Morro Bay WRF will be designed to treat an annual average flow of 0.97 million gallons per day (MGD) of wastewater through full advanced treatment. The WRF will provide preliminary, secondary, tertiary, and advanced treatment, and will produce recycled water meeting indirect potable reuse (IPR) standards for a groundwater replenishment reuse project (GRRP) using subsurface application, as defined in California Code of Regulations (CCR) Title 22 recycled water requirements. The WRF will be located at the South Bay Boulevard (SBB) site. IPR recycled water will be conveyed to injection wells in the Morro Valley (conveyance and injection infrastructure by others). An effluent pipeline (by others) will convey advanced treatment waste streams, including brine, to the existing Morro Bay Cayucos Sanitary District (MBCSD) jointly-owned ocean outfall at the site of the existing wastewater treatment plant (WWTP).

A new lift station (by others) near the existing WWTP will convey raw wastewater through a force main (by others) to the WRF. The WRF, access road to the WRF, and all design and construction within the South Bay Boulevard (SBB) site and adjacent area north of Highway 1 right-of-way (ROW) are collectively referred to herein as the WRF Onsite Improvements Project (Project).

1.3 APPLICABLE CODES AND DESIGN GUIDELINES

Where applicable, specific codes and standards are presented in the following sections for each discipline.

1.4 LIST OF TERMS, ACRONYMS, AND ABBREVIATIONS

BNR	Biological Nutrient Removal
CCC	California Coastal Commission
CDP	Coastal Development Permit
CCR	California Code of Regulations
CWA	Clean Water Act
DDW	Division of Drinking Water
GPM	gallons per minute
GRRP	groundwater replenishment reuse project
IPR	Indirect Potable Reuse
MBR	Membrane Bio-Reactor
MGD	million gallons per day
RO	Reverse Osmosis
ROW	Right of way
RWQCB	Regional Water Quality Control Board
SAFE	Stormwater Adaptive Filtration System
SBB	South Bay Boulevard
UV	Ultraviolet (Ultraviolet Disinfection)
UVAOP	Ultraviolet Advanced Oxidation Process
WRF	Water Reclamation Facility
WWTP	Wastewater Treatment Plant

1.5 JURISDICTIONAL AGENCIES

The following are the Jurisdictional Agencies for the Project:

- City of Morro Bay
- San Luis Obispo County
- California Regional Water Quality Control Board (RWQCB)
- California Division of Drinking Water (DDW)

1.6 PROJECT SCHEDULE

The proposed preliminary project schedule is shown in Table 1-1 below.

The duration of construction, from Notice to Proceed to Substantial Completion (full operation), is approximately 33 months.

Table 1-1: Preliminary Project Schedule

ACTIVITY	ESTIMATED DATE
Design Notice-to-Proceed	November 2018
Draft BDR	April 2019
Final BDR	May 2019
Begin Mass Excavation	June 2019
Early Procurements (Package Headworks, MBR, RO, UV)	June 2019
Complete 60% Design	July 2019
Start of Equipment and Material Purchasing	August 2019
Begin Facility Construction	August 2019
Complete 90% Design, Permit Review Set	October 2019
Final (Issued for Construction) Set	December 2019
Plant Startup	April 2021
Substantial Completion	August 2021
Final Completion	November 2021
Post Commissioning End	March 2022

1.7 DRAFTING STANDARDS

Drawings will be produced using Black & Veatch drafting standards. Drawings will be produced in Revit 2018 and AutoCad Civil 3D 2018 and reproducible ANSI D size (22"x 34") sheets with Black & Veatch standard border. Review submittals (Levels 1, 2, and 3) of drawings will be on half-sized sheets (11"x17") and in full size, ANSI D size, Acrobat/Bluebeam Revu PDF format.

1.8 PERMITTING AND APPLICATIONS

The Program Manager is responsible for project permitting coordination and management. Filanc Black & Veatch has permitting support responsibility as outlined in Exhibit B of the Contract and as summarized in Table 1-2 below.

Table 1-2: Project Permitting and Applications

PERMIT / APPLICATION	FBV ROLE	LEAD PARTY
Report of Waste Discharge	Support	City
Title 22 Report	Support	City

PERMIT / APPLICATION	FBV ROLE	LEAD PARTY
Air Pollution Control District permit application for construction	Lead	FBV
Air Pollution Control District permit application for plant operations (generator)	Support	City
Conditional Use Permit/Coastal Development Permit	Support	City
SAFE System Permitting (part of Report of Waste Discharge)	Support	City
Building Permit with City of Morro Bay (not San Luis Obispo County)	Lead	FBV
PG&E Electrical Service Application and Handout	Support	City
Southern California Natural Gas Service Application	Support	City
Stormwater Management and SWPPP for construction	Lead	FBV
Encroachment Permit Caltrans	Support	City
Property Acquisition	None	City
County Grading Permit – No longer required	None - No longer required. TBD	
Utility Easement Encroachment	Support	City
Flood Control Permit (as part of Report of Waste Discharge)	Support	City

1.9 REFERENCE MATERIAL

This BDR has been developed in coordination with various documents, including the following:

- Exhibit B Scope of Work, Black & Veatch, October 2018
- Preliminary Geotechnical Baseline Report, Yeh and Associates, Inc., November 2018
- Appendix 6 Drawings Proposal for the City of Morro Bay Design-Build Services of the Water Reclamation Facility Onsite Improvements, Black & Veatch, May 2018
- Request for Proposals for the City of Morro Bay Design-Build Services of the Water Reclamation Facility Onsite Improvements, City of Morro Bay, January 2018

2 Existing Information

This section discusses existing information for the Morro Bay Water Reclamation Facility (WRF) and the new site.

2.1 WRF SITE INFORMATION

The WRF site is located in unincorporated San Luis Obispo County north of Highway 1 at the northern terminus of South Bay Boulevard. It is a greenfield site that will be purchased by the City of Morro Bay from multiple property owners and annexed into City limits.

2.2 PROJECT DATUM, PROJECT BENCHMARKS, SURVEY CONTROL AND LOCAL FLOOD LEVELS

The project survey is in State Plane Coordinate System (NAD83) California Zone V, US foot. The project benchmark is NGS PID FV1098: brass cap stamped "J 693 Reset 1968" set in concrete, elevation = 151.79. The survey control will be verified and shown on the drawings.

The new WRF site is classified as Zone X, Area of Minimal Flood Hazard, according to the FEMA flood maps.

2.3 EXISTING WASTEWATER TREATMENT PLANT

The existing Morro Bay-Cayucos Wastewater Treatment Plant (WWTP) was originally constructed in 1953 with subsequent expansions in 1964 and 1982. The plant currently has an ADWF rating of 2 mgd though the secondary treatment facilities are only rated at 1 mgd. Flow in excess of 1 mgd requires bypassing of a portion of the primary effluent and blending with disinfected secondary effluent prior to discharge to an ocean outfall.

The existing WWTP site is located at 160 Atascadero Road in Morro Bay. The site is approximately 300 feet north of Morro Creek.

Upon substantial completion of the new WRF, the old WWTP will be demolished. This work is not currently in the scope of the WRF project, but a bid-alternate price was furnished should the City choose to incorporate it into the WRF project. The Cayucos Sanitary District is currently constructing their own facility off Toro Creek Road.

2.4 EXISTING UTILITIES

Existing utilities within the WRF plant parcel include a the Chorro Valley Pipeline of the State Water Project as well as a PG&E overhead high voltage transmission line. Both of these utilities are located at the southern end of the WRF plant parcel. These two utility locations are illustrated on the drawings.

There are additional utilities located outside of the WRF plant parcel, in the vicinity of Teresa Road. These utilities include a potable water main, natural gas pipe, and city sewer. These utilities are being confirmed and will be added to the drawings after the 30% set. This project includes connection of the plant entrance road in this area, and potential minor modifications to the Cal Trans Highway 1 offramps which will require detailed coordination of these existing utilities.

2.5 GEOTECHNICAL INFORMATION

A preliminary geotechnical baseline report was prepared by Yeh and Associates, Inc. in November 2017. This baseline report provided preliminary geotechnical and geologic conditions, including baseline groundwater characteristics, soil characteristics, rock characteristics, geotechnical performance criteria for design, and construction considerations. This baseline report was based on ten test pits, nine borings, and five seismic refraction lines that were included during a geophysical survey. Additional geotechnical information is provided in the Structural & Geotechnical Design Criteria Section.

The geotechnical baseline report by Yeh and Associates, Inc. is used as the basis for design in this BDR and the 30% drawings. Filanc Black & Veatch is in the process of having an updated geotechnical report developed to confirm and supplement these findings for detailed design. Any changes identified in that report which may impact project design will be identified to the City for discussion and confirmation.

3 Process Design Criteria

The WRF shall be designed to receive and treat the full influent wastewater flows from the City of Morro Bay in accordance with the effluent requirements described in this section.

An update of the plant influent water quality, and evaluation of any design impacts associated with changed quality values, is on hold pending further data from the City.

The criteria contained herein, and used as the basis of design for the WRF, was developed in the proposal phase based the wastewater quality data furnished by the City with the RFP. This data did not contain many of the constituents important to RO and UVAOP system designs. To develop this data, the City's potable water data was used and factored up based on potable to wastewater concentration factors seen at other typical facilities, such as at the Santa Clara Valley Water District Silicon Valley Advanced Water Purification Center.

Table 3-1 provides the influent annual average, minimum monthly average, maximum monthly average, maximum and peak hour flows. It also provides all corresponding water quality data.

Table 3-1: Influent Loads and Water Quality

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Flow	MGD	0.97		1.16	2.74	8.14
BOD_5	mg/L	354		374		
	lb/d	2,864		3,618	4,845	
TSS	mg/L	392		437		
	lb/d	3,171		4,228	6,193	
TKN	mg-N/L	57		60		
	lb-N/d	461		580	777	
NH_x-N	mg-N/L	46		48		
	lb-N/d	369		464	622	
Total Phosphorus	mg-P/L	6		8		
	lb-P/d	49		77	183	
Ortho Phosphorus	mg-P/L	4		5		
	lb-P/d	32		48	114	
Total Fats, Oils and Grease	mg/L	80		90	120	
Free Oils	mg/L	1		1	1	
Mineral or Non-Biodegradable Oils	mg/L	5		5	5	
pH	S.U	range: 6.7 - 8.5				
Temperature	°C	20	17			
Total Dissolved Solids	mg/L			920	1,029	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Conductivity	µS/cm			1,312	1,471	
Chloride	mg/L			250	315	
Fluoride	mg/L			0.36	1	
Sulfate	mg/L			125	165	
Calcium	mg/L			169	186	
Iron	mg/L			0.07	0.23	
Magnesium	mg/L			74	81	
Potassium	mg/L			12	17	
Silica	mg/L			12	24	
Sodium	mg/L			157	194	
Aluminum	mg/L			0.08	0.11	
Barium	mg/L			0.01	0.02	
Manganese	mg/L			0.04	0.05	
Strontium	mg/L			0.34	0.42	
Total Organic Carbon	mg/L			7	9	
Dissolved Organic Carbon	mg/L			7	9	
N-Nitrosodimethylamine (NDMA)	mg/L				$6.5x10^{-5}$	
N-Nitrosodiethyamine (NDEA)	mg/L				$5.0x10^{-5}$	
N-Nitrosodi-n-propylamine (NDPA)	mg/L				$8.3x10^{-5}$	
1,4-Dioxane	mg/L				$4.9x10^{-6}$	
Aluminum	mg/L				1.00000	
Copper	mg/L				13.00000	
Lead	mg/L				0.15000	
Antimony	mg/L				0.00600	
Arsenic	mg/L				0.01000	
Asbestos (for fibers >10 microns long)	MFL				7.00000	
Barium	mg/L				1.00000	
Beryllium	mg/L				0.00400	
Cadmium	mg/L				0.00500	
Chromium, Total	mg/L				0.05000	
Chromium, Hexavalent	mg/L				0.01000	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Cyanide	mg/L				0.15000	
Fluoride	mg/L				2.00000	
Mercury (inorganic)	mg/L				0.00200	
Nickel	mg/L				0.10000	
Perchlorate	mg/L				0.00600	
Selenium	mg/L				0.05000	
Thallium	mg/L				0.00200	
Boron	mg/L				0.20000	
n-Butylbenzene	mg/L				0.26000	
sec-Butylbenzene	mg/L				0.26000	
tert-Butylbenzene	mg/L				0.26000	
Carbon disulfide	mg/L				0.16000	
Chlorate	mg/L				0.80000	
2-Chlorotoluene	mg/L				0.14000	
4-Chlorotoluene	mg/L				0.14000	
Diazinon	mg/L				0.00120	
Dichlorodifluoromethane (Freon 12)	mg/L				1.00000	
Ethylene glycol	mg/L				14.00000	
Formaldehyde	mg/L				0.10000	
HMX	mg/L				0.35000	
Isopropylbenzene	mg/L				0.77000	
Manganese	mg/L				0.50000	
Methyl isobutyl ketone (MIBK)	mg/L				0.12000	
Naphthalene	mg/L				0.01700	
Propachlor**	mg/L				0.09000	
n-Propylbenzene	mg/L				0.26000	
RDX	mg/L				0.00030	
Tertiary butyl alcohol (TBA)	mg/L				0.01200	
1,2,3-Trichloropropane (1,2,3-TCP)	mg/L				0.00001	
1,2,4-Trimethylbenzene	mg/L				0.33000	
1,3,5-Trimethylbenzene	mg/L				0.33000	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
2,4,6-Trinitrotoluene (TNT)	mg/L				0.00100	
Vanadium	mg/L				0.05000	
Alachlor	mg/L				0.00200	
Atrazine	mg/L				0.00100	
Bentazon	mg/L				0.01800	
Benzo(a)pyrene	mg/L				0.00020	
Carbofuran	mg/L				0.01800	
Chlordane	mg/L				0.00010	
Dalapon	mg/L				0.20000	
1,2-Dibromo-3-chloropropane (DBCP)	mg/L				0.00020	
2,4-Dichlorophenoxyacetic acid (2,4-D)	mg/L				0.07000	
Di(2-ethylhexyl)adipate	mg/L				0.40000	
Di(2-ethylhexyl)phthalate (DEHP)	mg/L				0.00400	
Dinoseb	mg/L				0.00700	
Diquat	mg/L				0.02000	
Endrin	mg/L				0.00200	
Endothal	mg/L				0.10000	
Ethylene dibromide (EDB)	mg/L				0.00005	
Glyphosate	mg/L				0.70000	
Heptachlor	mg/L				0.00001	
Heptachlor epoxide	mg/L				0.00001	
Hexachlorobenzene	mg/L				0.00100	
Hexachlorocyclopentadiene	mg/L				0.05000	
Lindane	mg/L				0.00020	
Methoxychlor	mg/L				0.03000	
Molinate	mg/L				0.02000	
Oxamyl	mg/L				0.05000	
Pentachlorophenol	mg/L				0.00100	
Picloram	mg/L				0.50000	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Polychlorinated biphenyls (PCBs)	mg/L				0.00050	
Simazine	mg/L				0.00400	
2,4,5-TP (Silvex)	mg/L				0.05000	
2,3,7,8-TCDD (dioxin)	mg/L				3x10-8	
Thiobencarb	mg/L				0.07000	
Toxaphene	mg/L				0.00300	
Total Trihalomethanes	mg/L				0.08000	
Bromodichloromethane	mg/L				0.0010	
Bromoform	mg/L				0.0010	
Chloroform	mg/L				0.0010	
Dibromochloromethane	mg/L				0.0010	
Haloacetic Acids (five) (HAA5)	mg/L				0.06000	
Monochloroacetic Acid	mg/L				0.0020	
Dichloroacetic Adic	mg/L				0.0010	
Trichloroacetic Acid	mg/L				0.0010	
Monobromoacetic Acid	mg/L				0.0010	
Dibromoacetic Acid	mg/L				0.0010	
Bromate	mg/L				0.01000	
Chlorite	mg/L				1.00000	
Gross alpha particle activity	pCi/L				15.00000	
Gross beta particle activity	pCi/L				4.00000	
Radium-226	pCi/L				0.05000	
Radium-228	pCi/L				0.01900	
Radium-226 + Radium-228	pCi/L				5.00000	
Strontium-90	pCi/L				8.00000	
Tritium	pCi/L				20,000	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Uranium	pCi/L				20.00	
Benzene	mg/L				0.001	
Carbon tetrachloride	mg/L				0.0005	
1,2-Dichlorobenzene	mg/L				0.6	
1,4-Dichlorobenzene (p-DCB)	mg/L				0.005	
1,1-Dichloroethane (1,1-DCA)	mg/L				0.005	
1,2-Dichloroethane (1,2-DCA)	mg/L				0.0005	
1,1-Dichloroethylene (1,1-DCE)	mg/L				0.006	
cis-1,2-Dichloroethylene	mg/L				0.006	
trans-1,2-Dichloroethylene	mg/L				0.01	
Dichloromethane (Methylene chloride)	mg/L				0.005	
1,2-Dichloropropane	mg/L				0.005	
1,3-Dichloropropene	mg/L				0.0005	
Ethylbenzene	mg/L				0.3	
Methyl tertiary butyl ether (MTBE)	mg/L				0.013	
Monochlorobenzene	mg/L				0.07	
Styrene	mg/L				0.1	
1,1,2,2-Tetrachloroethane	mg/L				0.001	
Tetrachloroethylene (PCE)	mg/L				0.005	
Toluene	mg/L				0.15	
1,2,4-Trichlorobenzene	mg/L				0.005	
1,1,1-Trichloroethane (1,1,1-TCA)	mg/L				0.2	
1,1,2-Trichloroethane (1,1,2-TCA)	mg/L				0.005	
Trichloroethylene (TCE)	mg/L				0.005	

PARAMETER	UNIT OF MEASURE [1-7]	ANNUAL AVERAGE [9]	MINIMUM MONTHLY AVERAGE [10,11]	MAXIMUM MONTHLY AVERAGE [10,12]	MAXIMUM [14]	PEAK HOUR
Trichlorofluoromethane (Freon 11)	mg/L				0.15	
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	mg/L				1.2	
Vinyl chloride	mg/L				0.0005	
Xylenes	mg/L				1.75	

Footnotes:

1. Flow units:
   MGD = million gallons per day
2. Concentration units:
   mg/L = milligrams per liter;
   mg-N/L = milligrams per liter as Nitrogen;
   mg-P/L = milligrams per liter as Phosphorus
3. Mass Load Units:
   lb/d = pounds per day (calculated using on concentration and flow);
   lb-N/d = pounds nitrogen per day;
   lb-P/d = pounds phosphorus per day.
4. S.U. = standard units
5. °C = degrees centigrade
6. µS/cm = microsiemens per centimeter
7. pCi/L = picocuries per liter
8. Influent samples shall be collected as composite samples. A composite sample is a flow-weighted combination of no fewer than eight (8) individual samples obtained at equal time intervals over a 24-hour period. The volume of each individual sample collected is proportional to the flowrate at the time of sampling.
9. Annual average is the arithmetic average of the total number of data collected in a calendar year.
10. The monthly average is the arithmetic mean of the daily concentrations over a calendar month.
11. Minimum Monthly Average is the minimum value of the monthly average in a calendar year.
12. Maximum Monthly Average is the maximum value of the monthly average in a calendar year.
13. Maximum day flow and load incorporates a maximum day flow and a maximum day load. The maximum day flow is the maximum daily total flow in a calendar year. The maximum day load for a particular parameter is the largest amount received in the influent during a continuous 24-hour period expressed as a weight per day.
14. Maximum is the maximum concentration value of any composite sample in a calendar year.

3.1 EFFLUENT QUALITY REQUIREMENTS

This section summarizes the effluent quality requirements for the project.

3.1.1 Ocean Discharge Requirements

The effluent from the WRF discharged to the Ocean will meet the requirements for Effluent Limitations – Discharge Point No. 001 set forth in National Pollution Discharge Elimination System

(NPDES) No. CA0047881, Draft Order No. R3-2017-0050 adopted by the Central Coast Water Board on December 7, 2017 with compliance measured utilizing the effluent composite sample collected at the Morro Bay WRF site.

3.1.2 Potable Reuse Requirements

Finished water quality for the new potable reuse facility will meet all Maximum Contaminant Level (MCL) and secondary MCL values found in SWRCB (2015) and notification level (NL) requirements from the State of California (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/notificationlevels/notification_levels_response_levels_overview.pdf)

Table 3-2 illustrates the target log removal credits for the WRF.

Table 3-2: Log Removal Performance Expectations

PATHOGEN	DDW REQUIREMENT	MBR	RO	UV-AOP	FREE CHLORINE	UNDERGROUND RETENTION	TOTAL WRF
Virus	12	1	1.5(1)	6	4	2	14.5
Giardia	10	2.5	1.5	6	-	-	10
Cryptosporidium	10	2.5	1.5	6	-	-	10

(1) In consideration of the subsurface travel time and LRV credits offered through the suite of unit operations, only 1 log virus removal is required through the RO system.

4 Facility Design Criteria

Facility design criteria are organized into the various plant areas which correspond with drawing and P&ID numbering. The Plant Area numbers are illustrated in Table 4-1 below.

Table 4-1: Facility Area Numbers

AREA NUMBER	AREA NAME
00	General, non-area specific
10	Mass Earthwork
11	Grading and Paving
12	Yard Piping
13	Wash Rack
14	WRF Parking Canopy
15	Collection Vehicles Equipment Storage
16	Water Vehicles Equipment Storage
17	Permanent Open Storage
18	Plant Drain / Sewer Pump Station
19	Fire Flow Pump Station and Storage Tank
21	Headworks Area - Headworks
22	Headworks Area - Fine Screens
23	Headworks Area - Odor Control
24	Headworks Area - Vactor Washdown
31	Treatment Area - BNR Basins
32	Treatment Area - MBR System
33	Treatment Area - RO Feed Tanks
34	Treatment Area – Onsite Recycle Pump Station
51	RO/UV Building - RO System
52	RO/UV Building - UV System
61	Effluent Area - Calcite Contactor
62	Effluent Area - IPR Product Water Storage Tank
63	Effluent Area - IPR Product Water Pump Station
64	Effluent Area - Outfall Pump Station
65	Effluent Area - Disinfection System
71	Residuals Area - Sludge Holding Tanks & SAFE Settling Tank
72	Residuals Area - Dewatering Facility
73	Residuals Area - SAFE Filter System
80	Electrical Building
81	Emergency Power Facility
90	Chemical Facility
95	Operations Building
96	Maintenance Building

4.1 HEADWORKS – AREA 20

4.1.1 Coarse Screening and Grit Removal

Coarse screen, grit removal, and fine screen systems are dedicated to removing and processing suspended particulate matter, with each system treating debris of different size groups. Coarse screening and grit removal are provided to all flow entering the plant. Two coarse screen and grit removal trains are provided, each able to treat up to the peak hour flows.

Influent (coarse) screening system serves as the first treatment step by removing and processing large debris, such as rags, paper, and plastics. Solids are captured on the bar screen rack, while water passes through the screen to the grit removal system. Intermittently, the solid screenings are collected from the racks and discharged to the coarse screening washer compactor. The washer uses plant water to remove soluble organics from the screenings and sent to the mainstream for treatment in the BNR system. A screw auger dewaters and conveys screenings into a bag contained in a rolling dumpster. The top portion of the bag is covered by a canvas protective cover to shield the bag from wind or UV damage.

Wastewater from the coarse screens enters the grit basin where grit settles in a hopper at the bottom of the basin and grit slurry is pumped to the separator, while the overflow rejoins the mainstream. The separator further concentrates the grit through centrifugal force. Carrier water and lighter organics exit the separator and return to the grit basins. The heavier grit falls into the grit classifier, where plant water is used to wash organics from the grit. The settled grit is carried up an inclined screw auger, allowing the grit to dewater before falling into a grit hopper for offsite disposal. The grit hopper discharges the grit into a bag contained in a rolling dumpster. The top portion of the bag is covered by a canvas protective cover to shield the bag from wind or UV damage. The washwater and organics overflow the classifier weir and are sent to the plant drain.

Screened and degritted wastewater enters the the SAFE Diversion box, which diverts water between the fine screens and the SAFE system. Up to 1.88 mgd, the capacity of the MBR, is pumped to the fine screens. At flows exceeding 1.88 mgd, the flow control valve at the fine screens influent regulates the flow, fills the diversion box and eventually overflows a weir. The overflow is sent to the SAFE Settle Tank that feeds the SAFE Filter system by gravity once the SAFE Settle tank is at capacity. The design criteria for the influent coarse screens and grit removal headworks system are provided in Table 4-2.

Table 4-2: Influent Coarse Screening and Grit Removal Design Criteria

PARAMETER	VALUE
Area Number Location OEM Procurement Timing	21 - Headworks Headworks Area Kusters Zima, Huber, Lakeside Equipment, Vulcan, Headworks Inc., Westech, Parkson, Duperon, Hydrodyne Early, Submittals for 60% design
Process Objectives	Removes screenings and grit, washes screenings and grit and returns organics to the mainstream, compacts screenings and grit, conveys screenings and grit into bags that go to dumpsters.

PARAMETER	VALUE
Operational Summary	Flow enters the plant upstream of the packaged headworks (coarse screens and grit removal). Flow is pumped from sea level up to the plant (by others), passes through flow meters to measure influent, and enters one of the two packaged headworks units. The smaller meter is used all of the time. The larger meter is used in parallel with the smaller meter during high-flow periods. Flow passes through the coarse bar screen first, then enters the vortex grit removal basin. From the grit removal basin, flow is piped to the SAFE System Diversion Box.
Influent Flow Meters	
-# Units/Treatment Trains	2
-Design Flow Range per Unit	Small meter: 0.2 to 4.22 MGD Large meter: 0.7 to 8.14 MGD
-Type	Magnetic
-Diameter	Small meter: 10" Large meter: 14"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
Coarse Screens	
-# Units/Treatment Trains	2 @ 100% each, 1 duty/ 1 standby
-Design Flow per Unit	8.14 MGD
-Total System Design Capacity	8.14 MGD
-Type	Bar Screen
-Screen Opening	1/4"
-Screen Channel Width	3' minimum
-Motor Horsepower	2 hp maximum
-Drive type	Constant Speed
-Voltage	480
-Control Type	Local vendor control panel with Plant PLC start/stop and monitoring
-Equipment Housing Material	316 SS Channels
-Wetted Components Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	OEM Headworks Package System
-Procurement Timing	Early procurement, submittals for 60% design
-Listed Manufacturers	Manufacturer selection by Headworks Package OEM
Coarse Screenings Conveyance and Washer/Compactor	
-# Units	1 per screen
-Type	Integrated Screw-Auger Conveyor
-Dumpster Size	4-8 yd^3
-Motor Horsepower	2 hp maximum
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Headworks Package Control Panel
-Wetted Components Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Part of Headworks Package

PARAMETER	VALUE
Coarse Screenings Conveyance (if required by Vendor Layout)	
-# Units	1 per screen
-Type	Screw-Auger Conveyor
-Diameter	6" minimum
-Motor Horsepower	3 hp maximum
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Headworks Package Control Panel
-Wetted Components Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Part of Headworks Package
Vortex Grit Basin	
-# Units/Treatment Trains	2 @ 100% each
-Design Flow per Unit	8.14 MGD
-Type	Packaged Vortex Grit
-Basin Diameter	10' minimum
-Motor Horsepower	1 hp maximum
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Headworks Package Control Panel
-Equipment Housing Material	316 SS Packaged Unit
-Shaft Material	316 SS
-Blade Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Part of Headworks Package
Grit Pump	
-# Units/Treatment Trains	1 per Grit Basin
-Rated Flow	250 gpm
-Head	25 feet
-Type	End Suction Centrifugal
-Motor Horsepower	5hp maximum
-Drive Type	Constant Speed or VFD
-Voltage	480
-Control Type	Headworks Package Control Panel
	Epoxy lined cast iron
-Pump Housing Material	Carbon steel, AISI 1045
-Shaft Material	High chrome cast iron, ASTM A532 Type III or Ni-Hard, Brinell 500+
-Impeller Material	Epoxy with polyurethane on non SS metals
-Protective Coatings Required	Part of Headworks Package
-Procurement Type	Manufacturer selection by Headworks Package OEM
-Listed Manufacturers	
Grit Washing and Dewatering	
-# Units/Treatment Trains	1 per Grit Basin
-Type	Screw-Auger Conveyor
-Dumpster Size	4-8 yd^3
-Motor Horsepower	3 hp maximum
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Headworks Package Control Panel
-Equipment Housing Material	316 SS
-Shaft & Auger Material	Carbon Steel or SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Part of Headworks Package

4.1.2 Fine Screening

The fine screening system removes trash and fibrous materials such as hair and paper to protect the membranes and prolong their life. Flow from the SAFE diversion box is discharged to the fine screens at a maximum flow of 1.88 mgd, the maximum capacity of the MBR. The design consists of two identical fine screen and washer compactor trains, providing 100% redundancy. A conveyor is shared between the two trains. Manual bypass valves are also furnished.

Each fine screening train is comprised of a perforated plate drum screen and washer compactor. Floating and suspended materials are retained by the screen basket. The basket starts to rotate when a preset upstream water level is exceeded due to screen surface blinding. The rotating screen drum lifts the screenings and drops them into a trough. Screenings removal from the drum is supported by a scraper brush and a spray nozzle bar. A screw conveyor in the trough rotates with the drum and transports, dewaters and compacts the screenings, and discharges them into a bag contained in a dumpster. The top portion of the bag is covered by a canvas protective cover to shield the bag from wind or UV damage. Screened wastewater is combined in a pipeline that discharges to the BNR-MBR. Sodium hydroxide feed system is provided to add alkalinity for pH control in the biological process, if necessary. The design criteria for the fine screening design are provided in Table 4-3.

Table 4-3: Fine Screening Design Criteria

PARAMETER	VALUE
Area Number Location OEM Procurement Timing	22 – Fine Screens Headworks Area Kusters Zima, Huber, Smith & Loveless, Vulcan, Headworks Inc, Westech, Parkson, Duperon, Hydrodyne, or equal if approved. Early, submittals for 90% design
Process Objectives	Controls flow to the BNR/MBR system to its design capacity and diverts excess flow to the SAFE System. Removes fine screenings from flow going to BNR/MBR System, washes screenings and returns organics to the mainstream process, compacts screenings and conveys to a dumpster.
Operational Summary	The Diversion Box has adequate volume to allow the Fine Screen Influent Valve to adjust as needed to limit BNR/MBR System flow that that system's capacity. Any excess flow above that capacity is sent over the SAFE Diversion Weir to the SAFE System for Treatment and Ocean Discharge. Flow from the SAFE Diversion Box is routed to one of the two Fine Screens by gravity. Effluent from the Fine Screens flows to the BNR System by gravity. The Fine Screen Influent is normally routed through a flow meter where it is controlled by a control valve downstream of the flowmeter to limits the flow to the MBR maximum capacity. Any excess flow above the Fine Screen capacity will back up in the SAFE Diversion Box and be sent over the Diversion Box Weir to the SAFE System.

PARAMETER	VALUE
SAFE System Diversion Box	
-Dimensions, length x width	12' x 14'
-Maximum Sidewater Depth	13'-6"
-Freeboard	2'-0"
-SAFE Weir Length	10'
-Box Material	Concrete
-Weir Plate Material	Fiberglass Reinforced Plastic
-Box Cover	Removable fiberglass panels, rated for walking
-Protective Coatings Required	None
BNR/MBR Influent Flow Meter	
-# Units/Treatment Trains	1
-Design Flow Range per Unit	0.2 to 2.2 MGD
-Type	Magnetic
-Diameter	12"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
Fine Screens	
-# Units	2 units, 1 duty/ 1 standby
-Design Flow per Unit	1.88 MGD
-Total System Design Capacity	1.88 MGD
-Type	Perforated Plate Drum Screen
-Screen Opening	0.080"
-Screen Channel Width, feet	3' minimum
-Motor Horsepower	2 hp maximum
-Drive type	Constant Speed
-Voltage	480
-Control Type	Local vendor control panel with Plant PLC start/stop and monitoring
-Equipment Housing Material	316 SS Tank
-Wetted Materials	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	OEM Fine Screens Package
-Procurement Timing	Normal
-Listed Manufacturers	Kusters Zima, Huber, Smith & Loveless, Vulcan, Headworks Inc, Westech, Parkson, Duperon, Hydrodyne, or equal if approved.
Fine Screenings Washer/Compactor	
-# Units	1 per screen integrated into each screen
-Type	Screw
-Dumpster Size	4-8 yd^3
-Motor Horsepower	N/A, motor is combined with Fine Screen motor
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Fine Screens Package Control Panel
-Wetted Components Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Included in Fine Screens Package

PARAMETER	VALUE
Fine Screenings Conveyance	
-# Units	1 unit shared between both screens
-Type	Screw-Auger Conveyor
-Diameter	6" minimum
-Motor Horsepower	3 hp maximum
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Fine Screens Package Control Panel
-Wetted Components Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane on non SS metals
-Procurement Type	Included in Fine Screens Package

4.1.3 Headworks Odor Control

Odor control is provided to treat the foul air from the headworks, including the headspace of the fine screens, splitter box, grit basin, and coarse screens and channels. The biofilter system draws foul air from the headworks via the odor control fan and provides two-stage treatment within the modular biofilter vessel (humidification and odorant removal). The odor control system is comprised of the following key elements: foul air piping to convey the foul air from headworks to the odor control facility; pre-filter for grease and moisture removal; foul air fan; packaged two-stage biofilter; and damper(s) to isolate and balance airflow. Design criteria for the odor control system are provided in Table 4-4.

Table 4-4: Odor Control System Design Criteria

PARAMETER	VALUE
Area Number Location Listed OEMs	23 Headworks Area Biorem, Daniel, Evoqua, or equal if approved.
Process Objectives	Odor Control is provided for the headworks area to treat odorous air.
Operational Summary	The biofilter system will draw foul air from the headworks via the odor control fan and provides two-stage treatment within the packaged biofilter vessel (humidification and odorant removal). The system will operate with counter-current flow. Plant water with nutrient as required will be continuously added to the system to serve as makeup water and irrigation water. The first stage humidification will use a recirculation pump to recirculate the solution through a sump into the spray-down nozzles, providing some level of H_2S removal. The second stage will be irrigated to wet the media for target odorant removal. The odor control system is intended to operate continuously.

PARAMETER	VALUE
Pre-filter	
-# of Units	1
-Housing Material	FRP
-Pad Material	316L stainless steel pad, followed by a polypropylene pad
-Removal Efficiency	99.9% removal of particulates equal to or larger than 10 microns
-Initial Resistance, Maximum	1 in w.c. at 400 ft/min
-Procurement Type	Part of Biofilter Package
Fan	
-#Units	1 Unit
-Design Flow per Fan	480 scfm
-External Static Pressure, Maximum	10 in w.c.
-Type	Centrifugal, backward inclined
-Motor Horsepower, Maximum	5 hp
- Fan Speed, rpm	TBD by Packaged Biofilter Manufacturer
-Drive Type	V-Belt, Constant Speed
-Voltage	480 volt
-Control Type	Packaged Biofilter Control Panel
-Fan Housing Material	FRP
-Fan Wheel Material	FRP
-Shaft Material	FRP or epoxy coated steel
-Enclosure Type	Weatherproof, sound attenuating
-Protective Coatings Required	Ultraviolet inhibitor on all FRP and plastic components. Epoxy with polyurethane on all non SS metals.
-Procurement Type	Part of Biofilter Package
-Listed Manufacturers	New York Blower, Duall, or Hartzell (Furnished by packaged biofilter manufacturer)
Biofilter System	
-#Units	1 Unit
-Type	Two-stage, packaged biofilter (Stage 1 Humidification/Stage 2 Odorant Removal)
-Design Flow	480 scfm
-Inlet H2S, Average	20 ppm
-Inlet H2S, Maximum	100 ppm
-Minimum H2S removal efficiency (at average inlet concentration)	99% or 0.1 ppm discharge, whichever is less stringent
-Empty Bed Residence Time, Stage 1	2 seconds
-Empty Bed Residence Time, Stage 2	30 seconds
-Media	Stage 1 = Synthetic, structured Stage 2 = Engineered, inorganic
-Pressure Loss Across Biofilter, Max	6 in w.c.
-Vessel Material	FRP
-Vessel Dimensions, Maximum	Height: 10’-0”; Width: 10’-0”; Length: 12’-0”
-Control Type	Local vendor control panel with Plant PLC Start/Stop and monitoring.
-Protective Coatings Required	Ultraviolet inhibitor on all FRP and plastic components. Epoxy with polyurethane on all non SS metals
-Procurement Type	OEM Biofilter Package
-Procurement Timing	Normal
-Listed Manufacturers	Biorem, Daniel, Evoqua, or equal if approved.

PARAMETER	VALUE
Recirculation Pump	
-#Units	1 Unit
-Design Flow per Pump	Per biofilter manufacturer
-Head	Per biofilter manufacturer
-Type	Centrifugal
-Motor Horsepower, max	1 hp
-Voltage	480 volt
-Control Type	Packaged Biofilter Control Panel
-Pump Materials and Coatings	Per biofilter manufacturer
-Procurement Type	Part of Biofilter Package
-Listed Manufacturers	Manufacturer selected by Odor Control System OEM
Nutrient Tank	
-#Units	1
-Dimensions, Diameter	Per biofilter manufacturer
-Volume	Per biofilter manufacturer
-Procurement Type	Part of Biofilter Package
Nutrient Feed Pump	
-#Units	1
-Design Flow per Pump	Per biofilter manufacturer
-Head	Per biofilter manufacturer
-Motor Horsepower	1 hp
-Voltage	480 volt
-Control Type	Packaged Biofilter Control Panel
-Pump Materials and Coatings	Per biofilter manufacturer
-Procurement Type	Part of Biofilter Package
-Listed Manufacturers	Manufacturer selected by Odor Control System OEM

4.1.4 Vactor Washdown

The vactor washdown area provides a place for the City to dump and clean vactor trucks. Solids are collected and discarded. The liquid stream is routed by gravity to the plant sewer system to be pumped to the head of the plant for treatment. This system is summarized in Table 4-5.

Design of this facility is on hold pending information from the City of Morro Bay on preferred vactor washdown area examples to model this after.

Table 4-5: Vactor Washdown

PARAMETER	VALUE
Area Number	24 – Vactor Washdown
Location	Headworks Area
Process Objectives	Provide a location for washing and dumping sewage from the City's vactor trucks.
Operational Summary	The Vactor Washdown Area is a manually operated system. Trucks are drained onto the slab. Drainage is collected and routed to the plant sewer system by gravity. Solids are collected by operators and sent to disposal.

4.2 TREATMENT AREA – AREA 30

The components in the Treatment Area provide biological treatment and filtration of the influent wastewater. The BNR system treats carbon and nitrogen in the fine screened wastewater through the Modified Ludzack-Ettinger (MLE) biological process. Mixed Liquor from these basis is pumped to the Membrane Bioreactor (MBR) system which provides additional aerobic biological treatment and filtration. The combined BNR-MBR system produces effluent water supply suitable for feeding the RO system, supplying the Plant Recycled Water System, or discharging to the ocean.

4.2.1 Biological Nutrient Reduction (BNR) Basins

The BNR system is comprised of two identical treatment trains with a common deoxygenation zone and splitter zone. From the end of each aeration zone, the mixed liquor is pumped into a common header and is distributed between the MBR trains, with the total number of MBR trains to be determined by the vendor. During a maximum month flow event, one BNR basin may be taken offline for maintenance. The MBR supports 1 train redundancy for up to AA conditions.

Screened wastewater from the fine screens and return activated sludge (RAS) from the deoxygenation zone is combined at the mixing chimney, which is contained within the splitter zone. From the splitter zone, the combined flow is split between two identical biological treatment trains. The first zone of the trains is anoxic to support denitrification. Note that in addition to denitrification, the process design employs the RO filters to polish nitrite and nitrate to concentrations that meet the product water requirements. Mixing is provided in the deoxygenation, splitter, and anoxic zones by either pumping or submersible mixers.

MLSS from the anoxic zone is directed over a weir to the aerobic zone for nitrification and carbon oxidation. The aerobic zone consists of two fine bubble diffuser grids to support independent DO control between the front and end halves of the aeration basins. Mixed liquor flows into a channel at the end of each train, where MLSS is pumped to a common header and then split among three MBR membrane tanks. The common pipe header allows flexibility in MBR basin use. The MBR concentrates the biomass, which is directed to the RAS channel to be wasted or returned to the deoxygenation zone.

The blowers use compressed air for injection into the aeration basins to maintain aerobic biological activity. Each blower is equipped with inlet guide vanes, variable diffuser vanes, and a control system to optimize efficiency.

Biomass and scum is removed through multiple means. Scum and MLSS (i.e., surface WAS) flows over a submerged weir at the end of the aerobic basin. Within the channels at the end of each aerobic basin, there are additional submerged weirs which send scum to a collection box. Each collection box has a pipe and a motorized valve. The valve will be programmed to open for surface wasting and draw scum off the top. This WAS / Scum is sent to the Scum Tank. Additionally, WAS is wasted from the RAS Deox pipeline with a pump and flow meter. The WAS wetwell contains the option for foam spray. Two pumps are provided, one dedicated to pumping WAS directly to the Sludge Holding Tanks and one dedicated to pumping out of the Scum Tank. The combined scum and WAS is pumped to a common manifold that is metered.

The design criteria for the BNR system are provided in Table 4-6.

Table 4-6: Biological Nutrient Removal (BNR) System Design Criteria

PARAMETER	VALUE
Area Number Location	31 Treatment Area
Process Objectives	To treat carbon, nutrients, and suspended solids to a quality that can be suitable for RO facility or ocean discharge.
Operational Summary	Flow enters the BNR system by gravity from the fine screens. It is blended with deoxygenated RAS and distributed to the Anoxic Tanks (one for each BNR train). From the Anoxic Tanks, flow is split via weirs into the Aeration Tanks (one for each BNR train). Mixed Liquor is collected via a trough with a submerged weir at the end of the Aeration Tanks. The trough of each tank contains a MBR Feed Pump to pump flow over to the MBR System. WAS is wasted primary off of the RAS Pipe. RAS flows over a weir at the end of each MBR Tank by gravity to the head of the BNR Process. WAS/scum is also wasted periodically off of the Mixed Liquor Collection Channel at the end of each train.
RAS Flow Meters -# Units -Design Flow Range per Unit -Type -Diameter -Voltage -Control Type -Protective Coatings Required -Procurement Type -Procurement Timing	 2 0.6 to 3.88 MGD Magnetic 16" 120 Plant PLC Epoxy with polyurethane coating General Contract / Purchase Order Normal
RAS Deox Box and Pipeline -# Units -Box dimensions, length x width -Sidewater Depth -Freeboard -RAS Pipe Diameter -RAS Pipe Length -Volume, total (pipe+basin) -HRT at max flow -D.O. at inlet, mg/L @ max flow -D.O. at outlet, mg/L @ max flow -Box Materials -Protective Coatings Required	 1 9' x 6' 19'-6" 2'-0" 24" 140' 12,900 gallons 148 seconds @ 7.5 mgd (@4Q recycle) 2 to 4 mg/L 0.5 to 2.5 mg/L Concrete None for box, pipe is cement mortar lined

PARAMETER	VALUE
RAS Deox Mixer	
-# Units	1
-Maximum Mixing Flow	790 gpm
-Maximum Mixing Thrust	5.6 N
-Volume Mixed	11,000 gallons
-Type	Submersible, mast mounted (propeller type or submersible pump with nozzle, TBD in detailed design)
-Motor Horsepower, max	2.5 hp
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Plant PLC
-Mixer Material	All uncoated wetted materials shall be SS 316L
-Protective Coatings Required	Epoxy coating of all non SS materials
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Sulzer, Flow Systems, or equal if approved.
BNR Splitter Box	
-# Units	1
-Dimensions, length x width	8' x 6'
-Sidewater Depth	19'-6"
-Freeboard	2'-0"
-Volume	7,000 gallons
-Box Material	Concrete
-Protective Coatings Required	None
BNR Splitter Gates	
-# Units	2
-Dimensions, Height x width	36" x 30"
-Type	Sluice Gate
-Control Type	Manual
-Gate Leaf Material	Cast iron
-Gate Frame Material	Cast iron
-Shaft Material	Stainless steel
-Control Type	Manually actuated
-Protective Coatings Required	Submerged: High solids epoxy, Unsubmerged: epoxy with polyurethane
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Hydrogate, Rodney Hunt, or equal
Anoxic Zone	
# Units	2 trains
-Dimensions, length x width	10'-0" x 23'-0"
-Sidewater Depth	19'-6"
-Freeboard	2'-0"
-Volume/train	33,500 gallons
-Materials	Concrete
-Protective Coatings Required	None

PARAMETER	VALUE
Anoxic Mixer	
-# Units	1 per train
-Maximum Mixing Flow	5,500 gpm
-Maximum Thrust	50 N to 120 N
-Volume	33,500 gallons per train
-Type	Submersible mixer, mast mounted (propeller type or submersible pump with nozzle, TBD in detailed design)
-Motor Horsepower, max	2.5 hp
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Plant PLC monitoring
-Mixer Material	All uncoated wetted materials shall be SS 316L
-Protective Coatings Required	Epoxy coating of all non SS materials
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Sulzer, Flow Systems, or equal if approved.
Aerobic Basin	
-# Units	2 trains
-Dimensions, length x width	58'-6" x 23'-0"
-Sidewater Depth	18'
-Freeboard	3'-6" @ rated flow
-Volume/train	180,000 gallons
-Material	Concrete
-Protective Coatings Required	None
Fine Bubbled Diffused Aeration	
-# Units/ train	2 aeration zones per train
-Total Units	4 aeration zones
-Zone 1 Air Flow	675 scfm per train
-Zone 1 Diffusers	Minimum 170 diffusers per train
-Zone 2 Air Flow	353 scfm per train
-Zone 2 Diffusers	Minimum 90 diffusers per train
-Diffuser Type	Fine bubble disc
-Diffuser, Material	EPDM
-Piping and Accessories, Material	SS 316L (Drop Pipes and Cooling Loops) with PVC grids
-Protective Coatings Required	None
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Xylem, Environmental Dynamics, Sanitaire, or equal if approved.

PARAMETER	VALUE
BNR Process Blower	
-# Units	3 Units, 2 Duty / 1 Standby
-Design Flow per Blower	1,100 scfm
-Discharge Pressure	10.6 psig
-Type	Dry Screw Positive Displacement
-Motor Horsepower, max	75 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Local Protection Monitoring Panel and Plant PLC
-Casing Material	Cast iron
-Impeller Material	Cast iron
-Shaft Material	High carbon steel
-Protective Coatings Required	High-temperature epoxy with polyurethane on all non SS exterior metal surfaces
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Atlas Copco, Robuschi, or equal
Mixed Liquor Collection Channel Scum Collection Weirs and Valves	
-# Units	2 Units, 1 unit/train
-Weir Length	4'-0"
-Collection Box Dimensions	3'-0" x 4'-0"
-Scum Valve Type	Eccentric Plug Valve
-Drive Type	Motorized Open / Close
-Voltage	480
-Control Type	Plant PLC
-Material	Cast iron with epoxy lining
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
BNR Effluent Channel	
-# Units	2, 1 per train
-Dimensions, length x width	4'-0" x 20'-0"
-Sidewater Depth	7'-0"
-Freeboard	3'-6"
-Materials	Concrete
-Protective Coatings Required	None

PARAMETER	VALUE
MBR Feed Pumps	
-# Units	2 Units, 1 per train
-Design Flow per Pump	0.6 to 4.85 mgd (5Q MBR train capacity)
-Head	3' to 4'
-Type	Horizontal, submersible propeller pump
-Motor Horsepower	12.5 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Plant PLC
-Stator and oil chamber housing	SS 316
-Propeller Shaft	Alloy steel, hard chrome plated; or SS 316.
-Propeller & Mechanical Seal	SS with tungsten carbide or silicon carbide rings.
-Propeller	SS 316
-Inlet Cone	SS 316
-Guide Rail	SS 316
-Protective Coatings Required	Epoxy coating of non SS metals
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Sulzer, Flow Systems, or equal if approved.
BNR Effluent Isolation Valves	
-# Units	2, 1 per train
-Type	Knife Gate
-Drive Type	Motor operated open/close
-Voltage	480
-Control Type	Plant PLC
-Material	Epoxy coated steel/iron or stainless steel components
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
BNR Tank Drain Pumps	Shared with MBR Tanks Drain Pump via manual valving and manually coupled hose.
WAS / Scum Tank	
-# Units	1
-Dimensions, diameter	8'-0"
-Sidewater Depth	8'-0"
-Freeboard	2'-0"
-Volume	3,000 gallons
-Material	FRP
-Protective Coatings Required	No lining, epoxy with polyurethane exterior coating

PARAMETER	VALUE
BNR WAS / Scum Pumps	
-# Units	2 Units, 1 for WAS, 1 for Scum, Interchangeable
-Design Flow per Pump	40 gpm
-Head	25'
-Type	Rotary Lobe
-Motor Horsepower	4 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Plant PLC
-Barrel/ Case Material	Cast iron
-Inner Case Material	Corrosion resistant, material TBD
-Impeller Material	Corrosion resistant or protected, material TBD
-Shaft Material	Corrosion resistant or protected, material TBD
-Protective Coatings Required	Epoxy coating of non SS metals
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Borger, Netzsch, or equal if approved.
BNR WAS Pump and Combined WAS / Scum Flow Meters	
-# Units	2
-Design Flow Range per Unit	0-60 gpm
-Type	Magnetic
-Diameter	2"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal

4.2.2 Membrane Bioreactor (MBR) System

Mixed liquor effluent from each BNR train is pumped to a common MLSS header pipe. The MBR feed pumps feed the MBR trains and drive RAS flow return to the front of the BNR train. The membranes filter the inorganics and organics larger than the membrane pore size and provide a degree of pathogen removal. MBR Filtrate is sent to the RO Feed Tank. The remaining flow exits the MBR basins over the RAS weir. From the RAS weir channel, the water is set to the Deox Tank and back to the head of the BNR process. WAS is wasted from the RAS pipe via flow control pump.

The MBR system components include membrane cassettes, filtrate pumps, coarse bubble diffuser grids and dedicated blower, and a Clean-In-Place. To maintain performance, the MBR membranes are cleaned through both physical and chemical means, including aeration, maintenance and recovery cleans by an acid (citric acid) and/or base (sodium hypochlorite).

The MBR system equipment and configuration is vendor specific. The configuration shown herein is typical, utilizing typical equipment and function. The design configuration will be updated when a vendor is selected.

The design criteria for the MBR system are provided in Table 4-7.

Table 4-7: Membrane Bioreactor (MBR) System Design Criteria

PARAMETER	VALUE
Area Number Location OEM Procurement Timing	32 Treatment Area Fibracast, Suez, Evoqua, Koch, or equal if approved. Early, submittal for 60% design
Process Objectives	To treat carbon, nutrients, and suspended solids to a quality that can be suitable for RO facility or ocean discharge.
Operational Summary	Mixed liquor is pumped to the MBR system via a pipe manifold. Flow is split between the MBR trains by controlling the flow out of the MBR trains (either by controlling Membrane Filtrate flow via the Filtrate Pumps, or by a fixed RAS outlet weir for each train). Membrane Filtrate is routed to the RO Feed Tanks where it is distributed to the RO System or Recycled Water Pump Station. Excess flows passively overflow by gravity to the Outfall Pump Station to be pumped to the Ocean Outfall. The MBR equipment and operation is a function of the vendor selected. This BDR and the 30% drawing reflect a typical configuration, including use of the Filtrate Pumps to provide backpulse by running in reverse.
MBR Influent Isolation Valves -# Units -Type -Drive Type -Voltage -Control Type -Material -Procurement Type	 1 per train Knife Gate Motor operated open/close 480 MBR System Control Panel with Plant PLC monitoring and input Epoxy coated steel/iron or stainless steel components MBR System Package
Membrane Bio Reactor -# Units -Flow per Unit -Total System Design Capacity -MLSS -MBR Filtrate turbidity, maximum -Membrane Cassettes -Procurement Type -Listed Manufacturers	 2 minimum, with AA redundancy 0.2 - 0.97 MGD 1.88 MGD max day treatment capacity Less than 10,000 mg/l in MBR tank 0.5 NTU 2 per MBR train MBR System Package Fibracast, Suez, Evoqua, Koch, or equal if approved.

PARAMETER	VALUE
MBR Filtrate Pumps	
-# Units	2 min, 1 per train
-Design Flow per Pump	TBD by MBR Supplier
-HGL at pump discharge	141.90'
-Finished Grade Elevation at Pumps	120.50'
-Type	Rotary Lobe
-Motor Horsepower	TBD by MBR Supplier
-Drive Type	VFD
-Voltage	480
-Control Type	MBR System Control Panel with Plant PLC monitoring and input
-Casing Material	TBD by MBR Supplier
-Impeller Material	TBD by MBR Supplier
-Shaft Material	TBD by MBR Supplier
-Pump Internal Material	TBD by MBR Supplier
-Protective Coatings Required	Epoxy coating of non SS metals
-Procurement Type	MBR System Package
-Listed Manufacturers	Manufacturer selection by MBR Supplier
MBR Filtrate Pump Flow Meter	
-# Units	2
-Design Flow Range per Unit	0.2 MGD to 0.97 MGD
-Type	Magnetic
-Diameter	8"
-Voltage	120
-Control Type	MBR System Control Panel with Plant PLC monitoring
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	MBR System Package
-Listed Manufacturers	Manufacturer selection by MBR Supplier.
BNR / MBR Tank Drain Pumps	
-# Units	1 Unit
-Design Flow per Pump	250 gpm
-Head	15'
-Type	Rotary Lobe
-Motor Horsepower	5 hp
-Drive Type	VFD
-Voltage	480
-Control Type	MBR System Control Panel with Plant PLC monitoring and input
-Casing Material	Cast iron
-Impeller Material	Corrosion resistant, material TBD
-Shaft Material	Corrosion resistant or protected, material TBD
-Pump Internal Material	Corrosion resistant or protected, material TBD
-Protective Coatings Required	Epoxy coating of non SS metals
-Procurement Type	MBR System Package
-Listed Manufacturers	Borger, Netzsch, or equal if approved.

PARAMETER	VALUE
BNR / MBR Tank Drain Flow Meter	
-# Units	1
-Design Flow Range per Unit	0-250 gpm
-Type	Magnetic
-Diameter	3"
-Voltage	120
-Control Type	MBR System Control Panel with Plant PLC monitoring and input
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	MBR System Package
Membrane Scour Air Blowers	
-# Units	N+1
-Design Flow per Blower	TBD by MBR Supplier
-Discharge Pressure	TBD by MBR Supplier
-Type	Rotary lobe blowers
-Motor Horsepower	TBD by MBR Supplier
-Drive Type	VFD
-Voltage	480
-Control Type	MBR System Control Panel with Plant monitoring and input
-Casing Material	TBD by MBR Supplier
-Rotor Material	TBD by MBR Supplier
-Gear Material	TBD by MBR Supplier
-Shaft Material	TBD by MBR Supplier
-Protective Coatings Required	High-temperature epoxy with polyurethane on all non SS exterior metal surfaces
-Procurement Type	MBR System Package
-Listed Manufacturers	Manufacturer selection by MBR Supplier
Monorail and Hoist for Cassette Removal	
-# Units	2
-Capacity	5 Ton
-Span	51'
-Lift, ft	13'
-Type	Monorail
-Motor Horsepower	TBD by Monorail Supplier
-Drive Type	Constant
-Voltage	480
-Control Type	Manual control panel
-Protective Coatings Required	Epoxy with urethane or comparable
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Lift-Tech International, Morris/P&H, Yale, R&M Material Handling Inc., Konecranes, or equal

4.2.3 RO Feed Tanks (MBR Filtrate Storage)

MBR filtrate is stored in two FRP tanks piped in parallel. The MBR filtrate tanks (RO Feed Tanks) provide feed water to the RO system. Water exiting the RO feed tanks is directed to the onsite reclaimed water pumps or RO feed pumps. Overflows from the RO feed tanks are discharged to the outfall pump station. The RO Feed Tanks can also be drained to sewer. The design criteria for the RO feed tanks are provided in Table 4-8.

Table 4-8: RO Feed Tanks Design Criteria

PARAMETER	VALUE
Area Number Location	33 Treatment Area
Process Objectives	To store MBR filtrate for RO system supply and also as supply for plant Recycled Water Pump Station.
Operational Summary	MBR Filtrate is routed to the RO Feed Tanks by residual pressure from the MBR Filtrate Pumps. Normally both tanks are operated in parallel. The Recycled Water Pump Station draws flows directly from RO Feed Tanks. The tanks are operated to maintain a minimum level or higher to provide this water. The RO Feed Pumps are supplied directly from the RO Feed Tanks by gravity without use of transfer pumps. The level in the RO Feed Tanks will be used to control the RO System flow. Any excess water will be passively overflowed via internal overflow to the Outfall Pump Station for distribution to the Ocean Outfall.
RO Feed Tanks -# Units -Dimensions, Diameter -Straight shell length/height (floor to dome) -Useable Volume of each tank -Total Useable Volume -HRT at max MFF thru-flow -HRT at max RO Feed Flow -Material -Protective Coatings Required -Procurement Type -Procurement Timing	 2 12' 22'6" 15,000 gallons 30,000 gallons 23 minutes @ 1.88 mgd 35 minutes @ 1.23 mgd max RO System Feed Flow FRP No lining, epoxy with polyurethane coating General Contract / Purchase Order Normal

4.2.4 On-Site Reclaimed Water System

The on-site reclaimed water system provides water for washdown, foam and scum control, screening/grit washing, landscape irrigation and other suitable applications. The water is drawn from the RO feed tanks. A chlorination feed system is provided to add a disinfect the discharged plant water. The system is designed to operate between 60 and 80 psi.

Capacity of the system is based on approximated values. Specific flows will be coordinated in detailed design which may result in small changes to the capacity of this system.

The design criteria for the on-site reclaimed water system are provided in Table 4-9.

Table 4-9: On-Site Reclaimed Water System Design Criteria

PARAMETER	VALUE
Area Number Location	34 Treatment Area
Process Objectives	To provide water for washdown, foam and scum control, screening/grit washing, landscape irrigation and other suitable purposes.
Operational Summary	Pumps are operated to maintain a set pressure range in the discharge piping.
Onsite Recycled Water Pumps -# Units -Design Flow per Pump -Head (minimum rated) -Type -Motor Horsepower, max -Drive Type -Voltage -Control Type -Pump Casing Material -Impeller Material -Shaft Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 2 (1 duty/1standby for normal demand and 2 duty for peak demand)) 75 gpm each 175' TDH End suction centrifugal pumps 5 hp VFD 480 Plant PLC Epoxy-coated cast-iron or SS 316 SS SS Epoxy with polyurethane coating General Contract / Purchase Order Normal Fairbanks Morse/Pentair, Grunfos, Xylem or equal if approved
Onsite Recycled Water Pump Flow Meter -# Units -Design Flow Range per Unit -Type -Diameter -Voltage -Control Type -Protective Coatings Required -Procurement Type -Procurement Timing	 1 0-200 gpm Magnetic 3" 120 Plant PLC Epoxy with polyurethane coating General Contract / Purchase Order Normal
Air Bladder Tank -# Units -Volume -Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 1 500 gallons Steel Vessel with EPDM or similar bladder All wetted steel components are epoxy coated, epoxy with polyurethane coating or similar General Contract / Purchase Order Normal Amtrol WellXTroll, or similar

4.3 RO/UV BUILDING – AREA 50

The advanced treatment system to produce Indirect Potable Reuse (IPR) water is housed in the RO/UV Building. The system includes a Reverse-Osmosis (RO) purification system and Ultraviolet Advanced Oxidation Process (UVAOP) disinfection and trace compound oxidation process.

4.3.1 RO System

RO removes dissolved and particulate constituents from the feed water, which achieves permeate salinity control, organics removal and additional pathogen log removal credits. RO feed water flows by gravity from the RO feed tanks to the suction side of the RO feed pumps. The RO feed water is pretreated with chemicals and cartridge filters to protect the RO membranes against damage from large particles. The water is then pressurized and passed through two stages of RO membrane elements with a pressure boost before the second stage to achieve flux balance. RO permeate is discharged to the UV AOP for disinfection/advanced oxidation or the outfall pump station. RO concentrate is chlorinated as it flows by pressure to the ocean outfall where bisulfite is dosed. The RO system is controlled by a PLC that is integrated into a plant control system that operates the RO feed tanks, RO high pressure feed pumps, concentrate control valves, booster pumps, cartridge filters, CIP makeup and neutralization systems. Table 4-10 provides design criteria associated with various components of the RO System and the RO Feed Tanks.

Table 4-10: RO System Design Criteria

PARAMETER	VALUE
Area Number Location OEM (RO System Supplier – ROSS) Procurement Timing	51 RO/UV Building H2O Innovation USA, Inc; Wigen Water Tech; Biwater; Harn RO; or equal if approved Early, submittals for 90% design
Process Objectives	To remove dissolved solids, organics, bacteria and some viruses for the MBR filtrate as the primary treatment step to turn the water suitable for indirect potable reuse
Operational Summary	The RO System receives water from the RO Feed Tanks by gravity. Flow is conditioned with chemical feeds and monitored by instrumentation prior to the individual RO train feed pumps. The RO System is operated based on RO Feed Tank Level, higher levels indicate higher RO System flow is needed, lower levels indicate lower RO System flow is needed. Each RO train will be operated with 80-100% of its rated capacity to help ease the flow steps when changing the number of operating pumps. Detailed operating within the RO trains themselves is developed by the ROSS. Flush procedures are automated. CIP procedures are manually performed by the plant operators. RO Permeate flows to the UVAOP system by residual pressure. RO Concentrate flows to the RO Concentrate Disinfection Contactor Pipeline and then to the Outfall Transmission Pipe downstream of the Outfall Pump Station by using residual pressure to drive the flow.
Pretreatment Chemicals	Sulfuric acid, liquid ammonium sulfate (future optional chemical), sodium hypochlorite, antiscalant

PARAMETER	VALUE
RO Feed Flow Meter	
-# Units	1
-Design Flow Range per Unit	607-860 gpm
-Type	Magnetic
-Diameter	10"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
RO Feed Pumps (High Pressure)	
-# Units	3 Units, 1 duty dedicated per RO unit
-Design Flow per Pump	Operating capacity 202 gpm to 287 gpm
-Head	TBD by ROSS
-NPSHa	30'
-Type	Vertical Turbine
-Motor Horsepower	40-hp (ROSS to confirm)
-Drive Type	VFD
-Voltage	480
-Control Type	RO System Control Panel with Plant PLC supervision and input
-Pump Casing Material	Cast-iron with epoxy lining or SS
-Impeller Material	316 SS
-Shaft Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane coating of non SS materials
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by ROSS.
RO Feed Cartridge Filter	
-# Units	3 Units, 1 duty dedicated per RO unit
-Design Flow per Filter	300 gpm
-Max Loading rate	3.5 gpm per 10 inch equivalent length
-Pressure Vessel Rating	TBD by ROSS
-Filter Element Rating	5 micron
-Filter Element Length	40"
-Max Clean element head loss @ Design Flow	<3 psi
-Max Dirty element head loss @ Design Flow	15 psi
-Vessel Orientation	Horizontal
-Vessel Material	SS 316 or FRP
-Procurement Type	ROSS to determine, vertical anticipated
-Listed Manufacturers	316 SS
	RO System Package
	Parker Hannifin Corp; 3M; Pall or equal

PARAMETER	VALUE
RO Units	
-# Units/Treatment Trains	3 Duty
-Capacity of each unit	215 gpm design permeate flow rate per unit
-Number of stagers per unit	2
-Number of RO element per pressure vessel	7
-Number of Stage 1 pressure vessels	7
-Number of stage 2 pressure vessels	3
-Recovery through the RO system	Design 80%, Min 75%; Max 85%
-Control Type	RO Systems Control Panel with supervision and input by Plant PLC.
RO Elements	
- Material	8inch by 40", thin film composite, spiral wound
-Average element flux	<12 gfd, single element flux < 16 gfd
- Listed Manufacturers	Manufacturer selection by RO Supplier. Acceptable suppliers, DOW; Hydranautics; or Toray only.
RO Pressure Vessels	
-Material	Fiber glass reinforced plastic, ASME stamped
-Min pressure rating for RO vessels	300 psi
-Operating temperatures	4.4 to 88°C
-Procurement Type	RO System Package
-Listed Manufacturers	Pentair Codeline, Protec Arisawam RO PV or BEL Composite (no exceptions)
RO Inter-Stage Booster Pumps	
-# Units	3 Units, 1 duty dedicated per RO unit
-Design Flow per Pump	TBD by ROSS
-Head (minimum rated)	50 psi
-Type	End suction centrifugal/ Vertical Turbine in can
-Motor Horsepower	TBD by ROSS
-Drive Type	VFD
-Voltage	480
-Control Type	RO Control Panel with Plant PLC supervision
-Pump Casing Material	316 SS
-Impeller Material	316 SS
-Shaft Material	316 SS
-Protective Coatings Required	N/A
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
RO Permeate Flow Meter	
-# Units	3 Units, 1 duty dedicated per RO unit
-Design Flow Range per Unit	172-215 gpm
-Type	Magnetic
-Diameter	4"
-Voltage	120
-Control Type	RO Control Panel with Plant PLC supervision
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.

PARAMETER	VALUE
RO Concentrate Flow Meter	
-# Units	3 Units, 1 duty dedicated per RO unit
-Design Flow Range per Unit	30-72 gpm
-Type	Magnetic
-Diameter	2 1/2"
-Voltage	120
-Control Type	RO Control Panel with Plant PLC supervision
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
CIP Makeup Flow Meter	
-# Units	1
-Design Flow Range per Unit	0-100 gpm
-Type	Magnetic
-Diameter	3"
-Voltage	120
-Control Type	RO Control Panel with Plant PLC supervision
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
RO CIP Tank	
-# Units	1
-Volume	Minimum usable volume ,900 gallons
-Material	FRP or Polyethylene if compatible with CIP chemicals
-Heater required on skid	Inline flow through external to tank required to heat solution 10 Deg Centigrade in 3 hours
-Protective Coatings Required	Material to be resistant without coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
RO Neutralization Tank	
-# Units	1
-Volume	Minimum usable volume ,1800 gallons
-Material	FRP or Polyethylene if compatible with CIP chemicals
-Heater required on skid	No
-Tank mixer	Yes
-Tank mixer type	To be determined by RO Supplier.
-Protective Coatings Required	Material to be resistant without coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
CIP Recirculation Pumps	
-# Units	2 (1 duty/1standby)
-Design Flow per Pump	350 gpm each
-Head (minimum rated)	140' TDH, to be confirmed by ROSS
-Type	Horizontal End suction centrifugal
-Motor Horsepower, max	20 hp
-Drive Type	VFD
-Voltage	480
-Control Type	RO Control Panel with Plant PLC supervision
-Pump Casing Material	316 SS
-Impeller Material	316 SS
-Shaft Material	316 SS
-Protective Coatings Required	N/A
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.

PARAMETER	VALUE
RO CIP Cartridge Filter	
-# Units	1
-Design Flow per Filter	300 gpm
-Max Loading rate	<5 gpm per 10 inch equivalent length
-Pressure Vessel Rating	100 psi TBD
-Filter Element Rating	5 micron
-Filter Element Length	40"
-Max Clean element head loss @ Design Flow	<3 psi
-Max Dirty element head loss @ Design Flow	15 psi
-Vessel Orientation	Horizontal/ Vertical
-Vessel Material	316 SS
-Procurement Type	Ro System Package
-Listed Manufacturers	Parker Hannifin Corp; 3M; Pall or equal
RO CIP Flow Meter	
-# Units	1
-Design Flow Range per Unit	280 to 420 gpm
-Type	Magnetic
-Diameter	6"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
RO Flush Tank	
-# Units	1
-Volume	Minimum usable volume ,2300 gallons
-Material	FRP or Polyethylene
-Heater required on skid	No
-Protective Coatings Required	N/A
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.
RO Flush Pumps	
-# Units	2 (1 duty/1standby)
-Design Flow per Pump	210 gpm each
-Head (minimum rated)	140' TDH
-Type	Horizontal end-suction centrifugal
-Motor Horsepower, max	15 max
-Drive Type	VFD
-Voltage	480
-Control Type	RO Control Panel with Plant PLC supervision
-Pump Casing Material	316 SS
-Impeller Material	316 SS
-Shaft Material	316 SS
-Protective Coatings Required	N/A
-Procurement Type	RO System Package
-Listed Manufacturers	Manufacturer selection by RO Supplier.

4.3.2 Ultraviolet Advanced Oxidation Process (UV AOP)

The UVAOP provides two mechanisms for treating contaminants – disinfection via direct photolysis and oxidation via free hydroxyl radical formation. The UVAOP system is designed to achieve target pathogen and 1,4 dioxane log reduction value (LRV) based on DDW requirements for IPR via groundwater recharge by direct injection. The UV system receives permeate from the RO units and discharges product water to the Product Water Storage Tank. The UV system is comprised of two treatment trains (1 Duty + 1 Standby) with each train consisting of single UV reactor. Sulfuric acid and sodium hypochlorite provide pretreatment to the UV reactors and are dosed to the influent header. Disinfected flow that does not meet specifications may be bypassed to the Outfall Balancing Tank.

The UV system is an enclosed system that functions to provide specific wavelengths of electromagnetic radiation to inactivate microorganisms by damaging life sustaining biochemicals (e.g. DNA, RNA, proteins) and rendering them unable to replicate. The UV power will be adjusted automatically based on changes in influent flow, temperature, pH, UVT, oxidant dose, and lamp age to achieve the desired target treatment requirements. Each UV reactor is provided with a chemically free automatic wiping system which functions to avoid formation of organic and inorganic deposits on the UV lamps. Removal of 1,4 dioxane is provided by advanced oxidation by using sodium hypochlorite upstream of the UV process to create free hydroxyl radicals. The efficiency of free hydroxyl formation using sodium hypochlorite is significantly impacted by pH therefore sulfuric acid is dosed upstream of sodium hypochlorite to achieve desired pH (e.g. 5-5.5). The design criteria for the UVAOP system are provided in Table 4-11.

Table 4-11: Ultraviolet Advanced Oxidation Process System Design Criteria

PARAMETER	VALUE
Area Number Location OEM Procurement Timing	52 RO/UV Building Xylem (Wedeco), Calgon and Trojan (no exceptions) Early, submittals for 90% design
Process Objectives	The UVAOP shall receive water from RO system to provide disinfection and advanced oxidation of the RO permeate and create IPR quality water.
Operational Summary	The UVAOP System receives RO Permeate by residual pressure from the RO System. Sodium Hypochlorite is injected upstream of the UVAOP System. The UVAOP System is controlled by a vendor control system to deliver the required dose. Out of spec water is bypassed to the Outfall Pump Station. Effluent from the UVAOP System flows via residual pressure to the Calcite Contactor System.

PARAMETER	VALUE
UV Reactor	
-# Units	2 Units 1 Duty / 1 Standby
- Flow	0.31 - 0.93 MGD each
-UV dose	TBD by UV system supplier
-Lamp Type	Low Pressure High Output
-Control Type	UVAOP Control Panel with Plant PLC supervision and input
-Power Supply	480
-Reactor Material	316L stainless steel
-Accessories	Master Control Panel, control valves, meters and instruments, and Portable CIP Cleaning System (optional)
-Procurement Type	UVAOP System Package
-Listed Manufacturers	Xylem (Wedeco) and Trojan (no exceptions)
UV Disinfection Flow Meter	
-# Units	1
-Design Flow Range per Unit	0.2 – 1 MGD each
-Type	Magnetic
-Diameter	8"
-Voltage	120
-Control Type	UVAOP Control Panel with Plant PLC supervision
-Protective Coatings Required	Epoxy with urethane coating
-Procurement Type	UVAOP System Package
UV Inlet, Outlet, and Bypass Valves	
-#Units	2 inlet, 2 outlet, 1 bypass
-Type	Industrial butterfly valve
-Voltage	120
-Control Type	UVAOP Control Panel with Plant PLC supervision and input
-Procurement Type	UVAOP System Package

4.4 EFFLUENT AREA – AREA 60

Efflent from the UVAOP System flows by residual head through a Calcite Contactor and into the IPR Product Water Storage Tank. From there it is transferred to the IRP Injection Wellfield (by others) by the IPR Product Water Pump Station.

The Effluent Area also includes the Ocean Outfall System which includes the Ocean Outfall Balancing Tank, Ocean Outfall Pump Station, Ocean Outfall Disinfection Pipeline Contactor, and RO Concentrate Disinfection Pipeline Contactor. Effluent from the two contactors is combined and dechlorinated at the Dechlorination Station before leaving the site in the IPR Pipeline.

4.4.1 Calcite Contactor Post Treatment Stabilization

Product water from the UVAOP system undergoes post treatment stabilization (consisting of calcite remineralization contactor and sodium hydroxide addition) to reduce corrosivity and increase pH. Sodium hypochlorite is then added upstream of the product water storage tank to achieve a free chlorine residual for additional disinfection. The product water storage tank provides operational storage for the AOP product water. Flows exceeding the maximum tank level are sent to the Outfall Pump Station. The tank may also be drained to the sewer. The IPR pump station conveys the purified water to injection wells located in the Morro Valley via the AWPF distribution pipeline. The AWPF distribution pipeline provides chlorine contact time to achieve additional disinfection. The design criteria associated with the calcite contactor system, product water storage tank, IPR

pump station and the AWPF distribution pipeline disinfection system is provided in Table 4-12, Table 4-13, Table 4-14, and Table 4-15 respectively.

Table 4-12: Calcite Contactor System Design Criteria

PARAMETER	VALUE
Area Number Location OEM Procurement Timing	61 Effluent Area Wigen Water Technologies, Tonka Water, or equal if approved Early, submittals for 90% design
Process Objectives	The purpose of the calcite contactor is to reduce the corrosivity and increase the pH of the UV AOP effluent.
Operational Summary	The Calcite Contactor System receives Flow to the UVAOP System via residual pressure. The flow moves through calcite media to absorb minerals and then flows via residual pressure to the IPR Product Water Storage Tank. The Calcite Contractor is a passive system not requiring any online process control. Loading of new media and backwashing that media is manually performed by the operators. The Calcite Contractor is equipped with backwash pumps and Backwash Waste Holding Tank to allow for slow discharge of backwash waste to the plant sewer system to not cause a process upset.
Calcite Contactor Vessels -# Units -Design Flow -Design Working Pressure -Source Water -Influent Water Quality -Finished Water Quality Required -Filter Media -Filter Media Quantity -Material -Protective Coatings Required -Procurement Type -Listed Manufacturers	 2 (2 duty) One vessel sized to allow entire flow to pass through a single vessel so that the other can be taken offline for service or media loading. 0.93 mgd 100 psi or greater RO / UVAOP Effluent pH 5.12-5.46; Total Alkalinity 1.7-1.9 mg/ as CaC03; Calcium = 1.4 mg/L; Water Temp. 14-22 Deg C. pH 7-8.5; LSI > 0; Alkalinity 40-60 mg/L as CaC03; TDS 50-60 mg/L; turbidity < 1 NTU. Pur-cal or equal: 36" total depth above supporting gravel. The media shall have a uniformity coefficient less than 1.5. Adequate for 60 days operated 24 hours/day at maximum flow and average chemical demand Carbon steel Epoxy interior coating, epoxy with polyurethane exterior coating Calcite Contactor System Package To be determined to OEM

PARAMETER	VALUE
Calcite Contactor System Flush Pump	
-# Units	1
-Design Flow per Pump	1700 gpm each (to be confirmed with furnished equip)
-Head (minimum rated)	50' TDH (to be confirmed with furnished equip)
-Type	Horizontal End suction centrifugal
-Motor Horsepower	30 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Calcite Contactor Control Panel with Plant PLC supervision and input
-Pump Casing Material	Cast-iron with epoxy lining, or SS
-Impeller Material	316 SS
-Shaft Material	316 SS
-Protective Coatings Required	Epoxy with polyurethane coating on non SS metal
-Procurement Type	Calcite Contactor System Package
-Listed Manufacturers	To be determined by Calcite Contactor System Manufacturer.
Backwash Waste Holding Tank	
-# Units	1
-Dimensions, Diameter	16'
-Straight shell length/height (floor to dome)	24.5'
-Volume	34,000 gallons
-Material	FRP
-Protective Coatings Required	No lining, epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
Backwash Waste Holding Tank Flow Meter	
-# Units	1
-Design Flow Range per Unit	0-100 gpm
-Type	Magnetic
-Diameter	3"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal

4.4.2 IPR Product Water Storage Tank

The IPR Product Water Storage Tank stores IPR Product water for distribution to the IPR Injection Wellfield (by others) via the IPR Product Water Pump Station. The IPR Product Water Storage Tank also stores IPR Product water to supply backwash water to the Calcite Contactor in order to backwash and clean a new delivery of calcite. This system is summarized in Table 4-13 below.

Design development of the IPR Product Water Storage Tank is on hold pending further clarification from the City on what capacity is required. The IPR Wellfield is not yet designed which impacts the design of the IPR Product Water Storage Tank.

This BDR and the Drawings current show a tank sized at 500,000 gallons as required by the RFP. However, there is potential to downsize this tank depending on the needs of the IPR Wellfield. FBV has estimate a tank of 100,000 gallons could be adequate for plant operations.

Table 4-13: Product Water Storage Tank Design Criteria

PARAMETER	VALUE
Area Number Location	62 Effluent Area
Process Objectives	The product water storage tank provides operational storage of the disinfected product water.
Operational Summary	The IRP Product Water Storage tank receives water from the Calcite Contactor. It is used to: • furnish storage of water required to backwash new calcite filter media (34,000 gallons). • Furnish buffer volume to allow smooth operation of the RO/UV system. • *Furnish buffer volume to allow misbalanced operation of WRF and IPR wellfield deliveries (required volume to be furnished by City)*
Product Water Storage Tank -# Units -Dimensions, Diameter -Straight shell length/height (floor to dome) -Volume -Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 1 68' 23'6" 500,000 gallons Glass lined bolted steel Epoxy with polyurethane coating General Contract / Purchase Order Normal California Aquastore-CST; Engineering America or equal if approved

4.4.3 IPR Product Water Pump Station

The IPR Product Water Pump Station pumps IPR Product Water via the IPR Product Water Transmission Main (by others) to the IPR Wellfield for injection (by others). This facility is summarized in Table 4-14 below.

Design development of the IPR Product Water Pump Station is on hold pending further clarification from the City on what is required. The design of the IPR pipe (by others) is not complete, which impacts the hydraulic design of this pump station. Furthermore, the design of the IPR pipe includes surge mitigation which may require impacts to the design of the IPR Product Water Pump Station. The design of the IPR Injection Wellfield (by others) is not complete, which impacts the hydraulic design and operation of this pump station.

This BDR and the Drawings currently show the IPR Product Water Pump Station that was estimated based on the limited RFP information.

Table 4-14: IPR Pump System Design Criteria

PARAMETER	VALUE
Area Number Location	63 Effluent Area
Process Objectives	The IPR pump station conveys the recycled water to injection wells located in the Morro Valley.
Operational Summary	*Operation of the IPR Product Water Pump Station is unknown until requirements are furnished by the City relative to the design of the IPR Transmission Main and IPR Injection Wellfield.*
IPR Pumps -# Units -Design Flow per Pump -Head (minimum rated) -Type -Motor Horsepower, estimated max -Drive Type -Voltage -Control Type -Pump Casing Material -Impeller Material -Shaft Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 3 (2 duty/1standby) 323 gpm each 63' TDH (166' discharge HGL) End suction centrifugal pumps 7.5 hp VFD 480 Plant PLC Epoxy-coated cast-iron or SS 316 SS 316 SS or similar Epoxy with polyurethane for non SS metal General Contract / Purchase Order Normal Fairbanks Morse/Pentair, Grunfos, Xylem or equal if approved

The IPR Product Water Transmission Main (by others) is also used as a supplemental disinfection contactor. This facility is summarized in Table 4-15 below.

Design and operation of the IPR Product Water Transmission Main (by others) needs to be coordinated to furnish the disinfection contact requirements stated below. If these values cannot be met additional contact facilities may be required to achieve the needed log removal credits.

Table 4-15: AWPF Distribution Pipeline Disinfection Design System Criteria

PARAMETER	VALUE
Area Number Location	Offsite Offsite
Process Objectives	Achieve additional disinfection of AWPF product water via chlorine contact in the distribution pipeline.
Operational Summary	The Transmission Main is used to also provide disinfection contact time. This function is passively maintained by the highpoint at Quintanna without requiring operational input.
CT Required for 4 log virus inactivation @ 14 Degrees C, pH 6-9	4.4 mg/L-min (EPA Guidance Manual Disinfection Profile and Benchmarking August 1999)
Maximum pipeline flow rate	0.93 MGD
Pipeline Diameter	8"
Approx. Pipe Length to groundwater injection	9,504 ft
Approx. Pipe Length 100% full flow	4,752 ft (to high point of Quintana Road)
Pipe Volume 100% full flow	12,410 gallons
Contact time @ maximum flow associated with full pipe segment	19.22 minutes
Pipeline Baffling Factor	1
Required Free Chlorine Residual at end of full pipe segment	0.3 mg/L
CT Calculated at Max Flow - pipe full	5.7 mg/L-min

4.4.4 Outfall Pump Station

The Outfall Pump Station pumps flows to the Ocean Outfall (by others) via the Ocean Outfall Transmission Main (by others). The Outfall Balancing Tank receives, blends, and equalizes flows for the Outfall Pump Station. This system receives:

- Membrane Filtrate (MFF) from the MBR system
- Filtered Outfall Water (FOW) from the SAFE System
- RO Feed (ROF) and RO train permeate (ROP) bypass from the RO System
- UV Effluent (UVE) bypass from the UVAOP System
- Overflow (OF) from the IPR Product Water Storage Tank

This system is summarized in Table 4-16 below.

This system does not receive concentrate from the RO System. The residual pressure from that system is used to route that flow to the Ocean Outfall Transmission Main downstream of the Outfall Pump Station.

Design development for the Outfall Balancing Tank and Outfall Pump Station is on hold pending further clarification from the City on what is required. The design of the Outfall Transmission Main (by others) and the operation of the Ocean Outfall System (by others) can have a significant impact on the design and operation of the Outfall Balancing Tank and Outfall Pump Station at the WRF. Due to the length of the Outfall Transmission Main, the wide flow range required, and the rate of required flow changes surge potential is estimated to be high in the line. Surge design is in the scope of the Outfall Transmission Main designer.

This BDR and the Drawings show the conceptual Outfall Balancing Tank and Outfall Pump Station FBV developed based on the limited information in the RFP.

PCO Note: This BDR and the Drawings show 4 Outfall Pumps, instead of 3 per pending PCO.

Table 4-16: Outfall Balancing Tank and Outfall Pump Station System Design Criteria

PARAMETER	VALUE
Area Number Location	64 Product Water Area
Process Objectives	The outfall balancing tank provides operational storage for the treated effluent which exceeds the well field injection capacity, or water that does not meet the specification for ground water injection to the ocean outfall. The outfall (effluent) pump station conveys the flows to the ocean outfall.
Operational Summary	The Outfall Balancing tank receives the various flows for the Ocean Outfall and provides for equalized operation of the Outfall Pump Station. The Outfall Pump Station is operated based on level in the Outfall Pump Station, with higher level indicating more pumping is required and lower level indicating less pumping is required.
Outfall Balancing Tank -# Units -Dimensions, Diameter -Straight shell length/height (floor to dome) -Volume -Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 1 12' 15' 8500 gallons FRP Epoxy with polyurethane coating General Contract / Purchase Order Norma To be determined by FBV

PARAMETER	VALUE
Outfall Pumps	
-# Units	4 (3 duty/1standby)
-Design Flow per Pump	2503 gpm each at peak flow with RO System running 1884 gpm each at peak flow with RO System offline
-Head (minimum rated)	65' TDH (168' discharge HGL) with RO System running 84' TDH (187' discharge HGL) with RO System offline
-Type	End suction centrifugal pumps
-Motor Horsepower	60 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Plant PLC
-Pump Casing Material	Epoxy-coated cast-iron or SS
-Impeller Material	316 SS
-Shaft Material	316 SS or similar
-Protective Coatings Required	Epoxy with polyurethane coating on non SS metal
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Fairbanks Morse/Pentair, Grunfos, Xylem or equal if approved
Outfall Pump Flow Meter	
-# Units	1
-Design Flow Range per Unit	0.28 – 8.14 MGD
-Type	Magnetic
-Diameter	12"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Norman

4.4.5 Ocean Outfall Disinfection & Dechlorination

4.4.5.1 Ocean Outfall Disinfection Pipeline Contactor

Ocean Outfall water is disinfected in an onsite pipeline contactor and then dechlorinated at the Dechlorination Station before flowing via the Outfall Transmission Main (by others) to the Ocean Outfall (by others). Sodium hypochlorite is dosed in the Ocean Outfall Pump Station discharge upstream of the outfall disinfection pipeline contactor. The Ocean Disinfection Pipeline Contactor is configured to provide plug-flow contact volume. The pipeline contactor is sloped downward continuously in the direction of flow toward a blow-off at the Dechlorination Station. Residual pressure in the system can be used at that location to blow-down any settled fines or precipitants to the plant sewer. This system is summarized in Table 4-17 below.

Table 4-17: Outfall Disinfection Pipeline Contactor Station Design Criteria

PARAMETER	VALUE
Area Number Location	65 Product Water Area
Process Objectives	To achieve the retention time required for disinfection of fecal coliforms to meet the ocean outfall permit.

PARAMETER	VALUE
Operational Summary	Water pumped by the Outfall Pump Station is routed dosed with sodium hypochlorite and then routed through the Outfall Disinfection Contactor Pipeline to get the required contact time. From there, the flow is blende with flow from the RO Concentrate Disinfection Contactor Pipeline and dechlorinated at the Dechlorination Station before leaving the site via the Outfall Transmission Pipeline. Any solids accumulated in the contactor are manually blown down to the plant sewer by the operators. This is expected to be rarely needed.
Pipe Contactor -Flowrate -Contact Time -Chlorine Dose -Pipeline Baffling Factor -Volume (100% full flow), min -Diameter -Length -Material -Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers	 8.14 MGD maximum 19 minutes at maximum flow See Section 4.6 1 (plug flow) 110,000 gallons 78" 467 ft Steel Epoxy lining, Cement Mortar Coating or Epoxy with polyurethane on exposed exterior General Normal FBV to determine

4.4.5.2 RO Concentrate (Brine) Disinfection Pipeline Contactor

RO Concentrate is conveyed by residual pressure from the RO System to the Ocean Outfall (by others) via the RO Concentrate Disinfection Pipeline Contactor. The concentrate is dosed with sodium hypochlorite at the entry of the pipeline contactor to disinfect the concentrate and sodium bisulfite at Dechlorination Station to reduce the chlorine residual. The pipeline contactor is sloped downward continuously in the direction of flow toward a blow-off at the Dechlorination Station. Residual pressure in the system can be used at that location to blow-down any settled fines or precipitants to the plant sewer. Design criteria for the RO Concentrate Disinfection Pipeline Contactor are provided in Table 4-18 below.

Table 4-18: RO Concentrate Disinfection Pipeline Contactor Design Criteria

PARAMETER	VALUE
Process Objectives	To achieve the retention time required for disinfection of fecal coliforms to meet the ocean outfall permit.
Area Number Location	65 Product Water Area

PARAMETER	VALUE
Pipe Contactor	
-Flowrate	0.05-0.23 MGD
-Contact Time	18 minutes at maximum flow
-Chlorine Dose	See Section 4.6
-Pipeline Baffling Factor	1 (plug flow)
-Volume (100% full flow)	3,000 gallons
-Diameter	12”
-Length	467’
-Material	PVC
-Protective Coatings Required	None
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	FBV to determine

4.4.5.3 Dechlorination Station

Flows from the Outfall Disinfection Pipeline Contactor and Ro Concentrate Pipeline Contactor and joined and sodium bisulfite is injected to reduce chlorine residual at the Dechlorination Station which is located on the WRF site near the Operations Building.

4.5 RESIDUALS AREA – AREA 70

4.5.1 Sludge Holding Tanks

The sludge holding tanks receive, store, and aerate activated sludge wasted from the BNR-MBR process. The holding tanks consist of a two-cell design, with each zone designed to operate independently. Each zone shall include a mixer to mix the WAS sludge and coarse bubble diffusers to aerate it. The aeration will cycle to achieve both nitrification and denitrification to avoid excessively low pH values. The tanks are not designed to digest the sludge to meet state standards. It is expected that normally only one zone will be in use to minimize sludge age for optimization of dewatering system performance. The facility is designed to operate the belt press two days a week for 8 hours per day. The design criteria for the sludge holding tanks are provided in Table 4-19.

Table 4-19: Sludge Holding Tank System Design Criteria

PARAMETER	VALUE
Area Number Location	71 Residuals Area
Process Objectives	Sludge Holding tank will receive sludge from MBR process, tanks will store and aerate activated sludge to minimize sludge age for optimization of dewatering system performance.

PARAMETER	VALUE
Operational Summary	The Sludge Holding Tanks receive WAS sludge from the WAS and Scum Pumps. The operators manually configure valving to select which tank to deliver sludge to. The operators also manually configure valving to select which tank the Sludge Pumps will draw from. The tanks are equipped with mixers to keep solids suspended at lower tank levels and coarse bubble diffusers to aerate and mix the tank at levels above that. Operators manually select which mode to operate in from the PLC based on tank level and operational needs.
Sludge Holding Tanks	
-# Units	2
-Days of sludge storage	7 days, each with 1.14 safety factor
-Dimensions, length x width	38'-10" x 38'-10"
-Sidewater Depth	20'-0" east end, 21'-9" west end
-Freeboard	2'-0"
-Volume	236,400 gallons each
-Tank Material	Concrete
-Protective Coatings Required	None
Sludge Holding Tank Blowers	
-# Units	2 Units, 1 per Storage Cell
-Design Flow per Blower	320 scfm
-Discharge Pressure	10.8 psig
-Type	Positive Displacement Rotary Lobe
-Motor Horsepower	25 hp
-Drive Type	VFD
-Voltage	480
-Control Type	PLC
-Casing Material	Cast iron
-Rotor Material	Cast iron
-Shaft Material	High carbon steel
-Protective Coatings Required	High-temperature epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Kaeser Compressors, Universal Blower Pac, Excelsior, Atlas Copco, or equal if approved.
Coarse Bubble Diffusers	
-# Units	2 Grids, one per train
-Type	Coarse bubble
-Air Flow & Diffuser units	36 diffusers
-Material	SS 304L or 316L
-Manifolds & laterals Material	SS 304L
-Protective Coatings Required	None
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	EDI, Sanitaire, or equal if approved.

PARAMETER	VALUE
Mixer	
-# Units	2, 1 per train
-Mixing Flow	TBD by mixer supplier
-Mixing Thrust	TBD by mixer supplier
-Minimum mixer submergence	TBD by mixer supplier
-Maximum mixer submergence	19 feet
-Tank Volume	113,000 gallons min, 236,400 gallons max
-Type	Submersible
-Motor Horsepower, maximum	10 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Plant PLC
-Mixer Material	All uncoated wetted materials shall be SS 316L
-Protective Coatings Required	Epoxy for submerged non SS metal. Epoxy with polyurethane coating for exposed non SS metal.
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Sulzer, Flow Systems, Flygt, or equal if approved.

4.5.2 Sludge Dewatering

The sludge dewatering system pumps waste sludge from the Sludge Holding Tanks, or directly from the MBR system, and performs dewatering to a water content suitable for hauling and disposal. A belt filter press with a polymer storage and feed system perform the dewatering. The thickened solids drop to a conveyor that transports them to a roll-off container. The belt filter press is designed to be operated 2 days per week, 8 hours per day. The design criteria for the sludge dewatering system are provided in Table 4-20.

Table 4-20: Sludge Dewatering System Design Criteria

PARAMETER	VALUE
Area Number Location	72 Residuals Area
Process Objectives	Sludge Dewatering system will perform dewatering to remove water and increase total solid concentration.
Operational Summary	Operators will manually valve the Sludge Pumps to draw from the desired Sludge Holding Tank, manually operate the Sludge Pumps, and manually operate the Belt Filter Press equipment.

PARAMETER	VALUE
Sludge Pumps	
-# Units	2 Units, duty / standby
-Design Flow per Pump	305 gpm
-Head	40'
-Type	Rotary lobe
-Motor Horsepower	5 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Plant PLC
-Pump Casing Material	Cast iron
-Pump Casing Internal Material	Corrosion resistant, material TBD
-Rotor Material	Corrosion resistant or protected, material TBD
-Stator Material	Corrosion resistant or protected, material TBD
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Borger, Netzsch, or equal if approved.
Rotary Lobe Feed Pump Flow Meter	
-# Units	1
-Design Flow Range per Unit	100 – 305 gpm
-Type	Magnetic
-Diameter	6"
-Voltage	120
-Control Type	Plant PLC
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
Belt Filter Press	
-# Units	1 Unit (process sludge 8 hr/ day, 2 days/week)
-Liquid processed	WAS approx. 7,000 to 10,000 mg/l
-Liquid Flow, gpm	305 gpm
-Solid Flow,	1,313 lbs/hour
-Minimum guaranteed dry solids concentration, specified	17 %
-Minimum dry solids concentration required for transportation	16%
-Minimum capture efficiency	95%
-Type	Belt Filter Press
-Motor Horsepower	3 hp
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Vendor local control panel with Plant PLC supervision and input
-Housing Material	Steel
-Belt Material	Mfr to determine
-Protective Coatings Required	Epoxy on all wetted non SS metal. Epoxy with polyurethane on exposed non SS metal.
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	Komline-Sanderson, BDP, Charter Machine Company, Ashbrook, or equal if approved.

PARAMETER	VALUE
Conveyor	
-# Units	1 angled conveyor to lift solids from belt filter press 1 horizontal conveyor with 2 electric knife gate valves above dumpster
-Design Flow per Unit	3 cfm
-Type	Shaftless Screw
-Diameter	TBD"
-Motor Horsepower, ea	1.5 hp
-Drive Type	Constant Speed
-Voltage	480
-Control Type	Part of Belt Filter Press Control Panel
-Wetted Components Material	SS 316
-Protective Coatings Required	Epoxy with Polyurethane on all exposed non-SS metals
-Procurement Type	General Contract / Purchase Order
-Procurement Timing	Normal
-Listed Manufacturers	JDV, Custom Conveyor Corporation, or equal if approved.

4.5.3 SAFE System

The SAFE system uses cloth media filtration to provide side-stream treatment of peak flows for blending with effluent from the MBR system and discharge to the ocean. The SAFE system diversion box sends flow exceeding the MBR capacity to the SAFE system by gravity. A concrete tank, called the SAFE Settle, is located upstream of the SAFE Filter. The SAFE Settle basin captures and equalizes peak event flows. Many of the smaller peak flow events will not completely fill the SAFE Settle basin and therefore would not go to the SAFE Filter System. Water from these events will be pumped back to the headworks for treatment when plant flows have decreased.

In larger peak flow events, water fills the SAFE Settle basin until it passes over a weir and flows to the SAFE Filter System for filtration treatment. During this operation, the Safe Settle basin provides sedimentation treatment upstream of the Safe Filter System. Effluent from the SAFE Filter System is routed to the Outfall Balancing Tank where it is blended with MBR effluent and pumped by the Outfall Pump Station to the Outfall Disinfection Pipeline Contactor and then onto the Ocean Outfall. The design criteria for the SAFE system are provided in Table 4-21 below.

Table 4-21: SAFE System Design Criteria

PARAMETER	VALUE
Area Number Location	73 Residuals Area
Process Objectives	Flows in excess of the BNR-MBR capacity will l be treated with an auxiliary treatment system consisting of settling in an EQ tank and filtration. Effluent from this system will be routed to Outfall Pump Station.

PARAMETER	VALUE
Operational Summary	Excess plant influent flows passively overflow the SAFE Diversion Weir at the SAFE Diversion Box and flow by gravity to the SAFE Settle Tank. This tank provides equalization and settling before flow passively overflows to the SAFE Filter System by gravity. The SAFE Filter system filters the water by gravity. The filtered effluent flows to the Outfall Pump station by gravity. The SAFE filter system includes a backwash drive and pumps which start automatically as required during operation of the SAFE Filter system. Backwash waste is pump to the Fine Screens Influent for treatment by the BNR system.
SAFE Settle -# Units -Design Flow Range per Unit -Type -Operating Volume -Dimensions, Length x Width -Average Sidewater Depth -Effluent Weir Length -Protective Coatings Required	(Located in area 71) 1 0 to 6.26 MGD Concrete tank 99,600 gallons 38'-10" x 17'-0" 20'-2" 13'-0" None
SAFE Filter Inlet Flow Meter -# Units -Design Flow Range per Unit -Type -Diameter -Voltage -Control Type -Protective Coatings Required -Procurement Type -Procurement Timing	 1 0 to 6.26 MGD Magnetic 16" 120 Plant PLC Epoxy with polyurethane coating General Contract / Purchase Order Normal
SAFE Filter -# Units -Design Flow per Unit -Total System Design Capacity -Type -Total filtration area -Filter media size -Backwash Shoe Rotation Motor Horsepower -Drive type -Voltage -Control Type -Equipment Housing Material -Tank Interior Protective Coatings Required -Tank Exterior Protective Coatings Required -Procurement Type -Procurement Timing -Listed Manufacturers (OEM)	 1 6.26 MGD 6.26 MGD Cloth Media Disc Filter 1,076 square feet 5 micron 2 hp Constant Speed 480 Local vendor control panel with Plant PLC supervision and input Steel Epoxy Epoxy with polyurethane Disc Filtration System Package Early, submittals for 90% design Aqua-Aerobic Systems Inc., Veolia or equal if approved.

PARAMETER	VALUE
Filter Solid Pump	
-# Units	1
-Design Flow per Pump	520 gpm, TBD by Disc Filter System OEM
-Rated Flow and Head	51', TBD by Disc Filter System OEM
-Type	Centrifugal, solids handling
-Motor Horsepower	20 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Disc Filtration System Control Panel
-Casing Material	Cast iron with epoxy lining
-Impeller Material	TBD by Disc Filter System OEM
-Shaft Material	TBD by Disc Filter System OEM
-Protective Coatings Required	Epoxy with polyurethane
-Procurement Type	Disc Filtration System Package
-Listed Manufacturers	TBD by Disc Filter Systems OEM
Filter Solid Pump Flow Meter	
-# Units	1
-Design Flow Range per Unit	520 gpm
-Type	Magnetic
-Diameter	6"
-Voltage	120
-Control Type	Disc Filtration System Control Panel
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	Disc Filtration System Package
-Listed Manufacturers	TBD by Disc Filter Systems OEM
Filter Backwash Pump	
-# Units	1
-Design Flow per Pump	520 gpm, TBD by Disc Filter System OEM
-Rated Flow and Head	51', TBD by Disc Filter System OEM
-Type	Centrifugal, solids handling
-Motor Horsepower	20 hp
-Drive Type	VFD
-Voltage	480
-Control Type	Disc Filtration System Control Panel
-Casing Material	Cast iron with epoxy lining
-Impeller Material	TBD by Disc Filter System OEM
-Shaft Material	TBD by Disc Filter System OEM
-Protective Coatings Required	Epoxy with polyurethane
-Procurement Type	Disc Filtration System Package
-Listed Manufacturers	TBD by Disc Filter Systems OEM
Filter Backwash Pump Flow Meter	
-# Units	1
-Design Flow Range per Unit	520 gpm
-Type	Magnetic
-Diameter	6"
-Voltage	120
-Control Type	Disc Filtration System Control Panel
-Protective Coatings Required	Epoxy with polyurethane coating
-Procurement Type	Disc Filtration System Package
-Listed Manufacturers	TBD by Disc Filter Systems OEM

4.6 CHEMICAL STORAGE AND FEED FACILITIES – AREA 90

The following chemicals will be used as part of the Morro Bay WRF.

- Antiscalant (Threshold Inhibitor) – Added to the RO system feed water to minimize inorganic scaling on the membranes.
- Citric Acid – Used for periodic cleaning of both the RO and MBR membranes; Used to neutralize cleaning solutions.
- Polymer – Added to the sludge fed to the Belt Filter Press to assist in cake formation.
- Sodium Bisulfite – Added to remove residual chlorine from flow sent to the ocean outfall.
- Sodium Hydroxide – Used for pH control and alkalinity addition in the BNR feed and product water; used for periodic cleaning of both the RO and MBR membranes and neutralization of cleaning solutions.
- Sodium Hypochlorite – Used for bio-growth control and disinfection purposes throughout the plant; used for periodic cleaning of membranes; used as an oxidizing agent in the UV system.
- Sulfuric Acid – Added to the RO feed water to control pH and help minimize scaling; added to the UV AOP feed to control pH and ensure free chlorine is in the hypochlorous acid form.
- Liquid Ammonium Sulfate (LAS) – FUTURE CHEMICAL. Space and spare conduits are furnished to support addition of a LAS feed system in the future. The design of this plant is to operate the BNR system to leave ammonia carry-over sufficient for use in monochloramination of RO Feed water for biofouling control. If the City choses at a later date to not operate the BNR system in this way, addition of the LAS system would be required.

These chemicals listed above (with the exception of polymer) will be stored in a centralized storage and feed facility located near the middle of the plant site. This facility will be covered by a roof canopy to shade the area from the sun and reduce the amount of rain water that can enter the equipment area. Polymer will be stored near the belt press located in the Dewatering Area.

The Main Chemical Facility will have vehicular access as it located adjacent to the main access road through site. Deliveries to the facility will be either via bulk tanker truck or as liquids delivered in totes. Bulk tanker trucks will be able to pull off the main road and park adjacent to the Chemical Facility for unloading bulk chemical. The tanker truck pull off location will be slightly depressed such that in the event of a tanker leak, chemical will be directed to a sump so that it can be properly disposed of. Tote containment will be on the road side of the facility so that totes can be placed on their secondary containment tubs via a forklift from the road.

The tables below represent the design criteria for the chemical feed systems. Storage volumes have been designed to be sufficient for 15 days of operation under average conditions. Most of the tables below contain information on how long the selected volume of chemical will last under worst case (max flow at max chemical dose) operation for information.

4.6.1 Antiscalant

One antiscalant system will be provided to feed chemical upstream of the RO system. Antiscalant will be delivered and stored in a standard 330-gallon Intermediate Bulk Container (IBC) which will

be located on top of a secondary containment tub. The metering pumps will be peristaltic pumps designed to feed chemical over the full range of plant flows and doses.

Table 4-22: Antiscalant Design Criteria

PARAMETER	VALUE
Delivered Chemical	100% antiscalant Assumed SG – 1.12 (Final chemical selection to be verified)
Fed Chemical	Same as delivered
RO Influent Feed Point	
Objective	To minimize inorganic scaling on the membranes
Feed Point Description	Upstream of RO feed pumps
Estimated Pressure at Feed Point, ft	20
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 5 3 2
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 1.16 0.97 0.31
Required Chemical Pump Flow Range Maximum, gph Minimum, gph	 0.21 0.02
Turndown Required	11 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided)	Blue-White FlexPro A2 (0.075” Tube) Max flow: 1.6 gph Listed Turndown: 100:1 Min flow: 0.016 gph Wetted Materials: Flex-A-Prene
Chemical Storage	
Volume Required for 15 days storage at average consumption (gallon)	40
Chosen Storage Method	IBC
Quantity	1
Volume per container (gallon)	330
Selected volume will be consumed at max usage in this many days	65
Piping	
In-plant piping	CPVC
Yard Piping	Polyethylene tubing within CPVC carrier piping

4.6.2 Citric Acid

One citric acid feed system will be provided to feed 50% chemical to both the RO and MBR systems for periodic cleaning of the membrane systems and neutralization of the cleaning solution prior to discharge. Citric will be delivered and stored in a standard 330-gallon Intermediate Bulk Container (IBC) which will be located on top of a secondary containment tub. The metering pumps will be peristaltic pumps designed to feed chemical over the full range of plant flows and doses.

Table 4-23: Citric Acid Design Criteria

PARAMETER	VALUE
Delivered Chemical	50% Citric Acid SG – 1.24
Fed Chemical	Same as delivered
RO CIP Feed Point	
Feed Point Objective	To deliver acid for CIP maintenance and recovery procedures, including the neutralization of used cleaning solution
Feed Point Description	Fed to atmospheric tank
Estimated Pressure at Feed Point, ft	0
Chemical Flow, gph Note: chemical is fed to the RO system for both CIP tank fill and Neutralization of spent CIP solution. The pump can operate at constant speed as flow pacing is not required (but may be provided to utilize similar pumps)	105
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A4 (0.75” Tube) 158 0.06 2500:1 Flex-A-Prene
MBR Cleaning Feed Point	
Feed Point Objective	To deliver acid for maintenance and recovery cleaning procedures
Feed Point Description	Injected into the MBR Filtrate Line for each MBR train downstream of the MBR Filtrate Pump while being operated in reverse.
Estimated Pressure at Feed Point, ft	Vendor specific, assumed less than 30 psi
Chemical Flow, gph Note: chemical is fed to the MBR system for both maintenance and recovery cleans. The pump can operate at constant speed as flow pacing is not required (but may be provided to utilize similar pumps)	150

PARAMETER	VALUE
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1 (shared by MBR trains via automated valves)
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A4 (0.75" Tube) 158 0.06 2500:1 Flex-A-Prene
Chemical Storage	
Volume Required for 15 days storage at average consumption (gallon)	30.0
Chosen Storage Method	IBC
Material	Chem supplier's standard
Quantity	1
Volume per container (gallon)	330
Piping	
In-plant piping	PVC
Yard Piping	Polyethylene tubing within CPVC carrier piping

4.6.3 Sodium Bisulfite

One sodium bisulfite feed system will be provided to feed 38% chemical upstream ocean outfall termination point to prevent chlorinated water from entering the ocean. Sodium bisulfite will be delivered and stored in a standard 330-gallon Intermediate Bulk Container (IBC) which will be located on top of a secondary containment tub. The metering pumps will be peristaltic pumps designed to feed chemical over the full range of plant flows and doses. Above grade sodium bisulfite piping will be heat traced and insulated.

As bisulfite needs to be fed continuously, the system will be equipped with a small tank in the pump suction piping that can be gravity filled from the tote as the tote is low. This will allow pumps to pull fluid from this tank while the tote is being switched out to maintain continuous operation.

Table 4-24: Sodium Bisulfite Design Criteria

PARAMETER	VALUE
Chemical Information	
Delivered Chemical	38% Sodium Bisulfite SG – 1.31
Fed Chemical	Same as delivered
Ocean Outfall	

PARAMETER	VALUE
Feed Point Objective	To remove residual chlorine prior to discharge to the ocean
Feed Point Description	Ocean outfall pumps discharge
Estimated Pressure at Feed Point, ft	65
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 1.7 1.6 1.5
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 8.14 0.19 0.05
Required Chemical Flow Range Maximum, gph Minimum, gph	 11.6 0.002
Turndown Required Note: Due to the large turndown requirement, this may require multiple pumps (to be determined during detailed design)	2900 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A3 (0.187" Tube) 22 0.009 2500:1 Flex-A-Prene
Chemical Storage	
Volume Required for 15 days storage at average consumption (gallon)	5
Chosen Storage Method	IBC
Material	Chem supplier's standard
Quantity	1
Volume per container (gallon)	330
Selected volume will be consumed at max usage in this many days	2
Piping	
In-plant piping	CPVC
Yard Piping	Polyethylene tubing within CPVC carrier piping
Note	Above grade piping will be heat traced and insulated to prevent freezing

4.6.4 Sodium Hydroxide

One hydroxide bulk storage tank will be provided to store 25 percent solution. This solution strength was selected to prevent the need for heat tracing the tank and piping while still maintaining a reasonable volume of storage. This tank will supply all the pumps which feed hydroxide throughout the site. The tank is sized to hold 15 days of storage or approximately one full tanker delivery, whichever is greater. The metering pumps will be peristaltic pumps designed to feed chemical over the full range of plant flows and doses.

Table 4-25: Sodium Hydroxide Design Criteria

PARAMETER	VALUE
Chemical Information	
Delivered Chemical	25% Sodium Hydroxide SG 1.25
Fed Chemical	Same as delivered
RO CIP Feed Point	
Feed Point Objective	To deliver base for CIP maintenance and recovery procedures, including the neutralization of used cleaning solution
Feed Point Description	Fed to Atmospheric tank
Estimated Pressure at Feed Point, ft	0
Chemical Flow, gph Note: chemical is fed to the RO system for both CIP tank fill and Neutralization of spent CIP solution. The pump can operate at constant speed as flow pacing is not required (but may be provided to utilize similar pumps)	130
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A4 (0.187" Tube) 158 0.06 2500:1 Flex-A-Prene
BNR Feed Point	
Feed Point Objective	To increase alkalinity and control pH in the BNR basins
Feed Point Description	Ahead of MBR splitter box
Estimated Pressure at Feed Point, ft	10
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 30 5 0.5

PARAMETER	VALUE
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 1.88 1.16 0.84
Required Chemical Flow Range Maximum, gph Minimum, gph	 9.0 0.1
Turndown Required	90 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.187" Tube) 19.3 0.19 100:1 Flex-A-Prene
Product Water Feed Point	
Feed Point Objective	To control pH in the product water
Feed Point Description	Product water tank inlet
Estimated Pressure at Feed Point, ft	40
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 2.0 2.0 2.0
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 0.80 0.78 0.26
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.21 0.07
Turndown Required	3 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.075" Tube) 1.6 0.02 100:1 Flex-A-Prene
Chemical Storage	
Volume Required for 15 days storage (gallon)	~600

PARAMETER	VALUE
Chosen Storage Method	Vertical bulk storage tank sized for the estimated amount used or a full tanker, whichever is greater
Tanker delivery volume	4200 gallon
Material	FRP or PE
Quantity	1
Approximate selected tank dimensions	10’ diameter x 10’ side shell height
Volume of selected tank	5800 gallon
Selected volume will be consumed at max usage in this many days Note: The storage requirements listed are based on annual average use. However, during maximum month, the alkalinity requirements for the BNR process significantly increase (8x higher). Moreover, the annual average requirements can significantly change based on influent raw alkalinity (assumed to be 275 mg CaCO3 in analysis). Tanker delivery was selected to ensure adequate storage for 15 days at annual average and maximum month conditions.	140
Piping	
In-plant piping	Carbon Steel
Yard Piping	Polyethylene tubing within CPVC carrier piping

4.6.5 Sodium Hypochlorite

One hypochlorite bulk storage tank will be provided to store 12.5 percent solution. As Hypochlorite can degrade over time, the values used to calculate pump sizes and storage volumes were assumed to be at less than full strength to ensure adequate capacity. The storage tank is sized to hold 15 days of storage or approximately one full tanker delivery, whichever is greater. The metering pumps will be peristaltic pumps designed to feed chemical over the full range of plant flows and doses.

Table 4-26: Sodium Hypochlorite Design Criteria

PARAMETER	VALUE
Chemical Information	
Delivered Chemical	12.5% Sodium Hypochlorite SG 1.18
Fed Chemical	Same as delivered
MBR Cleaning Feed Point	
Feed Point Objective	To perform maintenance and recovery cleaning procedures
Feed Point Description	Injected into the MBR Filtrate Line for each MBR train downstream of the MBR Filtrate Pump while being operated in reverse.
Estimated Pressure at Feed Point, ft	Vendor specific, assumed less than 60 psi

PARAMETER	VALUE
Chemical Flow, gph Note: chemical is fed to the MBR system for both maintenance and recovery cleans. The pump can operate at constant speed as flow pacing is not required (but may be provided to utilize similar pumps)	150
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1 (shared by each MBR train via automated valve)
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided)	Blue-White FlexPro A4 (0.75" Tube)
Max flow, gph	158
Min flow, gph	0.06
Listed Turndown	2500:1
Wetted Materials	Flex-A-Prene
Ocean Outfall Feed Point	
Feed Point Objective	To disinfect flow from the Outfall Balancing Tank
Feed Point Description	Outfall pump discharge
Estimated Pressure at Feed Point, ft	65
Chemical Dosage	
Maximum, mg/L	20
Average, mg/L	5
Minimum, mg/L	3
Process Flow Stream	
Maximum, MGD	8.14
Average, MGD	0.97
Minimum, MGD	0.50
Required Chemical Flow Range	
Maximum, gph	65
Minimum, gph	0.6
Total Turndown Required	110 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided)	Blue-White FlexPro A4 (0.75" Tube)
Max flow, gph	158.5
Min flow, gph	0.06
Listed Turndown	2500:1
Wetted Materials	Flex-A-Prene
RO Concentrate Feed Point	
Feed Point Objective	To disinfect RO Concentrate
Feed Point Description	Outfall Balancing Tank inlet
Estimated Pressure at Feed Point, ft	20

PARAMETER	VALUE
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 7 2 2
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 0.23 0.19 0.05
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.63 0.04
Total Turndown Required	16 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.075” Tube) 1.5 0.02 100:1 Flex-A-Prene
RO Influent Feed Point	
Feed Point Objective	To disinfect RO feed, for biofouling prevention on the membranes
Feed Point Description	Suction of RO Feed Pumps
Estimated Pressure at Feed Point, ft	10
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	10 5 5
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	1.16 0.97 0.31
Required Chemical Flow Range Maximum, gph Minimum, gph	4.6 0.6
Total Turndown Required	8 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1

PARAMETER	VALUE
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials: Flex-A-Prene	Blue-White FlexPro A2 (0.187" Tube) 19.3 0.19 100:1 Flex-A-Prene
UV AOP Feed Point	
Feed Point Objective	To serve as the oxidant for UV AOP treatment
Feed Point Description	UV / AOP inlet piping
Estimated Pressure at Feed Point, ft	60 (estimated)
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	4 3 2
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	0.80 0.78 0.26
Required Chemical Flow Range Maximum, gph Minimum, gph	1.3 0.2
Total Turndown Required	7 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.187" Tube) 19.3 0.19 100:1 Flex-A-Prene
Plant Water Feed Point	
Feed Point Objective	To disinfect MBR filtrate prior to use in the plant
Feed Point Description	Plant water pumps discharge
Estimated Pressure at Feed Point, ft	175
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 1 1 0.75

PARAMETER	VALUE
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 0.27 0.09 0.03
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.11 0.01
Total Turndown Required	11 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.075" Tube) 2.0 0.02 100:1 Flex-A-Prene
IPR Pump Discharge Feed Point	
Feed Point Objective	For disinfection to achieve log removal
Feed Point Description	IPR pumps discharge
Estimated Pressure at Feed Point, ft	75
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 1 1 0.75
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 0.80 0.78 0.03
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.32 0.01
Total Turndown Required	32 : 1
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.075" Tube) 2.0 0.02 100:1 Flex-A-Prene
Chemical Storage	
Volume Required for 15 days storage (gallon)	2600

PARAMETER	VALUE
Chosen Storage Method	Vertical bulk storage tank sized for the estimated amount used or a full tanker, whichever is greater
Tanker delivery volume	4500 gallon
Material	FRP or PE
Quantity	1
Approximate selected tank dimensions	10’ diameter x 10’ side shell height
Volume of selected tank	5800 gallon
Selected volume will be consumed at max usage in this many days	4.5
Piping	
In-plant piping	CPVC
Yard Piping	Teflon tubing within CPVC carrier piping

4.6.6 Polymer

One polymer system will be provided to mix and feed an emulsion polymer with potable water. This solution will be fed to the belt filter press to assist with cake formation. As mentioned above, the polymer storage tote and feeder / blender system will be located in the Dewatering Area adjacent to the press. Chemical will be delivered and stored in a standard 330-gallon Intermediate Bulk Container (IBC) which will be located on top of a secondary containment tub. The polymer feeder / blender skid will be a standard system provided by a manufacturer of these types of systems. The pump provided on the feeder / blender skid will be specified as a peristaltic pump to be similar to those used for other chemical applications. This system will dilute polymer down to approximately a 0.5 - 1% solution for feeding into the press at the required flow.

Table 4-27: Polymer Design Criteria

PARAMETER	VALUE
Chemical Information	
Delivered Chemical	Emulsion polymer Final chemical selection to be verified
Fed Chemical	~0.5-1% solution mixed with potable water
Belt Filter Press Feed Point	
Feed Point Objective	To enhance solids capture and cake formation
Feed Point Description	Belt filter press feed piping
Estimated Pressure at Feed Point, ft	40

PARAMETER	VALUE
Chemical Usage Maximum, lb / dry ton Average, lb / dry ton Minimum, lb / dry ton	 30 30 25
Estimated Solids in Process Flow Stream Maximum, dry ton / day Average, dry ton / day Minimum, dry ton / day	1.5 0.99 0.67
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.60 0.22
Turndown Required	
Selected Type of Pump	Peristaltic with automatic speed control
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	Blue-White FlexPro A2 (0.075" Tube) 2.0 0.02 100:1 To be Verified
Chemical Storage	
Volume Required for 15 days storage (gallon)	15
Note: This is based on an assumed operating schedule of 8 hours of press operation per day and 2 days of operation per week	
Chosen Storage Method	IBC
Material	Chem supplier's standard
Quantity	1
Volume per container (gallon)	330
Selected volume will be consumed at max usage in this many days (assuming continuous press operation)	23
Piping	
In-plant piping	PVC
Yard Piping	N/A – Polymer solution dosed at location stored

4.6.7 Sulfuric Acid

One sulfuric acid feed system will be provided to feed a dilute solution of chemical to the RO / UVAOP system. Sulfuric acid will be delivered and stored in a standard 330-gallon Intermediate Bulk Container (IBC) at 93% solution strength which will be located on top of a secondary containment tub. The metering pumps will not be peristaltic pumps as used elsewhere in the plant as this type of pump is not recommended for concentrated sulfuric acid. These pumps will instead be diaphragm metering pumps designed to feed chemical over the full range of plant flows and doses and will feed into a dilution panel capable of diluting down the chemical to approximately 5-10% solution strength. This dilution will help to mitigate any problems should a minor leak occur as the chemical is routed through the site.

The specific chemical flow ranges for sulfuric acid cannot be finalized until updated water quality is received form the City and analyzed. Estimated values are included in the table below, but are subject to verification upon receipt of final water quality data.

Table 4-28: Sulfuric Acid Design Criteria

PARAMETER	VALUE
Chemical Information	
Delivered Chemical	93% Sulfuric Acid SG – 1.81
Fed Chemical	5-10% Solution diluted with plant water (potable quality)
RO Influent Feed Point	
Feed Point Objective	To suppress the pH, to inhibit scaling of sparingly soluble salts
Feed Point Description	Suction of RO Feed Pumps
Estimated Pressure at Feed Point, ft	10
Chemical Dosage Maximum, mg/L Average, mg/L Minimum, mg/L	 30 25 20
Process Flow Stream Maximum, MGD Average, MGD Minimum, MGD	 1.16 0.92 0.31
Required Chemical Flow Range Maximum, gph Minimum, gph	 0.84 0.15
Turndown Required	6 : 1
Selected Type of Pump	Diaphragm Metering Pump with automatic speed control and manual stroke length
Quantity of Pumps for Feed Point	1

PARAMETER	VALUE
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	TBD TBD TBD TBD Alloy 20 / Teflon
UV AOP Influent Feed Point	
Feed Point Objective	To provide pH control to ensure free chlorine is in the desired form
Feed Point Description	Suction of UV System
Estimated Pressure at Feed Point, ft	60 (Estimated)
Chemical Dosage	
Maximum, mg/L	5
Average, mg/L	3
Minimum, mg/L	1
Process Flow Stream	
Maximum, MGD	0.80
Average, MGD	0.78
Minimum, MGD	0.26
Required Chemical Flow Range	
Maximum, gph	0.10
Minimum, gph	0.01
Turndown Required	10 : 1
Selected Type of Pump	Diaphragm Metering Pump with automatic speed control and manual stroke length
Quantity of Pumps for Feed Point	1
Example Pump (this pump is chosen as acceptable for the application but another equivalent pump may be provided) Max flow, gph Min flow, gph Listed Turndown Wetted Materials	TBD TBD TBD TBD Alloy 20 / Teflon
Chemical Storage	
Volume Required for 15 days storage (gallon)	275
Chosen Storage Method	IBC
Material	Chem supplier's standard
Quantity	1
Volume per container (gallon)	330
Piping	
In-plant piping – Concentrated sulfuric from storage tote	Carpenter 20 alloy stainless steel

PARAMETER	VALUE
In-plant piping – Downstream of dilution to handle heat generation	Teflon lined carbon steel
In-plant piping – Within RO building (dilute solution)	CPVC
Yard Piping	Teflon tubing within CPVC carrier piping

4.6.8 Liquid Ammonium Sulfate (FUTURE)

Space and spare conduits are furnished to support addition of a Liquid Ammonium Sulfate (LAS) feed system in the future. This chemical would be used to react with sodium hypochlorite to form monochloramine in order to carry a monochloramine residual through the RO system for biofouling prevention. This system would be required if the City chooses to no longer operate the BNR to leave carry-over ammonia for use in monochloramine formation.

5 Civil Site Design Criteria

This section provides the design criteria associated with site-civil elements of the WRF.

5.1 GRADING

In general, on-site grading will be designed to meet the following:

- Maintain 2 percent or less slope in building access areas
- Maintain 4 percent or less slope in operational maneuvering areas. For example, between the Maintenance Building and RO Building.
- Maintain 5 percent or less (preferably 4 percent or less) cross slope on roads.
- Maintain 8 percent or less running slope on site roads. A maximum 10 percent running slope is permitted in special cases on straight runs.
- Maintain 2:1 slopes per Baseline Geotechnical Report, or flatter.
- Maintain 3:1 slopes in detention basins.

5.2 MAJOR YARD PIPING

Plant process piping and site utility piping is shown on the Yard Piping Drawings. Pipes will be bedded in sand or pea-gravel (to be determined) and backfilled with suitable onsite material. Trench sections will be developed to clarify these requirements. Pipe materials will be as shown on the Process & Instrumentation Drawings and as will be scheduled in the specification. The plant makes wide use of PVC piping due to its excellent corrosion resistance and ease of installation.

5.2.1 Soil Corrosivity

The geotechnical work done to date indicates on-site materials are not corrosive. As such, no special corrosion protection measures have been included beyond normal standard practice as follows:

- Steel or ductile iron piping will have cement mortar or epoxy coating.
- Buried stainless steel will have pipe wrapping.
- Copper will be direct buried with poly bagging when running through concrete.
- PVC, CPVC, and HDPE pipes will be direct buried.
- Concrete structures do not require any coatings unless required to mitigate groundwater from seeping into below grade dry structures.

5.3 DRAINAGE

Stormwater management for the site will be based on the guidelines from the City of Morro Bay Stormwater Guidance Manual for Low Impact Development & Post-Construction Requirements.

5.3.1 Hillside Drainage

All stormwater from the western hillside area is captured by a hillside toe swale along the west side of the site. The flow in this swale is captured by catch basins and routed via culvert under the plant site to the dry creek east of the site.

5.3.2 Plant Site Drainage

All stormwater generated on-site will be captured in gutters, swales, and trenches to be routed to the detention basins. The design is avoiding storm drain piping to the extent possible to minimize long-term maintenance requirements. The detention basins will include some dead-volume at the bottom to give plant operators some reaction time between flow entering the basin and being discharged to the outlet.

The North Process Area, as shown on the drawings, drains to the North Stormwater Detention Basin. Drainage is routed via sheet-flow on the roadways to a curb and gutter running on the eastern side of the site. This gutter is intercepted by a trench with grating that routes the flow across the road into the detention basin.

The North Detention Basin will be equipped an Outlet Control and Pumping Station. Normally this structure will regulate the discharge rate from the detention basin to the dry creek east of the site to be within the pre-development rate. This structure also allows the plant operators to manually isolate this discharge and pump water from this basin to the plant headworks for treatment. This feature is included with intent of using it to capture and treat first-flush water from the first storm of the season.

The South Process Area, North Operations Area, and South Operations area, as shown on the drawings, drain to the South Stormwater Detention Basin. Drainage is routed via sheet-flow on the roadways to a curb and gutter running on the eastern side of the site. This gutter is intercepted by a trench with grating that routes the flow across the road into the detention basin. An Outlet Control Structure is provided to regulate the discharge rate from the detention basin to the dry creek east of the site to be within the pre-development rate. A manual gate valve will be furnished at this outlet to give the operators option to capture first flush flows without discharge to the dry-stream. This structure will not be equipped with a pump.

5.4 EROSION CONTROL

5.4.1 Construction Phase Erosion Control

Silt and sediment collected by runoff during construction will be captured on site with temporary silt fence along the border of the site adjacent to the dry creek. This silt fence will be maintained through the construction to protect from construction debris.

5.4.2 Finished Site Erosion Control

All disturbed site areas that are not paved or landscaped will be hydroseeded per local requirements. Drainage outlets will be furnished with rip rap to dissipate energy and prevent erosion. Earthen swales will be hydroseeded, planted, or lined with rip-rap as required.

5.5 LANDSCAPING

All improved areas within the site that are not concrete, asphalt, or landscaping will be crushed rock.

Landscaping utilizing well-adapted drought-tolerant plantings will be furnished at the entrance road and around the Operations Building. Landscaping plans will be furnished in drawings for the 60% or 90% design level submittals.

Landscaping will be irrigated with reclaimed water from the Recycled Water Pump Station. Though this water is treated and filtered to Title 22 Recycled Water requirements, it is not furnished with adequate disinfection contact time to make it Title 22 compliant. All piping, valves, and sprinklers using this water will be marked as recycled water not suitable for human consumption. Purple pipe and fixtures will be furnished to the extent possible.

Additional landscaping details are provided in Section 3 of Exhibit B Scope of Work.

5.6 FENCING

5.6.1 WRF Site Fencing

The WRF Plant Site will be secured with a 6 ft galvanized steel chain-link fence with 3-strand barb wire cap. A motorized gate is furnished to access the secured site.

The Operations Building are is secured with a combination of decorate fence where visible from Highway 1 and chain-link fence in less visible locations. This area will be secured with a manually closed gate which will be left open during weekday working hours and secured at all other times.

5.6.2 Parcel Fencing

The WRF does not occupy the entire land parcel. As of the authoring of this Basis of Design Report, the City is in the land purchasing process for the WRF parcel. The City's land purchase agreement may require fencing of the entire parcel. If required, details of that fencing and its installation will be coordinated and executed separately by the City.

6 Structural Design Criteria

The structural design criteria are used to establish minimum design requirements for building structures, environmental and liquid containing structures, yard structures, miscellaneous equipment foundations, non-structural components, piping supports and other miscellaneous items requiring structural design.

6.1 APPLICABLE CODES AND STANDARDS

The design codes, standards and references below will serve as the basis of design for building and nonbuilding structures including all lateral force resisting systems, components and cladding.

- 2016 California Building Code (CBC).
- ASCE7-10: Minimum Design Loads for Buildings and Other Structures.
- ACI 318-14: Building Code Requirements for Structural Concrete.
- ACI 350-06: Code Requirements for Environmental Engineering Concrete Structures.
- ACI 350.3-06: Seismic Design of Liquid-Containing Concrete Structures.
- ACI 350.4R-04: Design Considerations for Environmental Engineering Concrete Structures.
- Portland Cement Association (PCA) Circular Concrete Tanks without Prestressing, 1992.
- PCA Rectangular Concrete Tanks, 1998.
- PCA Design of Liquid-Containing Concrete Structures for Earthquake Forces, 2002.
- ACI 530-13: Building Code Requirements and Specification for Masonry Structures.
- American Institute of Steel Construction (AISC) Steel Construction Manual, 14th Edition.
- AISC 360-10: Specification for Structural Steel Buildings.
- AISC Seismic Design Manual, 2nd Edition.
- AISC 341-10: Seismic Provisions for Structural Steel Buildings.
- American Welding Society (AWS), Structural Welding Code for each type of welded material including seismic supplement.
- AWWA D100-11: Welded Carbon Steel Tanks for Water Storage.
- AWWA D103-09: Factory-Coated Bolted Carbon Steel Tanks for Water Storage with D103a-14 Addenda.
- American Iron and Steel Institute (AISI) Framing Standards and Specifications, 2012 Edition.
- AISI S100-07: North American Specification for the Design of Cold-Formed Steel Structural Members.
- AISI S200-12: North American Standard for Cold-Formed Steel Framing - General Provisions.
- AISI S213-07 with S1-09: North American Standard for Cold-Formed Steel Framing - Lateral Design.
- Aluminum Association Design Manual, 2015 Edition.

- Preliminary Geotechnical Baseline Report prepared by Yeh and Associates, Inc. 2017.
- American Society of Mechanical Engineers (ASME) B30.16-2017 Overhead Underhung and Stationary Hoists.
- AISC Steel Design Guide 7: Industrial Buildings Roofs to Anchor Rods, 2nd Edition (2004).

6.2 MATERIAL PROPERTIES AND LOADING CRITERIA

6.2.1 Material Properties

6.2.1.1 Concrete

- Cast-in-Place Structural Concrete – Flatwork: f'c = 3,000 psi
- Cast-in-Place Structural Concrete – Environmental (water-bearing) structures: f'c = 4,500 psi
- Cast-in-Place Structural Concrete – Other structures: f'c = 4,000 psi
- Prestressed/Precast Structural Concrete: f'c = 5,000 psi
- Nonstructural Concrete – Concrete fill, duct banks, pipe blocking, pipe encasement: f'c = 3,000 psi

6.2.1.2 Concrete Finishing

- Formed concrete – exposed or water bearing: ACI 347.3R – CSC2
- Formed concrete – buried ACI 347.3R – CSC1
- Basin/tank floors – water bearing: Floated finish
- Interior floors – exposed Troweled finish w/ clear sealer
- Interior floors – covered with flooring Troweled finish
- Exterior slabs Troweled finish w/ light broom
- Sidewalks Troweled finish w/ light broom
- Ductbanks Screeded with red colorant

6.2.1.3 Concrete and Masonry Reinforcement

- Reinforcing Bars (ASTM A615 or ASTM A706): fy = 60,000 psi
- Welded Wire Reinforcement (ASTM A1064): fy = 60,000 psi

6.2.1.4 Masonry

- Masonry unit assembly f'm = 1,500 psi

6.2.1.5 Structural Steel

- W and WT Shapes (ASTM A992): fy = 50,000 psi
- HP Shapes (ASTM A572 Grade 50): fy = 50,000 psi
- M, S, C, MC Shapes (ASTM A36): fy = 36,000 psi
- L, Bars, Plates and Other Structural Shapes (ASTM A36): fy = 36,000 psi
- Rectangular and Square HSS Sections (ASTM A500 Grade C): fy = 50,000 psi
- Round HSS Sections (ASTM A500 Grade C): fy = 46,000 psi

- Pipe Sections (ASTM A53 Grade B, Type E or S): fy = 35,000 psi
- Weld Materials (ANSI/AWS D1.1, Table 3.1), using E70XX filler metal with minimum tensile strength: Fw = 70,000 psi
- High Strength Bolts (ASTM F3125 Grade A325 type 1), tensile strength: Fu = 120,000 psi
- Pre-Engineered Metal Building Primary Framing, Web Plates (ASTM A529, ASTM A572, ASTM A1011, Grade 55) fy = 55,000 psi
- Pre-Engineered Metal Building Primary Framing, Flanges (ASTM A529, ASTM A572, Grade 55) fy = 55,000 psi

6.2.1.6 Aluminum

- Aluminum Association Standard Shapes (ASTM B308, Alloy 6061-T6).
- Sheet and Plate (ASTM B209, Alloy 6061-T6).
- Material Strengths for All Aluminum Materials:

Tensile Yield Strength:	Fty = 35,000 psi
Compressive Yield Strength:	Fcy = 35,000 psi
Shear Yield Strength:	Fsy = 20, 000 psi

6.2.1.7 Cold-Formed Steel

- Cold-Formed Steel Joists, Studs and Track (ASTM A653 Grade 33 or 50, ASTM A1003 Type H Grade 33 or 50) Fy = 33,000 psi

6.2.1.8 Fiber Reinforced Plastics (FRP)

- Pultruded Structural Shapes:

Tensile Strength:	30,000 psi
Flexural Strength:	30,000 psi
Flexural Modulus:	1,800,000 psi
Transverse Shear Strength:	4,500 psi

- Molded Gratings, as necessary to meet the design requirements and dimensions specified in the contract documents: --

6.2.2 Loading Criteria

Self-weight, dead, live and fluid loads will be considered as vertical loads. Lateral loads considered will be from the effects of soil, hydrostatic, wind and seismic loads.

The design loads will address the dead loads for the equipment, tanks, piping, ancillary equipment and the roof. Live loads will address the roof, walkways, chemical storage, and operating floors.

Wind loads will be addressed for a maximum expected wind speed, exposure and risk category. Seismic loads will be addressed for acceleration based on mapped acceleration parameters, risk

category, and geotechnical investigations for the site. The risk category will be used to determine the importance factor and seismic design category for the seismic design of the project. Lateral loads will include lateral earth pressure, surcharge loads from compaction, hydrostatic loads, and soil pressure surcharge loads. These design criteria are listed in the following tables.

6.2.2.1 Dead Loads

The weight of all permanent construction including such items as roofs, ceilings, walls, floors, partitions, interior finishes, fixed equipment, tanks and bins including contents, equipment bases, pipes, HVAC ducting, and electrical lighting will be included as dead load. Dead load design criteria are indicated in Table 6-1.

Table 6-1: Dead Load Design Criteria

PARAMETER	VALUE
Equipment, tanks, bins, silos, etc.	Actual weights including contents
Pipe, 12 inch diameter and smaller	25 psf minimum over full length of member
Pipe, 14 inch diameter and greater	Actual weights including contents
Incidental (phantom) loads	2,000 lbs on primary beams, 1,000lbs on secondary beams
Concrete	150 pcf
Roofing and insulation	Actual (12 psf minimum)
HVAC ductwork (general)	5 psf
Lighting (general)	5 psf
Additional collateral	Actual
Partitions and ceilings	Actual

6.2.2.2 Live Loads (Floor and Roof)

All operating floors with equipment, shop and storage loads will be designed to a minimum floor live load of 150 psf. Non-operating floors (e.g. operations building) will be designed for 100 psf. Floors will be designed for loads due to equipment lay down. For large equipment areas, the combined weight of equipment and concrete pad plus an additional live load of 50 psf over the base area may be used as the live load. The equipment weight may be assumed to be evenly distributed over an area within the concrete pad perimeter. Additional live load design criteria are indicated in Table 6-2.

Table 6-2: Live Load Design Criteria

PARAMETER	VALUE
Walkways, platforms, stairs	100 psf
Storage, general	250 psf
Control room floors	250 psf
Roof live	20 psf (live load reduction permitted)
Handrails and guards	50 plf, 200 lbs
Intermediate rails	50 lbs

6.2.2.3 Wind Loads

Primary frames that are part of the lateral-force-resisting system along with components and cladding of structures will be designed for the effects of wind loading in accordance with CBC Section 1609 and ASCE 7. ASCE7 Chapter 28 (Wind Loads on Buildings – MWFRS) will be used for low-rise buildings meeting the scope requirements of Section 28.1.1. For other structures, ASCE7 Chapter 29 (Wind Loads on Other Structures and Building Appurtenances – MWFRS) will apply. Additional wind load design criteria are indicated in Table 6-3.

Table 6-3: Wind Load Design Criteria

PARAMETER	VALUE
Risk Category	III
Importance Factor	1.0
Basic Wind Speed	115 mph
Exposure Category	C

6.2.2.4 Seismic Load

Primary frames that are part of the lateral-force-resisting system along with components of building structures will have seismic loads determined in accordance with CBC section 1613 and ASCE7. ASCE 7, Section 12 (Seismic Design Requirements for Building Structures) will provide the basis for design of buildings and similar structures. Nonbuilding structures will be designed to ASCE 7, Section 15 (Seismic Design Requirements for Nonbuilding Structures). For liquid containing (environmental) concrete structures including basins and reservoirs ACI 350.3-06 will be the basis of design using the response modification factors, R, from ACI 350.3-06, Table 4.1.1(b). Additional seismic load design criteria are indicated in Table 6-4.

Table 6-4: Seismic Load Design Criteria

PARAMETER	VALUE
Risk Category	III
Importance Factor	1.25
Site Class	C (to be confirmed in final geotechnical report)
Spectral response acceleration parameter at short periods, Ss	1.135
Spectral response acceleration parameter at a period of 1 sec, S1	0.421
Seismic design category	D
Design coefficients and factors for seismic force resisting system - Building Structures	ASCE7 chapter 12
Design coefficients and factors for seismic force resisting system - Nonbuilding Structures	ASCE7 chapter 15
Design coefficients and factors for seismic force resisting system - Environmental Structures	ACI 350.3-06
Seismic dead loads	Actual

6.2.2.5 Soil, Backfill and Groundwater

Allowable soil bearing pressures for foundations, walls and below grade structures shall be in accordance with the project geotechnical report. Lateral earth pressures and groundwater loading on foundations, walls and below grade structures will also be in conformance with the recommendations provided in the project geotechnical report. Active earth pressures will only be used for walls that are free to rotate and deflect at the top. Geotechnical load design criteria are indicated in Table 6-5.

Table 6-5: Geotechnical Load Design Criteria

PARAMETER	VALUE
Allowable bearing pressure (compacted fill)	3,000 psf[1]
Allowable bearing pressure (bedrock)	5,000 psf[1]
Active equivalent fluid pressure (drained)	45 pcf[1,2]
Active equivalent fluid pressure (undrained)	50 pcf[1,2]
At-rest equivalent fluid pressure (drained)	60 pcf[1,2]
At-rest equivalent fluid pressure (undrained)	80 pcf[1,2]
Passive equivalent fluid pressure	360 pcf[1,2]

PARAMETER	VALUE
Coefficient of sliding friction	0.3[1,2]
Normal groundwater level elevation	8 ft[1]

Notes:

1. To be confirmed in final geotechnical report.
2. Typical values for alluvium. Not applicable to rock.

6.2.2.6 Equipment and Piping Loads

Unless noted otherwise, all equipment will be mounted on a concrete equipment pad. These concrete equipment pads shall have a level surface, chamfered edges and allowance for up to 1-1/2" of high-strength, non-shrink grout (where required). Unless noted otherwise, equipment pads for electrical equipment will be four inches high and equipment pads for all other equipment will be six inches high. All equipment pads resting on slabs will be positively connected. All equipment will be anchored with either 316 stainless steel threaded rod or 316 stainless steel expansion anchors. Penetrations will be provided for cables, embedded conduit, etc. as required for electrical equipment. The effects of vibration from large pieces of equipment (e.g. pumps, generators) will be investigated for supporting structures.

All piping with a diameter of twelve inches or less will be evaluated as a uniform distributed load. Piping with larger diameter will be sized for actual weights and locations prior to the design of the structure. The weight of all piping and contents will be considered as a dead load. Thrust loads from piping will be evaluated as live loads and located and sized prior to the design of the structure.

6.2.2.7 Bridge Cranes and Monorails

Bridge crane and monorail loads will be included with the design criteria for pre-engineered metal buildings. Design will be in accordance with applicable design standards and code regulations. Bridge crane runways and monorails will account for 125 percent of the rated load for each hoist as provided by ASME B30.16 and ASCE7. Each bridge crane runway beam and rail will be designed to resist 100 percent of the horizontal load. The maximum allowed vertical deflection will be L/800 for bridge crane runway beams and L/450 for monorail runway beams.

6.2.2.8 Storage Tanks

Storage tanks and their supporting structures will be designed to comply with AWWA D100 "Welded Carbon Steel Tanks for Water Storage" and AWWA-D103 “Factory-Coated Bolted Carbon Steel Tanks for Water Storage.” Storage tanks will be designed for the actual specific gravity of the stored medium and will account for bulking within the tank. Liquid storage tanks will be designed for a minimum specific gravity of 1.0. Structural design for storage tanks will include effects for impulsive and convective components. Impulsive and convective components will be combined by direct sum or the square root of the sum of the squares (SRSS) method. Damping for the convective (sloshing) force component will be taken as 0.5 percent. Detailed shop drawings and calculations sealed by a registered professional engineer, licensed in the state of the project site will be required.

6.2.2.9 Load Combinations and Allowable Stresses

Building structures, components, and cladding will be designed in accordance with the load combinations contained in the CBC, Section 1605. Aluminum and cold-formed steel will be designed using load combinations of CBC, Section 1605.3, and allowable stresses will not be increased unless specifically allowed per section 1605.3.1.1. Masonry will be designed using the load combinations in CBC, Section 1605.3. Reinforced concrete for non-environmental structures will be designed using the load combinations in ACI 318, Section 5.3. Reinforced concrete for environmental structures will be designed using load combinations in ACI 350, Section 9.2 or Appendix C. Structural steel will be designed using load combinations of CBC, Section 1605.2.

6.3 DESIGN PROCEDURES AND ASSUMPTIONS

6.3.1 Structural Analysis

Structures will be analyzed for the applicable loads, load combinations and allowable stresses as required by the governing code and design standards. Structural systems and component forces, reactions and stresses may be determined using hand calculations or computer programs such as spreadsheets, RISA-3D, Enercalc, RetainPro, RisaFoundation, etc.

6.3.2 Building Structure Design

Building structures will be designed based upon the criteria established in the CBC and applicable design standards for loads, load combinations and allowable stresses. Additional concrete design requirements as specified by ACI 350 will not be considered for building structures unless exposed to water or aggressive chemicals.

6.3.2.1 Lateral Force Resisting Systems

Lateral loads including wind and seismic forces will be transferred from their origin to the foundation in a rational manner. Lateral loads will be transferred to vertical and horizontal resisting elements according to relative rigidity. Accidental torsion, where applicable, will be considered for seismic design as specified by code and applicable design standards.

6.3.2.2 Horizontal Diaphragms

Diaphragm displacement relative to the supporting vertical lateral force resisting elements will determine the horizontal distribution of wind and seismic forces. Diaphragm flexibility will be determined in accordance with ASCE7 section 12.3.1. Where diaphragms meet the requirements for a flexible diaphragm, lateral load distribution to vertical lateral force resisting elements will be based on tributary area. Where diaphragms are considered to be rigid, a rigid diaphragm analysis will be performed to distribute lateral forces based on the relative rigidity of the lateral force resisting elements.

6.3.2.3 Exterior Walls

Buried exterior walls will be designed to resist the lateral earth pressures specified by the project geotechnical report. Where roadways are adjacent to buried structure walls, an additional two feet of soil surcharge will be added to the wall design to account for vehicular live load surcharge. Additional surcharge loads from compaction equipment during construction will be considered in design.

6.3.2.4 Interior Walls

Interior walls will be designed for a minimum 5 psf lateral pressure in accordance with CBC section 1607.14. Interior walls shall be properly anchored to resist these loads and transfer to supporting elements of the main lateral force resisting system and shall consider roof and floor deflections.

6.3.2.5 Reinforced Concrete Masonry

Reinforced concrete masonry will be designed in accordance with CBC chapter 21 and ACI 530. All masonry shall be designed as fully grouted with vertical reinforcement spaced no farther than 48 inches on center. Horizontal reinforcement will also be included as required per applicable design standards.

6.3.2.6 Pre-Engineered Metal Buildings

Pre-engineered metal buildings (PEMB) shall be designed, detailed and fabricated in accordance with governing design codes and standards by a metal building manufacturer qualified for the applicable scope of work. PEMB buildings will consist of all steel structures, occupied or not, located throughout the project site. All metal buildings will be classified as frame-and-purlin buildings and will be in accordance with the project documents. All frame reaction loads will be provided by the metal building manufacturer for design of foundations in accordance with the parameters of the project geotechnical report. Detailed shop drawings and calculations sealed by a registered professional engineer, licensed in the state of the project site will be required.

6.3.3 Environmental (Liquid-Containing) Structures

6.3.3.1 Scope

This section shall apply to environmental engineering concrete structures as defined in ACI 350 but does not supersede ASTM standards for precast structures. Generally, environmental structures shall pertain to structures that will contain process liquids under normal operating conditions. Structures within the treatment facilities that are exposed to external groundwater pressure or provided secondary containment for chemicals will also be included.

6.3.3.2 Rectangular Wall Analysis

Environmental structures with rectangular walls will be analyzed as two-way rectangular plates with appropriately selected boundary conditions where the length to height ratio is 2:1 or less. Where the length to height ratio exceeds 2:1, the wall will be designed as a one-way rectangular plate for vertical effects and the corners evaluated for horizontal effect due to boundary conditions assuming an aspect ratio of 2:1.

6.3.3.3 Axial Tension in Slabs and Walls

Water containment walls shall be designed considering the effects of both flexure and tension in the wall. Horizontal reinforcement will be distributed for 100% flexure steel and 50% tension steel (e.g. 50% of tension steel distributed to each face). Direct tension in foundations and top slabs due to internal water pressure will also be accounted for in the design of horizontal slab reinforcement.

6.3.3.4 Minimum Shrinkage and Temperature Reinforcement

Minimum reinforcement for shrinkage and temperature will be provided in accordance with ACI 350. A minimum reinforcement ratio of 0.005 will be used for walls and base slabs unless

reductions are otherwise permitted by ACI 350. Concrete sections of 24 inches or more will have a minimum reinforcement ratio based on 12 inches at each face. Concrete wall and base slab sections greater than 10 inches thick will be reinforced with two layers of minimum #5 bars. Concrete wall and base slab sections 10 inches thick or less will be reinforced with a single layer of minimum #5 bar. Reinforcement in the bottom of base slabs in contact with soil may be reduced to 50 percent of the required minimum shrinkage and temperature reinforcement listed in Table 7.12.2.1 of ACI 350.

6.3.3.5 Design Load Cases

Basic design load cases will consider the effects of dead load, live load, live roof load and lateral loads due to hydrostatic loads, lateral earth pressures, seismic, hydrodynamic, dynamic earth pressure, wind and groundwater pressures. Soil pressure will include at-rest or active pressures, surcharge and seismic effects. A maximum service water level will be considered for the design of all liquid containing structures along with soil with normal groundwater, maximum overflow water, seismic water, flooded soil and seismic soil conditions.

6.3.3.6 Load Case: Service Water Level

The service level water condition will assume adjacent chambers or basins as empty and ignore the counteractive effects of soil backfill loads. Service level water condition is the maximum water level during normal operations. This condition will also consider direct tension in the walls due to the service water level. Durability factors as defined in ACI 350 apply to this condition.

6.3.3.7 Load Case: Soil with Normal Groundwater Elevation

This condition assumes the maximum soil backfill pressures, including surcharges, with the groundwater at normal elevations. The tanks or basins will be assumed to be without liquid and ignores any counteractive effects due to internal liquid loads. Surcharge vehicle loading will be considered by increasing the soil surcharge height by two feet. Durability factors as defined in ACI 350 apply to this condition.

6.3.3.8 Load Case: Maximum Water Condition

The maximum level water condition is the temporary maximum internal water level. This level will be considered the greater of the tightness testing water elevation and the maximum water level that is possible hydraulically. Counteractive effects of soil backfill loads will be ignored. This condition will also consider direct tension in the walls due to the maximum water level. ACI 350 durability factors do not apply to this condition.

6.3.3.9 Load Case: Saturated Soil Condition

This condition will consider maximum backfill conditions with groundwater at the 100 year flood elevation in combination with adjacent design truck surcharge. The tank will be considered to be empty and any counteractive effects of internal water pressure will be neglected. ACI 350 durability factors do not apply to this condition.

6.3.3.10 Load Case: Seismic Water Condition

Seismic water condition will evaluate the hydrodynamic forces in the internal water at its maximum service level due to earthquake ground motions. The hydrodynamic forces evaluated will include convective and sloshing forces in accordance with the referenced design standards.

Counteractive effects of soil backfill loads will be ignored. ACI 350 durability factors do not apply to this condition.

6.3.3.11 Load Case: Seismic Soil Condition

This load case will consider the additional lateral pressures at the maximum backfill elevation and normal groundwater elevations induced by seismic ground motions on the backfilled material in accordance with the project geotechnical report. The tanks will be considered without internal liquid forces. ACI 350 durability factors do not apply to this condition.

6.3.4 Buoyancy

Buried and partially buried structures will be designed for the effects of buoyancy for normal and elevated groundwater levels at the maximum backfill elevation. Two conditions will be evaluated, each with a respective factor of safety, as summarized Table 6-6. Dead weight resistance only will be considered in the effects of buoyancy and the structures will be assumed to be empty. Dead weight will be calculated as the weight of all walls and slabs, weight of soils on slabs, weight of soil on shelves, weight of permanent equipment attached to the structure and weight of additional permanent material (e.g. concrete) added inside the structure. Resistance to uplift due to buoyancy will be designed in coordination with the project geotechnical engineer.

Table 6-6: Minimum Safety Factors - Buoyancy

PARAMETER	VALUE
Normal groundwater elevation	1.25
Elevated groundwater elevation due to flood condition	1.10

6.3.5 Nonstructural Components

Seismic design for architectural, mechanical and electrical nonstructural components will be in accordance with ASCE7 chapter 13. Where applicable, shop drawings signed and stamped by a registered design professional, will be required. Nonstructural components that meet the exemptions of the CBC and ASCE7 will not require seismic design or special submittal requirements. Nonstructural components will also be required to be designed to resist any other applicable load cases such as wind loading.

6.3.6 Handrails, Guards and Intermediate Rails

Handrails and guards will be designed in accordance with CBC section 1607.8.1 to resist a linear load of 50 pounds per lineal foot and a concentrated load of 200 pounds. These loads will be applied as a live load with the corresponding load factor. The linear and concentrated loads shall not be applied concurrently and will be applied in any direction to produce the maximum load effect. These loads will be designed to transfer loads through the supports to the structure. Handrails and guards will be designed with a top rail height of 42 inches above the walking/working level.

Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to resist a concentrated load of 50 pounds on an area not to exceed 12 inches by 12 inches, applied as

a live load. This concentrated load need not be applied simultaneously with handrail and guard loads.

6.3.7 Site Retaining Walls

Site retaining walls will be designed in accordance with the requirements and design values provided in the project geotechnical report. Site walls will be designed as unrestrained at the top with the active earth pressure applied at the maximum anticipated backfill elevation. If detailed with proper restraint at the top of the wall, the at-rest earth pressure will be used. An additional two feet of backfill material will be applied to the design of retaining walls to account for adjacent roadway surcharges where applicable.

To the extent possible, segmental block retaining walls (such as Versa-Lok) will be utilized. Below 3 feet tall, no structural design is required. Above 3 feet tall will be engineered per segmental block retaining wall manufacturer requirements.

6.4 SPECIAL INSPECTION AND STRUCTURAL OBSERVATION

Special inspections and structural observations will be required in accordance with the requirements of CBC chapter 17. These inspections and observations will be included with the project documents. The requirements listed on the project documents does not waive the right of the governing jurisdiction to require testing and inspection of any material at any time.

7 Architectural Design Criteria

7.1 GENERAL

WRF building layouts, proportions, systems and materials are chosen to meet the City of Morro Bay's programmatic requirements, life-cycle cost effectiveness criteria, and compliance with the regulatory constraints described below. Additional design considerations are durability, compatibility with the marine environment, low maintenance, energy conservation and related sustainable features.

Walls, roof forms, exterior colors schemes, and landscape screening are designed to meet the City's desire for an appearance from the Highway 1 scenic corridor that is recognizably agricultural, giving the overall impression typical of a dairy farm or ranch.

7.2 BUILDING CODES

7.2.1 Building Codes and Applicable Laws

The architectural design and construction of the WRF facilities will comply, at a minimum, with these building codes and applicable laws:

- 2016 California Building Code - (CBC) 2016 - Title 24, Part 2 of the California Code of Regulations (CCR), incorporating by adoption the 2015 International Building Code (IBC) with California Amendments.
- 2016 California Electrical Code - (CEC) 2016 - Title 24, Part 3 of the California Code of Regulations (CCR), incorporating by adoption the 2014 National Electric Code (NEC) with California Amendments.
- 2016 California Mechanical Code - (CMC) 2016 - Title 24, Part 4 of the California Code of Regulations (CCR), incorporating by adoption the 2015 Uniform Mechanical Code (UMC) with California Amendments.
- 2016 California Plumbing Code - (CBC) 2016 - Title 24, Part 5 of the California Code of Regulations (CCR), incorporating by adoption the 2015 Uniform Plumbing Code (UPC) with California Amendments.
- 2016 California Fire Code - (CFC) 2016 - Title 24, Part 9 of the California Code of Regulations (CCR), incorporating by adoption the 2015 International Fire Code (IFC) with California Amendments.
- 2016 California Green Building Standards - (CALGreen) 2016 - Title 24, Part 11 of the California Code of Regulations (CCR).
- 2015 California Division of Occupational Safety and Health - (Cal/OSHA) 2015 - Title 8 of the California Code of Regulations (CCR), with applicable component updates.
- California Coastal Zone Management Act, applicable provisions.

7.2.2 Accessibility Recommendations

The process areas of the WRF are generally considered exempt from the accessibility requirements of CBC Chapter 11B. The design is based on the following recommended application of accessibility standards:

- Building entrances and interiors of Operations Building and Maintenance Building
- Building entrances only at RO/UV Building and Electrical Building
- Parking and Exterior Path-Of-Travel at Operations Building and Maintenance Building

7.2.3 Additional Standards

In addition to the applicable codes and standards previously identified, the system designs will also be based on, but not limited to, the following reference standards described in the project's specifications:

- Underwriters Laboratories (UL)
- Builders Hardware Manufacturers Associations (BHMA)
- American Society for Testing and Materials International (ASTM)
- American National Standards Institute (ANSI)
- Factory Mutual (FM)
- American Wood Protection Association (AWPA)
- American Concrete Institute (ACI)
- American Institute of Steel Construction (AISC)
- The Aluminum Association

7.3 BUILDING DESCRIPTIONS

7.3.1 OPERATIONS BUILDING

7.3.1.1 Description

The Operations Building contains functions that can all be defined as "office," serving as the administrative hub for the facility. The floor plan locates visitor spaces (Lobby, Conference Room, and Break Room) adjacent to the visitor entry on the east side of the building. Staff functions are accessed from staff parking on the north side. The control room is open access without doors per City request and placed centrally in the staff function spaces, along with the three primary offices, on the northeast wall for daylighting. The break and training room is placed on the south side of the building which opens to a staff patio, allowing passive solar heating of these spaces. Visitor access is via controlled entry to the building. Once inside, there are no physical access restrictions which limit visitor access to the Control Room and most spaces with exception of locked offices and rooms.

The building was laid in out per City input to facilitate direct access from the staff parking lot to the

Laundry/Uniform and Locker Rooms. Men's and Women's Locker Rooms are furnished with ganged shower stalls. A single unisex bathroom is furnished but no unisex shower is furnished per City request to focus expenditure on providing the greatest number of showers possible in the Men's and Women's Locker Rooms. Plumbing fixture counts substantially exceed minimum code requirements.

7.3.1.2 Code Compliance

Occupancy Classification:	B (Office)
Construction Type:	Type VB
Floor Area:	5,550 s.f. (36,000 allowed)
Minimum Setback:	approx. 87 feet (east property line)
Exterior Wall Fire Resistance:	none required
Fire Sprinklers:	NFPA 13 wet system throughout
Title 24 Compliance:	all conditioned spaces

7.3.1.3 Exterior Walls

The exterior building walls are a combination of metal siding and concrete masonry over insulated, wood or metal stud framed cavity walls. A concrete masonry base rises to +48 inches and all exposed-to-view units are pigmented, with a split-face or burnished surface. The masonry portion of the wall is structural only where it provides retaining. Upper wall surfaces are a combination of two profiles of metal siding, with "Zincalume" treatment and fluoropolymer coating. Trims and transitions are standard products available from the selected pre-engineered building manufacturer.

7.3.1.4 Roofs

All roofs are ribbed metal structural or non-structural panels with a standing-batten appearance, with "Zincalume" treatment and fluoropolymer coating. Exposed fasteners, gutters, downspouts, penetrations, and transitions are standard products of the pre-engineered building manufacturer to the extent possible.

7.3.1.5 Interior Walls, Finishes

The interior building walls are non-bearing wood or metal stud walls, sound insulated at all occupied spaces, and finished with painted, light orange peel textured gypsum board. Ceilings in utility spaces are painted gypsum board; other ceilings are suspended acoustic tile. Floors are polished and sealed concrete. Moisture-exposed walls and floors in showers and restrooms will be finished with porcelain or glazed ceramic tile.

7.3.1.6 Openings

Exterior utility doors are fiberglass in painted, galvanized steel frames. Other exterior doors, sidelights and windows are an aluminum storefront system with a fluoropolymer frame finish and high performance glazing. Interior doors are painted, galvanized steel in galvanized steel frames.

7.3.2 MAINTENANCE BUILDING

7.3.2.1 Description

The Maintenance Building combines open vehicle maintenance and shop space with enclosed restroom, I&C workshop, control, and laboratory spaces that can be defined as "accessory," assuming they do not involve storage or operations considered hazardous. An exterior opening paint and oil storage room is furnished to provide space for these materials per City request without impacting the code classification of the entire building. The floor plan is arranged to accommodate vehicle drive-through oriented to site circulation. The enclosed functions are placed at a 3.75 foot higher elevation in response to site topography. The vehicle and shop space is laid out to provide a clear path for a bridge crane.

7.3.2.2 Code Compliance

Occupancy Classification:	F-2 (Low Hazard Factory Industrial)
Construction Type:	Type IIB
Floor Area:	5,400 s.f. (92,000 allowed)
Minimum Setback:	approx. 30 feet (Chemical Area)
Exterior Wall Fire Resistance:	none required
Fire Sprinklers:	NFPA 13 wet system throughout
Title 24 Compliance:	conditioned I&C workshop, control, and laboratory space

7.3.2.3 Exterior Walls

The exterior building walls are a combination of metal siding and concrete masonry. At the restroom, workshop, control, and laboratory spaces exterior finishes are over insulated, metal stud framed cavity walls. Maintenance space exterior finishes are exposed at the interior. The concrete masonry base rises to +48 inches and all exposed-to-view units are pigmented, with a split-face or burnished surface, and provides structural retaining at grade changes. Upper wall surfaces are a ribbed profile of metal siding, with "Zincalume" treatment and fluoropolymer coating, and manufacturer's standard trims and transitions.

7.3.2.4 Roofs

The roof is made of ribbed metal structural or non-structural panels with a standing-batten appearance, "Zincalume" treated and fluoropolymer coated. Exposed fasteners, gutters, downspouts, penetrations, and transitions are standard manufacturer's products.

7.3.2.5 Interior Walls, Finishes

Interior walls are non-bearing metal stud walls, sound insulated and finished with painted, light orange peel textured gypsum board. The wall and ceiling structure is exposed in the open shop space. Ceilings in enclosed spaces are painted gypsum board. Floors are polished and sealed concrete. Moisture-exposed restroom walls will be finished with porcelain or glazed ceramic tile.

7.3.2.6 Openings

Exterior utility doors are fiberglass in painted, galvanized steel frames. Overhead sectional doors are motorized with manual override, constructed of prefinished aluminum slats. Windows are prefinished aluminum. Interior doors are painted, galvanized steel in galvanized steel frames.

7.3.3 RO/UV BUILDING

7.3.3.1 Description

The RO/UV Building is made up of open process space and an enclosed electrical room. Building openings are arranged to accommodate equipment access from the exterior. The facility includes a weather protected exterior containment pad.

7.3.3.2 Code Compliance

Occupancy Classification:	F-2 (Low Hazard Factory Industrial)
Construction Type:	Type IIB
Floor Area:	3,960 s.f. (23,000 allowed)
Minimum Setback:	approx. 20 feet (Calcite Contactors Area)
Exterior Wall Fire Resistance:	none required
Fire Sprinklers:	no
Title 24 Compliance:	no (non-conditioned)

7.3.3.3 Exterior Walls

The exterior building walls are a combination of metal siding and concrete masonry. In the open equipment area, exterior finishes are exposed at the interior. At the enclosed electrical room, exterior finishes are over insulated, metal stud framed cavity walls The concrete masonry base rises to +48 inches and all exposed-to-view units are pigmented, with a split-face or burnished surface. Upper wall surfaces are a ribbed profile of metal siding, with "Zincalume" treatment and fluoropolymer coating, and manufacturer's standard trims and transitions.

7.3.3.4 Roofs

The roof is made of ribbed metal structural or non-structural panels with a standing-batten appearance, "Zincalume" treated and fluoropolymer coated. Exposed fasteners, gutters, downspouts, penetrations, and transitions are standard manufacturer's products.

7.3.3.5 Interior Walls, Finishes

Interior walls are framed with non-bearing metal studs, finished with painted, light orange peel textured gypsum board. The wall and ceiling structure is exposed in the open shop space; the ceiling in the electrical room is painted gypsum board. Floors are polished and sealed concrete.

7.3.3.6 Openings

Exterior utility doors are fiberglass in painted, galvanized steel frames. The overhead sectional door is motorized with manual override, constructed of prefinished aluminum slats. Windows are prefinished aluminum. The interior door is painted, galvanized steel in a galvanized steel frame.

7.3.4 MISCELLANEOUS STRUCTURES AND CANOPIES

7.3.4.1 Description

The WRF list of structures contains additional pre-engineered metal buildings and weather protective covers, including the dewatering canopy, chemical facility canopy, collection supply storage, water supply storage, covered parking and covered storage slabs.

7.3.4.2 Code Compliance

Occupancy Classification:	F-2 (Low Hazard Factory Industrial) or H-4 (High Hazard), depending on chemical storage
Construction Type:	Type IIB
Floor Area:	varies
Minimum Setback:	varies, 10 feet minimum
Exterior Wall Fire Resistance:	none required
Fire Sprinklers:	no
Title 24 Compliance:	no (non-conditioned)

7.3.4.3 Exterior Walls

Canopies and miscellaneous weather protective covers are open at the exterior, with exposed, primed and painted steel vertical structure. Exterior walls at enclosed miscellaneous structures are a ribbed profile of metal siding, with "Zincalume" treatment and fluoropolymer coating, and manufacturer's standard trims and transitions.

7.3.4.4 Roofs

Roofs are made of ribbed metal structural or non-structural panels with a standing-batten appearance, "Zincalume" treated and fluoropolymer coated. Exposed fasteners, gutters, downspouts, penetrations, and transitions are standard manufacturer's products.

7.3.4.5 Interior Walls, Finishes

Miscellaneous enclosed structure have exposed wall and roof panels at the interior. Floors are polished and sealed concrete.

7.3.4.6 Openings

Exterior utility doors are fiberglass, in painted, galvanized steel frames. Windows are prefinished aluminum.

8 Building Mechanical and Fire Design Criteria

8.1 GENERAL

This section presents the criteria and basis of mechanical design associated with the plumbing, heating, ventilating, and air conditioning (HVAC) and fire protection systems. The intent of this section is to define the design criterion, establish the minimum design requirements, and describe the mechanical systems. The selection of the systems will be based on operating performance, system efficiency, life safety considerations, long-term durability, redundancy, local representation/service, ease of operation as well as site and specific requirements identified by the project team or Owner as described herein.

8.2 APPLICABLE CODES AND STANDARDS

In addition to the applicable codes and standards previously identified, the system design will also be based on but not limited to the following building codes and standards.

- 2016 California Building Code (2015 International Building Code with California Amendments)
- 2016 California Mechanical Code (2015 Uniform Mechanical Code with California Amendments)
- 2016 California Plumbing Code (2015 Uniform Plumbing Code with California Amendments)
- 2016 CFC (2015 International Fire Code with California Amendments)
- 2016 California Energy Code.
- 2016 California Green Building Standards Code.
- California Title 24 Building Energy Efficiency Standards
- American Society of Plumbing Engineers (ASPE) Handbooks.
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbooks and Standards.
- Sheet Metal and Air Conditioning Contractor National Association (SMACNA) handbooks.
- National Fire Protection Association Recommended Practices (NFPA) and Manuals.
- Recommended Standards for Sewage Works - Great Lakes - Upper Mississippi River Board of Sanitary Engineers (10 States Standards).
- Occupational Safety and Health Act (OSHA) Standards Manual.

In addition to the applicable codes and standards previously identified, the system designs will also be based on but not limited to the following publications and standards:

- Underwriter Laboratories (UL)
- American Society for Testing and Materials International (ASTM)
- Aluminum Association (AA); Aluminum Sheet Metal Work in Construction
- National Fire Protection Agency (NFPA) recommended practices and manuals
- Life Safety Code – National Fire Protection Agency (NFPA)

- Air-Conditioning, Heating, and Refrigeration Institute, a trade association representing manufacturers of heating, cooling, water heating, and commercial refrigeration equipment(AHRI)
- Air Movement and Control Association International, Inc. (often incorrectly called Air Moving and Conditioning Association) (AMCA).
- American National Standards Institute (ANSI)
- National Electrical Manufacturers Association(NEMA).

8.3 SITE AND TEMPERATURE DESIGN CRITERIA

Design criteria are summarized in Table 8-1 below.

Table 8-1: Building Mechanical Design Criteria

CRITERIA	
SITE ELEVATION Above sea level, ft	 115 (Note 3)
SITE LOCATION [3] Morro Bay FD, San Luis Obispo. North Latitude, degrees West Longitude, degrees	 35.4 120.9
HVAC AMBIENT DESIGN TEMPERATURES [1] Winter, design dry bulb, F Summer, design dry bulb/mean coincident wet bulb, F	 31 Refer to Section 8.8.1
CLIMATE ZONE	5
CLIMATIC DATA Mean Daily Dry Bulb Temperature Range, F 20 yr Frequency Minimum Outdoor Temperature, F [4] 20 yr Frequency Maximum Outdoor Temperature, F [4]	 14 23.1 110.6
RAINFALL INTENSITY (2) Actual, inches/hour Design, inches/hour	 1.5 2.0

(1) The winter and summer design temperatures are based on the Exhibit B Scope of Work.
(2) The actual rainfall intensity rate is based on a 60 minute duration and 100 year return period.
(3) The site location is for determining representative weather data for the project site but is not necessarily the specific project location.
(4) These outdoor temperatures are extreme temperature range for consideration in mechanical and electrical equipment design. These values are from ASHRAE for San Luis Obispo, CA, the closest location to the site in the guidelines.

8.4 MATERIALS

Materials will be selected giving preference to those materials that require the least maintenance and have the longest life as shown in Table 8-2 below.

Table 8-2: Building Mechanical Pipe and Duct Materials

SYSTEM	MATERIALS
Sanitary Drainage Systems	Cast Iron
Laboratory Drainage System	PVC, Polypropylene, or PVDF as required
Water Systems	Copper*
Ductwork	Galvanized steel*
* Alternate corrosion resistant materials will be used in corrosive locaitons where incidated on the drawings.	

8.5 SEISMIC

The seismic design will comply with the "Seismic Design Requirements for Nonstructural Components" of the latest edition of American Society of Civil Engineers Standard ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures".

8.6 BUILDING DESIGN REQUIREMENTS

The following subsections provide a description of the plumbing and HVAC systems serving the Operations, Maintenance, Chemical, RO/UV, MBR, Headworks, Dewatering, Water and Collection Supplies Storage Shed and Buildings Collection Supplies Storage Sheds and the Dewatering Facility areas.

8.7 PLUMBING DESIGN

8.7.1 Storm Drainage Systems

Roof drainage systems will consist of gutters and downspouts provided under the Architectural design for all sloped roof buildings.

8.7.2 Sanitary Drainage Systems

General floor drainage will be provided in the process areas of the Maintenance, RO/UV and Water and Collection Supplies Storage Shed Buildings. Funnel receptors will be located adjacent to equipment with equipment drains. Where practical, receptors will be located to serve multiple equipment drains. Drains will be provided at overhead doors to collect any water off vehicles or wind driven rain that enters the building when the door is open.

In finished areas of the Operation and Maintenance Building , floor drainage will be provided in the restrooms, showers, janitor's closets, and laboratory.

All floor drains, funnel receptors, and plumbing fixtures connected to the sanitary drainage system will be provided with traps and vents. Where individual vents cannot be provided for each trap due to physical constraints, a combination waste and vent system will be utilized for floor drains and funnel receptors. All other drains will be individually vented. Piping materials will be cast iron soil

pipe with hubless or bell and spigot joints for above grade locations and bell and spigot joints for below grade locations.

All plumbing fixtures and floor drains located on the floor at or above grade will discharge by gravity to the plant sanitary sewer.

The floor drains, sinks, and equipment drains located in the laboratory area will discharge into a neutralization tank if required. The neutralization tank will be below grade and discharge to the sanitary system. All drainage and vent piping and accessories associated with the laboratory waste system will be constructed of chemical resistant materials.

All plumbing fixtures and floor drains located at the WRF will discharge by gravity to a lift station on site, which will discharge to the WRF sanitary sewer system.

In the Chemical Facility, permanent air diaphragm sump pumps will be designed by process mechanical.

In the Dewatering Area and Maintenance Building, floor drainage will be provided in the Dewatering Area, Mechanical and Laboratory Rooms. Plumbing fixtures and floor drainage will be drained directly to the sanitary drainage system.

In the RO/UV and Maintenance Buildings, trench drains will be provided in the RO room and Service Truck bay. Plumbing fixtures and floor drains will be drained directly to the sanitary drainage system.

8.7.3 Water Piping System

Potable hot, cold and tempered water will be supplied to the domestic water fixtures and emergency shower/eyewash fixtures. The anticipated water pressure is approximately 70 psig; therefore, water pressure boosting equipment will not be required. A central water meter will be provided at the site water service entrance. Piping materials will consist of soft annealed copper tubing with flared fittings for buried sizes 2 inch and smaller and type K hard drawn copper tubing with solder joint fittings for above grade piping.

All materials in contact with the potable water will comply with the Safe Drinking Water Act of 1986 as amended by the Reduction of Lead in Drinking Water Act of 2011. All plumbing fittings and fixtures intended to convey or dispense water for human consumption will comply with the requirements of NSF/ANSI 61 and NSF/ANSI 372 for low lead.

Domestic hot and cold water will be provided to plumbing fixtures as required. A water heater and blending valve will be provided in the cold water supply to the emergency shower/eyewash fixtures to permit tepid water temperatures (60°F to 90°F) to be supplied to the fixtures. Hot water recirculation system will be provided for fixtures over 50 feet from the water heater. In chemical facility instantaneous electric water heater will be provided to supply tepid water to emergency fixtures.

¾ inch hose faucets and 1-1/2 inch hose valves will be provided in unfinished areas including the Truck Service Bay, Headworks ,MBR, and Dewatering Area.

In the Operations Building, potable water will be piped to the domestic plumbing fixtures. A hot water piping system will be furnished to supply hot water to all sinks and lavatories. A hot water circulating system will be provided to ensure timely delivery of hot water to all fixtures. Wall hydrants will be provided as necessary for irrigation or washdown needs outside the structure. Wall hydrants will be provided next to packaged air conditioning units and make-up air units for service. Frost proof 3/4 inch wall hydrants will be provided at intervals around the exterior of the structures.

In the Chemical Facility, a nonpotable water system consisting of piping downstream of a backflow preventer on the potable water system, will be piped to the chemical feed water needs. Pressure reduction will be provided as necessary for each chemical system water feed. Sanitary yard hydrants with integral vacuum breakers will be provided as necessary for washdown and irrigation needs in and around the structure.

In the RO/UV and Maintenance Buildings, a nonpotable water system consisting of potable water downstream of a backflow preventer will be provided. Hose faucets and wall hydrants with integral vacuum breakers will be provided as necessary for washdown in and around the structure. Potable hot and cold water will be provided to a service sink in these buildings.

In the MBR, Headworks and Dewatering Area, on-site recycled water will be provided for washdown and connections to equipment that require water supplies. On-site recycled water will be provided for landscape irrigation needs.

The following table describes the uses at each building at the facility, and the associated water types.

Table 8-3: Water Uses throughout the Plant

AREA	DEMAND LOCATION	TYPE OF WATER		
		PW	NPW	Recycled Water
Area 10 – Maintenance Storage Shops.				
Service Sink	Indoors	Faucet	-	-
¾" Hose bibb	Indoors	-	Yes	-
¾" Wall Hydrant	Outdoors	-	Yes	-
Area 16 – Water & Collection Supplies Storage Sheds				
Service Sink	Indoors	Faucet	-	-
¾" Hose bibb	Indoors	-	Yes	-
¾" Wall Hydrant	Outdoors	-	Yes	-
Area 21 - Headworks				
Coarse Screen #1 Spray Water	Outdoors	-	-	Yes
Coarse Screen #2 Spray Water	Outdoors	-	-	Yes

AREA	DEMAND LOCATION	TYPE OF WATER		
		PW	NPW	Recycled Water
Grit Pump #1 Seal Water	Outdoors	-	-	Yes
Grit Pump #2 Seal Water	Outdoors	-	-	Yes
¾" Yard Hydrant	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
Area 22 – Fine Screens				
Fine Screen #1 Spray Water	Outdoors	-	-	Yes
Fine Screen #2 Spray Water	Outdoors	-	-	Yes
¾" Yard Hydrant	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
Area 24 – Vactor Washdown				
¾" Yard Hydrant	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
Area 31 - BNR				
Scum Spray	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
¾" Hose bibb	Outdoors	-	-	Yes
Area 32 - MBR				
1" Yard Hydrant	Outdoors	-	-	Yes
¾" Hose bibb	Outdoors	-	-	Yes
Area 50 – RO/UV				
1-½" Hose valves	Indoors	-	Yes	-
¾" Hose bibb	Indoors	-	Yes	-
Emergency Shower and Eyewash(CIP Tank Area)	Indoors	Yes	-	-
Exterior wall hydrants	Outdoors	-	Yes	-
Area 60 – Product Water				
Calcite Contactors Area	Outdoors	-	Yes	-

AREA	DEMAND LOCATION	TYPE OF WATER		
		PW	NPW	Recycled Water
Product Water Tank	Outdoors	-	Yes	-
IPR/Product Pump Area	Outdoors	-	Yes	-
Outfall Pump Area	Outdoors	-	Yes	-
1" Yard Hydrant	Outdoors	-	-	Yes
Area 70 – Solids Area				
Emergency Eyewash & Shower	Outdoors	Yes	-	-
Polymer Blender Water	Outdoors	-	Yes	-
Sludge Holding Tank Blowers	Outdoors	-	-	-
Electrical Building	Outdoors	-	-	-
¾" Yard Hydrant	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
Area 72 – Dewatering Area				
Belt Filter Press	Outdoors	-	-	Yes
SAFE Area	Outdoors	-	-	Yes
¾" Yard Hydrant	Outdoors	-	-	Yes
1" Yard Hydrant	Outdoors	-	-	Yes
Area 80 – Electrical Area				
Utility Transformer	Outdoors	-	-	-
Emergency Generator	Outdoors	-	-	Yes
Electrical Building	Outdoors	-	-	-
¾" Yard Hydrant	Outdoors	-	-	Yes
Area 90 – Chemicals				
Emergency Shower and Eyewashes	Outdoors	Yes	-	-
Chemical Carrier Water	Outdoors	-	Yes	-
¾" Yard Hydrant	Outdoors	-	-	Yes
Area 90 – Operation Building				

AREA	DEMAND LOCATION	TYPE OF WATER		
		PW	NPW	Recycled Water
Lavatories	Indoors	Yes	-	-
Water Closets	Indoors	Yes	-	-
Urinals	Indoors	Yes	-	-
Kitchen Sink (Break Room)	Indoors	Yes	-	-
Service Sink (PW Sample Storage Room)	Indoors	Yes	-	-
¾" Wall Hydrant	Outdoors	Yes	-	-
Area 96– Maintenance Building				
Water Closet	Indoors	Yes	-	-
Lavatory	Indoors	Yes	-	-
Emergency Eyewash & Shower (Laboratory)	Indoors	Yes	-	-
Lab sinks (Laboratory)	Indoors	Yes	-	
Service Sink (Mechanical Room)	Indoors	Yes	-	-
¾" Hose Bibb (Maintenance Area/Truck Service Bay)	Indoors	-	Yes	-
1-½" hose valve (Truck Service Bay)	Indoors	-	Yes	-
¾" Wall Hydrant	Outdoors	-	Yes	-

8.7.4 Plumbing Fixtures

Plumbing fixtures will be selected for durability and ease of maintenance and housekeeping. Water closets will be wall mounted flushometer valve type. Showers will be of the pressure balanced type for scald protection. All fixtures will be of the high efficiency (1.28 gpf) type. Plumbing fixtures accessible to the disabled will be provided in accordance with Federal and State requirements.

Water heaters located downstream from a backflow prevention device will be protected by use of an expansion tank.

In the Dewatering Area, Chemical Facility and Maintenance Building, emergency shower and eyewash stations with tepid water supply will be located where injurious corrosive materials are

handled or stored, or for general work area safety. The emergency fixtures will be located in well lit, highly visible, accessible locations on the same level as the hazard with an obstruction free travel path. The station will be plumbed to a tepid water supply as described in the water supply piping paragraph designed to provide 15 minutes of flow. A floor drain will be located under the emergency shower. Each emergency shower and eyewash station will have an alarm device for local and remote alarms. The local alarm will consist of an audible and visible alarm light.

In the Maintenance Building, a water closet and lavatory will be provided in the restroom, a janitor's sink and domestic water heater will be provided in the Storage Room.

In the Operations Building, water closets, urinals, and lavatories will be provided in the restrooms as necessary, a janitor's sink and domestic water heater will be provided in the Janitor's Closet, and a kitchen sink will be provided in the Break Room.

In the Chemical Facility, emergency shower and eyewash fixtures will be provided with tepid water supply as required. Emergency fixtures will be of the frost proof type with insulated and heat traced tepid water supply. Emergency fixtures will also be provided outside adjacent the chemical truck unloading stations.

8.7.5 Natural Gas Piping System

The City will coordinate the new natural gas supply to the site. Natural gas piping and pressure regulation will be provided at each building for building heat, domestic and process water heaters as necessary. The gas meter will be provided and located by the gas utility. A pressure reducing valve will be located adjacent to the facility to reduce gas pressure before entry into the building. The natural gas building service entrances will be located and protected from accidental damage by equipment, settlement, or vibration. The natural gas service into the facility will be located above grade. Piping materials will consist of polyethylene pipe with butt fusion joints for buried sizes 3 inch and larger and socket fusion joints for buried sizes 2 inch and smaller. For above grade and interior locations, pipe will consist of schedule 40 black steel with butt welding fittings for 2-1/2 inch and larger and socket welding or malleable iron fittings for 2 inch and smaller

8.7.6 Onsite Recycled Water Piping System

Recycled water will be used for irrigation, scum sprays, and exterior washdown where appropriate. The on-site recycled water system will operate at approximately 75 psi. Water pressure reducing valves will not be required.

8.7.7 Product Water System

Product water will not be used on the site.

8.8 HEATING, VENTILATION, AND AIR CONDITIONING

The following is a description of the HVAC systems.

8.8.1 Indoor Design Conditions

The following Table describes the indoor design conditions and ventilation rates for each room within the buildings.

Table 8-4: Indoor Design Conditions

AREA	OUTDOOR SUMMER (F) (1) DESIGN (DB/WB)	DESIGN TEMPERATURES (F) (1) SUMMER DESIGN	WINTER DESIGN	WINTER SETPOINT	VENTILATION REQUIREMENTS	VENTILATION NOTES
Area-10-Corporation Yard Area.						
Water Supply Storage Room	88/65	98	55	55	6 AC/hr (I)	1
Collection Supply Storage Room	88/65	98	55	55	6 AC/hr (I)	1
Area-16-Water and Collection Supplies Storage Sheds Building						
I & C Work Shop Room	88/65	75	68	65	Air Conditioned	4
PW/WW Sample Storage Room	88/65	98	55	55	6 AC/hr (I)	1
Area-50 -RO/UV Building						
Electrical Room	88/65	90	55	55	Air Conditioned	4, 7
RO/UV Room	88/65	98	55	55	6 AC/hr (I)	1
Area-80 -Electrical Building						
Electrical Room	88/65	90	55	55	Air Conditioned	4, 7
Area-95-Operations Building						
Conference Room	88/65	75	68	65	Air Conditioned	4
Restrooms/Locker Rooms	88/65	75	68	65	Air Conditioned	3, 4
Office areas, Reception, Meeting, Break Rooms	88/65	75	68	65	Air Conditioned	4
Electrical Room	88/65	90	55	55	Air Conditioned	4, 7
Closet, Unisex Shower, Locker room & Accessible Unisex room	88/65	78	68	65	Air Conditioned	3, 4
Server Room	88/65	68	68	65	Air Conditioned	4, 7
Mechanical Room	88/65	75	68	65	Air Conditioned	4
Operation Room/Operation Center	88/65	75	68	65	Air Conditioned	4
Laundry/Uniform Storage	88/65	75	68	65	Air Conditioned	4
Area-96-Maintenance Building						

AREA	OUTDOOR SUMMER (F) (1) DESIGN (DB/WB)	DESIGN TEMPERATURES (F) (1) SUMMER DESIGN	WINTER DESIGN	WINTER SETPOINT	VENTILATION REQUIREMENTS	VENTILATION NOTES
Mechanical/Electrical Room	88/65	90	55	55	Air Conditioned	4, 7
I & C Workshop	88/65	75	68	65	Air Conditioned	4
Shop & Storage Space	88/65	98	55	55	6 AC/hr (I)	2
Office areas, Training, Meeting, Break Rooms	88/65	75	68	65	Air Conditioned	4
Satellite Control Room	88/65	75	68	65	Air Conditioned	4
Truck Service Bay	88/65	98	55	55	6 AC/hr (I)	2
Laboratory	88/65	68	68	65	Air Conditioned	4, 5, 6
Closet, Accessible Unisex room and Restroom	88/65	78	68	65	Air Conditioned	3, 4

(1) Indoor conditions reflect operating temperatures for personnel comfort, code/standard recommendations, or equipment protection.
AC/HR - designates air changes per hour.
(C) - designates the ventilation system operates continuously.
(I) - designates the ventilation system operates intermittently.

Notes:
1. The ventilation system will be sized on the more restrictive of the AC/HR listed or the airflow required to maintain the indoor design temperature based on the summer outside design temperature.
2.Additional intermittent ventilation will be provided as required to maintain the indoor design temperature based on the summer outside design temperature.
3. The exhaust rate will be based on the most stringent requirement of: 0.5 CFM per square foot of floor area; 50 CFM per water closet or urinal; or 100 CFM minimum.
4. The ventilation rate will be based on the exhaust requirements or as required by ASHRAE 62, whichever is more stringent.
5. Intermittent additional ventilation tied to canopy hood over ovens/furnaces.
6. Outdoor air ventilation sufficient to maintain the spaces at a positive differential pressure of 0.1 inches water column relative to ambient.

8.8.2 HVAC General Requirements

8.8.2.1 Intakes.

Outdoor air intakes will be designed to manage rain entrainment in accordance with the latest ASHRAE standards. Louvers will be selected to limit water penetration to a maximum of 0.01

oz/ft2 (3 g/m2) of louver free area at the maximum intake velocity. Corrosion resistant screens will cover the openings with openings of 1/2 inch.

8.8.2.2 Air Filtration.

Outdoor air will be filtered for air-conditioned areas. Filtration will consist of 2-inch disposable pleated media filters with a minimum efficiency reporting value (MERV) based on ASHRAE 52.2 guidelines of at least 6.

8.8.2.3 Internal Load Factors.

Heating and cooling loads will be calculated in accordance with ASHRAE Standards. Internal heat gains will be included in the calculations based on the following:

- Lighting: 1.3 watts/sq ft (unless otherwise indicated)
- Equipment: Equipment heat loss from equipment anticipated to operate simultaneously.

8.8.2.4 Ductwork.

Ductwork will be sized for 0.08-inch water column per 100 feet for a friction loss. Ductwork will be insulated for air conditioning systems, outside air, and heating systems. Insulation will consist of duct liner tested to be resistant to mold growth and erosion under a standardized test method. Insulated plenums will be externally insulated and include drain provisions for removal of any moisture that may carryover through the outside air louver.

8.8.2.5 Outside Air.

Air conditioning and ventilation will be provided in offices and other normally occupied areas in accordance with ASHRAE Standards 55 and 62. Buildings containing WRF processes and equipment will be provided with supply air and exhaust air ventilation in accordance with NFPA 820.

8.8.3 Heating Systems

Space heating will be provided by either individual natural gas or electric unit heaters in the process areas. Electrical rooms will be provided with electric unit heaters. The heaters will be located to provide uniform space heating of the area served. Each unit heater will be controlled by an adjustable wall mounted digital thermostat.

8.8.4 Ventilation Systems

In the RO/UV Building, the ventilation systems will consist of intermittent systems. The makeup air unit will be controlled by a local "ON-OFF" selector switch and each power roof ventilator/ wall mounted propeller will be controlled by a local "ON-OFF-AUTO" selector switch. When each power roof ventilator selector switch is in the "AUTO" position, the power roof ventilator will be interlocked with the makeup air unit. The makeup air unit will be filtered and tempered to the room design temperature before supplied to the space. A thermostat will modulate the discharge air temperature to the design space temperature.

In the remaining process areas, the intermittent ventilation systems will consist of wall mounted propeller fans or inline duct fans for exhaust and supply fan, with louvers for air intake. Air filters will be installed inside the duct. The intermittent systems will serve the process and storage areas.

Each fan will be controlled by a local "ON-OFF-AUTO" selector switch. When the selector switch is in the "AUTO" position, the fan will be interlocked with the thermostat.

8.8.5 Air Conditioning Systems

In the Operation Building, the air conditioning system will consist of a variable air volume, packaged grade mounted air conditioning/heat pumps. The air conditioning unit/heat pump will be provided with a backup emergency electric heating coil. Each unit will be controlled by a remote wall mounted temperature sensor to maintain the desired space temperature. The Server Room will be served by a split system air conditioner.

The Men's and Women's Toilet/Locker rooms and the Janitors Closet/Mechanical/Electrical room will be exhausted by inline duct fans. Each fan will be controlled by a local "ON-OFF-AUTO" selector switch. When the selector switch is in the "AUTO" position, the fan will be interlocked with the heat pump serving this area of the building

The air conditioning system for the Maintenance (Control and I&C Workshop spaces) and RO/UV Building Electrical Rooms will consist of single zone, constant volume packaged grade mounted air conditioning/heat pumps. The heat pumps will not be provided with backup emergency electric heating coils due to the mild climate and heat generated within the rooms. Each unit will be controlled by a remote wall mounted thermostat to maintain the desired space temperature. An economizer system will be provided to allow the use of outdoor air for cooling the space when ambient temperatures are suitable.

In Maintenance Building the packaged air conditioning unit for the Laboratory will be sized to handle the additional cooling load of any outdoor air required for fume or canopy hoods. Any fume hoods required will be grade mounted with stacks discharging above the building.

The air conditioning system for the pre-engineered Electrical Building will be a packaged grade mounted air conditioning or split system air conditioner. Full 100% HVAC system redundancy will be provided.

For areas described to have Full 100% HVAC system redundancy, two units each sized to provide the total heating and cooling loads will be used to maintain the indoor design conditions. Only one unit will operate at a time and the units will alternate in operation so that the run times for each unit remain approximately the same. In the event that a single unit fails, the other unit will start and maintain the desired space conditions.

8.8.6 Building Control Systems

The HVAC controls will consist of automatic industrial grade electromechanical and electronic controls. Control component enclosures will be selected based on the environment where they are installed. Typical controls will consist of the following:

- Differential pressure indication across supply and exhaust fans designed to operate continuously to indicated fan flow or failure. Where insufficient differential pressure occurs due to limited ductwork, motor current switches will be used.

- Duct mounted smoke detectors where systems have airflows greater than 2000 CFM and are capable of spreading smoke beyond the enclosing walls, floors and ceilings of the room or space in which the smoke is generated.
- Differential pressure gauge and differential pressure switch with alarm across air filters.
- Electric thermostats for control of intermittent ventilation systems to start and stop equipment operation.
- Electric thermostats or electronic sensors to control heating equipment for maintaining the leaving air temperature within the design temperature range.
- Electric thermostats for detection and alarming of low air temperatures.
- Programmable electric thermostats for control of packaged air conditioning systems.
- Local ON-OFF control stations to be provided for vault ventilation systems.

A microprocessor-based stand-alone system or building automation system (BAS) is anticipated only for the Operations Building. The remainder of the plant HVAC systems can be designed to be on the same BAS system if the Client prefers. This would allow for better remote operation of the facility in the future.

8.9 FIRE PROTECTION DESIGN

8.9.1 Applicable Codes and Standards

The fire protection system design will conform to the latest editions of the following applicable standards and codes:

- California Building Code (with local jurisdiction amendments)
- California Fire Code (with local jurisdiction amendments)
- National Fire Protection Association (NFPA)
- Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)
- Standard for the Installation of Private Fire Service Mains and Their Appurtenances (NFPA 24)
- Life Safety Code (NFPA 101)
- Fire Alarm Signaling (NFPA 72)

8.9.2 Fire Protection

Fire protection designed to meet the requirements of the National Fire Protection Association (NFPA) will be provided where indicated on the Code Classification Table in the drawings. Fire protection will be installed based upon the 2016 edition of California Building and Fire Codes along with local amendments.

All new WRF buildings were analyzed for the fire suppression system requirements. Per local amendments to State adopted code, sprinkler systems are required inside all buildings exceeding 1000 square foot fire areas; however, California Government Code Section 53091(d) allows construction of facilities for the production, storage, treatment, or transmission of water or wastewater by local agency to not comply with building ordinances of county or city. This allows

all buildings of the project to only comply with California Building and Fire Codes, which does not require any project building to be protected with automatic sprinkler system based on building floor area or occupancy hazard. A clarification and reconfirmation from the authority having jurisdiction (AHJ) is required to finalize the requirement of sprinkler system based on size of the buildings.

The following will be used for the building and sprinkler design:

- All hazardous chemicals will be stored outside buildings with sufficient fire separation as required by the CBC, and thus no sprinkler protection will be provided for outdoor storage.
- In buildings without sprinklers, the exterior wall openings will be placed every 50 feet on at least one side.
- Maximum fire flow requirements for each project building will be 1500 gpm for a maximum 2 hour duration.
- Dedicated electrical rooms will be provided with smoke detection systems.
- Standpipes are not expected to be required for any of the buildings, although this will be evaluated further in detail design.

The following will be used for the fire hydrant and fire water main design:

- Every building will be provided with a hydrant within 400 feet of all portions of the building and a minimum of 40 feet away from the building so it can be operated by the Fire Response Team during an emergency.
- Fire hydrants will be provided on the access roads with bollard having sufficient clearance to protect against mechanical damage.
- The farthest hydrant along the fire water main will be dedicated for a minimum of 1500 gpm fire flow and a minimum 20 psi residual pressure.
- The fire main will be sized to deliver the flow and pressure requirements listed in this section and designed per NFPA 24.
- Fire pumper trucks will boost the hydrant water pressure to required level using truck pump station.
- All control valves on the water supply piping will be electrically monitored by fire alarm control unit.

8.9.3 Water Supply

Initial assessment of city potable firewater supply to the site indicates that adequate fire water flow is available for largest flow required for fire flow or sprinkler system operation. Available water supply information furnished by the City is summarized in

Table 8-5 below.

Table 8-5: Available Water Supply Flow & Pressure

CRITERIA	VALUE

Potable Supply Main Size	10” (with pending project to be completed prior to occupation of WRF)
Potable Supply Main Connection Location	Teresa Road at South Bay Boulevard
Elevation of Connection Point	54.6 ft
Static Pressure at Connection Point	110 psi
Available Pressure at 1,500 gpm flow	65.5 psi
Available flow at 20 psi outlet pressure	2,240 gpm

9 Electrical Design Criteria

9.1 GENERAL ELECTRICAL DESIGN CRITERIA

This section presents the design criteria for the electric power system for the Project. The intent is to provide a safe and reliable means of delivering and distributing power while ensuring ease of maintenance as much as possible. The following criteria also address other electrical requirements that are not specifically related to power delivery.

9.2 CODES AND STANDARDS

Electrical design will conform to the latest editions of the following applicable standards and codes:

- State of California, Title 24, Part 3 Electrical Code
- State of California, Title 24, Part 6 Energy Code
- State of California, Title 8 Industrial Relations, Chapter 4, Electrical Safety Orders
- National Electrical Code (NEC – NFPA 70)
- National Electrical Safety Code (NESC)
- Life Safety Code (NFPA 101 HB)

Standards and codes of the following organizations will also govern, where applicable:

- American National Standards Institute (ANSI)
- Illuminating Engineering Society (IES)
- International Society of Automation (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Administration (ASTM)
- Underwriters Laboratory (UL)

9.3 POWER DISTRIBUTION DESIGN

The design of the power distribution system for the Project will follow the current design guidelines recognized by IEEE and current industry standards.

9.4 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM

The new electrical service will be provided by Pacific Gas & Electric (PG&E). A 12KV power line from PG&E will be via an overhead utility distribution line adjacent to plant property and will be routed underground to an on-site pad mounted PG&E furnished outdoor transformer. The PG&E transformer will connect to the PG&E metering cabinet inside the Electrical Building and feed a new 480Y/277 V, three-phase, four-wire, 2000A, indoor automatic transfer switch (ATS) in the

Electrical Building. The ATS will have an emergency power source connection from 1MW, 480V, three-phase, four-wire generator which will be located outdoor and adjacent to Electrical Building. The ATS will feed a 2000A indoor switchboard located in the Electrical Building. The switchboard will have radial feed to 3 MCC's with 2 of them located in the Electrical Building and one of them located in the RO Building.

The switchboard will also include an 800A spare breaker for future PV connection.

The MCC's will feed power panels, which will contain feeder breakers to power process loads and miscellaneous 480 volt building and auxiliary loads not requiring a motor starter within the MCC. The MCC will use NEMA type motor starters and feeder breakers to feed the power panel and the lighting transformer.

For small loads requiring lower voltages, a dry-type transformer will be located in the Electrical Building and will step the voltage down to a 208Y/120 volt, three-phase panelboard. The panelboard will distribute power to HVAC, lighting, receptacle, and other miscellaneous small loads. The lighting transformer and panelboard will be mounted external to the MCC.

Control panels, as applicable, will conform to UL 508A. This includes requirements for conformance to the latest short circuit equipment rating requirements. All free standing electrical equipment will be installed on concrete housekeeping pads.

9.5 DISTRIBUTION AND UTILIZATION VOLTAGES

The following distribution and equipment utilization voltages and ratings will generally be used. Depending on the specific equipment requirements determined in design, there may be some exceptions.

Plant distribution:	480Y/277 volts, three-phase
Motors, 1/2 hp and larger:	480 volts, three-phase
Motors, less than 1/2 hp:	120 volts, single-phase
Motor control:	120 volts, single-phase
Lighting:	120 volts, single-phase
Convenience outlets:	120 volts, single-phase
Instrumentation and Control:	24VDC

9.6 STANDBY POWER

A stand-by rated diesel fueled engine-generator will be provided for the project in the event utility supplied power is not available. The engine-generator package will consist of an engine-generator, control panel, cooling system, sub-base fuel storage tank, and accessory items all installed outside in a weather-proof enclosure on a concrete base.

A double walled sub-base type fuel storage tank will be used to supply fuel to the engine-generator. The sub-base tank will meet NFPA requirements and have sufficient capacity for a minimum of 24

hours of operation of the engine-generator at full capacity. The fuel storage tank will be installed underneath the engine-generator, inside the enclosure. The tank will be equipped with leak detection and fill box to contain any accidental spillage during filling of the tank.

The engine-generator size is based on operating the treatment facility at 1 mgd capacity. Preliminary sizing estimates the unit to be rated at 400 kW. An ATS will be furnished to transfer between utility power and generator power.

9.7 ELECTRICAL EQUIPMENT DESIGN CRITERIA

The following general requirements and guidelines will be used in the design of electrical equipment and support systems.

9.7.1 480 Volt Switchboard

Indoor, NEMA 1 rated switchboard will be used for the project. Control cabling will be insulated and rated for 600V.

Circuit powering the switchboard will be 480 V, three-phase. All equipment will be rated to handle short circuit currents equal to or greater than the available fault current. The switchboard will have power main breakers with solid-state trip units with long-time (L), short-time (S), instantaneous (I) and ground-fault (G) protection functions. Downstream distribution breakers will be molded case type with solid-state adjustable trip units to improve coordination and downstream arc flash characteristics. Surge protection devices (SPDs) will be provided.

The switchboard will have a spare breaker connection for the future PV system.

9.7.2 480 Volt Motor Control Center and Starters

Indoor, NEMA 1 rated MCC will be used for the project. Internal and external monitoring and control of MCC devices such as motor starters and HMI control screens will be via hardwiring. MCC power monitoring units will have Modbus/Ethernet network protocol to connect to the Plant Control System. Control cabling installed within the MCC will be insulated and rated for 600V.

Feeder circuit powering the MCC originating from the switchboard feeder breaker will be 480 volt, three-phase, three-wire. The MCC will have a tin-plated copper phase bus and a copper ground bus. MCC will be a single bus configuration and will be rated to handle short circuit currents equal to or in excess of the available fault current. Customer power quality monitoring equipment will be included in the MCC to connect metering data to the Plant Control System. The MCC main breaker will be molded case type with solid-state trip units with LSI protection functions. The MCC main breaker will also be provided with ground-fault protection when required by the NEC. Distribution breakers on the MCC will be molded case type with solid state or thermal-magnetic trip units. MCC will measure 20 inches deep. Some spares and spaces will be allotted. Surge protection devices (SPDs) will be provided integral to the assembly.

Except for packaged equipment and HVAC equipment, motor starters will generally be located within the MCC. Starters will include a GREEN indicated lamp for RUNNING (ON), a RED indicating lamp for OFF, and an AMBER indicating lamp for trouble or FAILURE (where applicable). All pilot lamps will be push-to-test type. Only full sized NEMA contactors will be used for all systems. IEC contactors will not be acceptable.

9.7.3 Motors and Variable Frequency Drives

Motors will be specified with "NEMA Premium" high efficiency ratings. Motor enclosures will be suitable for the environment in which they are installed. All motors driven from variable frequency drives (VFDs) will be inverter-duty rated and will be rated for such applications. The heaters will be designed to operate on 120-volt ac power from the associated motor starter or VFD.

VFDs will be pulse width modulated type. VFDs will be fed from a dedicated 480 volt, three-phase feeder. Drives for motors smaller than 100 hp may use 6-pulse type.

9.7.4 Power Transformers

Transformers that supply 208Y/120 volts or 240/120 volts for lighting requirements will be dry type with copper windings and suitable for the area in which they are to be located. Transformers will be industry standard sizes.

9.7.5 Panelboards

Power distribution panelboards or power centers, if required, will be 480, three-phase, three, with a copper bus and a main circuit breaker.

Lighting panelboards will be either 208Y/120 volts, three-phase, four wire type or 240/120 volts, single phase, three-wire type, with a copper bus and a main circuit breaker sized to match the lighting transformer capacity.

Each panelboard will have a minimum of 20 percent of its capacity reserved for spare breakers with spaces, bus work, and terminations to complete the standard sized panelboard. SPDs will be provided integral to each panel assembly.

9.7.6 Receptacles

Convenience receptacles for general service will be located on walls or columns. Provisions for receptacles at all air conditioning units and air handling units will be made as required by NEC. Convenience receptacles will generally be mounted 18-inches above floors, except outdoors or in rooms where equipment could be hosed down. Receptacles in such areas will be mounted 48-inches above the floor or grade. Weatherproof in-use receptacles will be utilized outdoor, and in wet and damp locations. Receptacles installed outdoors will be provided with ground fault circuit interrupting capability.

9.7.7 Raceways and Cable

Specific types of raceways will be chosen for locations vulnerable to damage by moisture, extreme temperature, or corrosion, and considering voltage and cost. An underground duct bank consisting of direct buried schedule 40 PVC type conduits for non-traffic area and concrete encased schedule 40 PVC type conduits for traffic area will be provided for most circuits that are routed outside of buildings. Duct banks will include spare conduits. The following systems will be separately grouped in duct banks:

- Power and discrete control wiring 600 volts and below.
- Process instrumentation analog and communication wiring, including 24-volt discrete signals, and LAN/Data Highway computer circuits.

The following general guidelines will be used for raceway sizing, selection, and installation:

- Conduit will be sized based on XHHW-2 insulation for all conductors 600 volts and less.
- The minimum diameter of all conduit will be 3/4-inch.
- Raceways in duct banks will not be smaller than 2-inches.
- Exterior, exposed conduit will be PVC-Coated galvanized rigid steel.
- Interior, exposed conduit in non-corrosive areas will be rigid galvanized steel.
- Interior, exposed conduit in corrosive areas will be Schedule PVC-Coated galvanized rigid steel.
- Exterior, underground, direct buried and concrete-encased conduit will be schedule 40 PVC.

Power and control wiring rated 600 volts and less will be stranded copper conductors with XHHW-2 insulation. Lighting and receptacle circuit wiring rated 600 volts and less will be single solid conductor copper with THHN/THHW insulation. Individual 14 AWG conductors will be used for discrete control circuits, unless it is practical to use multi conductor cables to group control circuits. Cables will have 600-volt insulation.

Power cable to equipment controlled by an variable frequency drive operating 600 volts or less will be 2000-volt VFD cable with stranded copper conductors and XLP insulation.

Twisted shielded pair control cable with 16 AWG individual stranded copper conductors, PVC insulation, and an aluminum Mylar tape shield around the pair will be used for analog signals. Multi pair cables will be used where grouping of circuits is practical. Cables will have 600-volt insulation.

9.8 GROUND AND LIGHTNING PROTECTION

The electrical system and equipment will be grounded in compliance with the NFPA National Electrical Code (NEC). Conductors will be at least 4/0 AWG copper, minimum, for interconnecting ground rods and for connections to transformers and MCC. A grounding ring will be provided for each building. Electrical equipment, devices, panelboards, and metallic raceways that do not carry current will be connected to the ground ring as well as building steel and metal water piping. Transformer neutrals of wye connected transformers will be solidly grounded through a grounding electrode conductor connected to the grounding electrode system.

A lightning risk analysis will be performed during final design to determine if a lightning protection system is required. Any lightning protection system installed will meet the requirements of NFPA 780, Standard for Lightning Protection Systems. Lightning protection system will be specified to be designed and installed through a UL approved lighting protection system supplier. It is anticipated that the lightning protection system will consist of roof-mounted copper lightning aerial terminals interconnected by bare copper wire. This lightning protection matrix will be secured with copper mounting hardware and bonded to the respective building's ground ring via bare copper wire run down the exterior of the building.

9.9 LIGHTING DESIGN CRITERIA

LED lighting systems will be used for all areas. Illumination levels in the Electrical Building will be provided following the recommended levels suggested in the Illuminating Engineering Society (IES)

handbook for the space and tasks being performed. Lighting fixture types are to be suitable for the environments where installed and will be located (serviceable and accessible) for routine maintenance.

Indoor Locations: Means of egress lighting fixtures will be incorporated in the normal lighting layout / scheme to ensure that all passages and exits remain illuminated in the event of a power failure. These fixtures will be switched and will include an emergency battery pack integral with the fixture.

Where otherwise required by the authority having jurisdiction, means of egress and emergency lighting systems will be provided in conformance with NFPA 101 (Life Safety Code)

Exit Signs: Provide LED type and placed inside the facilities per the latest requirements of NFPA 101 (Life Safety Code).

In general, the following suggested foot candle levels will be used for preliminary design. Actual levels provided will be further evaluated during detailed design.

Table 9-1: Suggested Foot Candle Loads

AREA	FOOT CANDLE
Electrical rooms	35
General site	1
Maintenance areas	50
Office	70
Process, inside	30
Process, outside	5
Storage, inside	15
Walkway	5

9.10 FIRE ALARM SYSTEM DESIGN CRITERIA

Fire alarm and detection system will be provided in dedicated electrical rooms of project buildings. Fire alarm and detection system will provide alarm, trouble, or supervisory signals to constantly attended location either within the protected premises or signals will be transmitted to remote supervising station. Local fire alarm control panel(s) will be connected to a fire alarm network and all system signals are provided to an alarm annunciator panel in a constantly attended location. Water supply control valves are monitored for normal and abnormal conditions using the fire alarm system and signals transmitted to local fire alarm control panel. A reliable electrical power is needed for the operation of fire alarm control panel with standby power provided by panel battery backup. All wiring for communication between the local fire alarm control panel and remote supervisory control panel (located in constantly attended area) and power cable will be provided by general Electrical Contractor. Smoke detection will be provided at the location of fire control panel to quickly detect any fire condition. In addition, any fixed sprinkler system required in any

project building will be monitored by local fire alarm control panel to detect and alarm anytime sprinkler system is activated due to fire.

Fire alarm system will be provided to meet current code requirements. Design of the fire alarm system will adhere to NFPA 72. Final design of fire alarm system will be via performance specification in the contract. A local fire alarm system supplier will be contracted to determine all local fire code requirements and submitting a complete design with complies with those requirements.

9.11 HAZARDOUS AREAS

NFPA 820 will be utilized to determine the area classifications. The design will include specification for the components and installation to meet these requirements, including but not limited to seal off fittings, junction boxes, disconnects, light fixtures, combustible gas detectors (CGD), audible and visual alarms, ventilation systems and control stations.

The selection of type and location of CGD units shall be performed by a qualified person as described by NFPA 70. The units shall be placed in accordance to the appropriate table in NFPA 820. The items selected shall be set to 10% of lower explosive limit (LEL) unless otherwise directed by local AHJ, and connected to the alarm signaling system.

Ventilation audible and visual alarms shall be installed both within the space and be tied to the plant control system.

9.12 TELEPHONE AND COMMUNICATION DESIGN CRITERIA

A telephone and/or data system will be installed as required. Data communication links for the Process Control Network, Office Network, and Off-site connections area described in Instrumentation and Controls Design section. Conduit installation and required equipment installation will be included as determined by the detailed Instrumentation & Control network design.

9.13 SECURITY SYSTEM DESIGN CRITERIA

A security control panel and annunciator will be installed to monitor the facilities on site. Intrusion/proximity switches will be provided for the building exterior doors. Card key access control will be provided for the building main entrance locations and provisions for the electronic access system will be installed. All security signals will be routed to the security control panel.

Fixed Closed Circuit Television (CCTV) cameras will also be installed for each building. Pan-Tilt-Zoon (PTZ) camera will be installed at the site gate entrance location. PTZ CCTV camera will be provided with two 1” conduits for routing separate 120 V power circuit and video signal which the fixed CCTV camera will be provided with one 1” conduits for the power and video signal. The power for the fixed CCTV will be from the Ethernet switch. Video signals will be routed to the communications cabinet.

A motor controlled road security gate will be provided to grant access to the site.

9.14 CALCULATION AND ANALYSIS REQUIREMENTS

The following calculations and analyses will be performed during final design or during the construction of the facility as indicated below.

9.14.1 Load Analysis

A load analysis will be prepared during final design to help plan the power distribution system. Major loads, including the estimated values of connected loads and peak running loads will be calculated. Redundant and standby units will be excluded from the total connected load to establish the critical running load requirements.

During final design, the load analysis will be based on an increased level of design detail. Final computations will be based on the actual specified loads shown on the drawings and on best estimates of anticipated demand.

9.14.2 Short-Circuit Analysis and Coordination Study

A preliminary short circuit analysis will be prepared during the final design phase to properly specify the equipment in the power distribution system. A short circuit current calculation along with a protective device analysis (coordination study) will be required to be submitted by the electrical subcontractor during the construction phase. Final short circuit and coordination study documents and data will be provided prior to electrical equipment start-up.

9.14.3 Arc Flash Analysis

During the construction phase of the Project, an arc flash hazard analysis will be specified to be commissioned by the electrical subcontractor. The analysis will cover all pieces of electrical equipment in accordance with OSHA 29 CFR Part 1910, NEC, NFPA 70E, and IEEE 1584. The arc flash analysis will be performed in coordination with the short circuit and coordination studies. Arc flash study results will be used to properly label all electrical equipment as to the severity of the arc flash hazard and the minimum personal protective equipment (PPE) required to perform work on each piece of energized equipment.

Applicable federal and local codes and UL listing requirements will be followed. Exit signs, emergency egress lighting, and emergency lighting power supply will conform to requirements of the local code authority.

10 Instrumentation and Control Design Criteria

This section describes the basis of I&C design for the City of Morro Bay WRF. The project will include a new SCADA System and the latest technology for instrumentation. The design will stress efficient monitoring and control of equipment and process conditions. All of the I&C work will be in accordance with local codes and the criteria outlined in this report.

10.1 CONTROL SYSTEM DESIGN STANDARDS

Instrumentation and Control design will conform to the latest editions of the following applicable standards and codes:

- National Electrical Code (NEC - NFPA 70)
- National Electrical Safety Code (NESC)
- Life Safety Code (NFPA 101 HB)

Standards and codes of the following organizations will also govern, where applicable:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Society of Automation (ISA)
- Insulated Cable Engineers Association (ICEA)
- National Electrical Manufacturers Association (NEMA)
- Occupational Safety and Health Act (OSHA)
- Underwriters Laboratory (UL)

10.2 CONTROL AND MONITORING SYSTEM

The Plant Control System (PCS) consisting of a Supervisory Control and Data Acquisition (SCADA) system and Programmable Logic Controllers (PLC) will monitor and control all process systems, and some auxiliary systems, at the plant. The PCS will utilize a redundant ring fiber optic network to communicate between the Plant PLC and Remote I/O units (RIO) in each building. Within the building, vendor PLCs will communicate with the local RIO via Ethernet protocol over CAT6 cable. Redundant SCADA historians will be located between two firewalls in a Demilitarized Zone (DMZ) to restrict direct data transfers between the PCS and external networks.

The SCADA system will utilize the GE iFix platform and will consist of redundant SCADA servers, historian software, an I/O server, and a SCADA client server. Operators will remotely interact with equipment by interfacing with the SCADA Human Machine Interface (HMI) graphical displays. The graphical displays will represent system processes and will be designed based on design standards listed herein and as shown on the Control Block Diagram in the drawings set. An operator workstation PC with dual monitors running a full SCADA HMI run-time license will be present for operator access to SCADA. An engineering workstation with dual monitors with a full SCADA development will be present for an engineer to manage the SCADA system. The SCADA package

will include additional licenses for SCADA HMI on an operator workstation in the nearby fire station, and tablet/laptop PCs to be carried around the plant. Tablet/laptop PCs will access the SCADA system via wireless access points throughout the plant.

Equipment and instrumentation will be controlled and monitored by a Plant PLC communicating with a series of Remote I/O (RIO) panels located through the plant. PLCs will be based on the Schneider Electric Modicon platform. PLCs, RIOs, and vendor panels will communicate using an Ethernet-based communications protocol. Instrumentation will communicate with PLCs and RIOs using hardwired 4-20 mA dc analog and 24V dc discrete wiring. Discrete outputs from the PLC will utilize relay cards to actuate interposing relays.

10.3 SYSTEM RELIABILITY

The plant will utilize redundancy and backup power to increase system reliability. The plant control network will be a self-healing fiber optic ring allowing continued communication in the event of a fiber break or a network switch failure. Switches will be specified with IEEE 802.1w Rapid Spanning Tree protocol for instantaneous failover. The SCADA system will utilize physically redundant historian and I/O servers so SCADA functionality is not affected in the event of a server failure. In addition to a redundant historian, off-site redundant servers for historian data storage and general file storage will be located at the nearby fire station.

The main plant PLC will redundant processors, communication modules, and power supplies to reduce the possibility of total PLC failure.

In the event of a power loss Uninterruptible Power Supplies (UPS) will provide backup power to the main plant PLC, SCADA servers, and operations computers. The UPSs will be sized to allow for communication to continue during a short power outage of at least 30 minutes, or to properly power down SCADA systems if the outage is expected to last longer than what the UPS backup can supply.

10.4 INSTRUMENTATION

Plant instrumentation is provided to support monitoring and control of the process and equipment systems. Additional instrumentation is provided to alarm abnormal system operation, bending problems, or safety hazard conditions. Where possible, instruments are microprocessor based 'smart' instruments, which can be calibrated and maintained through a digital interface.

Flow Instrumentation: It is currently anticipated that magnetic type flow meters will be utilized for liquid flow measurement in full pipe processes. Magnetic type flow meters are a proven technology widely used in wastewater facilities. Flowmeter technology for open channel processes will be selected based on accuracy for the dimension and flow pattern of the channel; possible options being time-of-flight or open channel ultrasonic level. Thermal mass flow meters will be utilized for air flow measurements.

Level Instrumentation: Level measurement technology for enclosed tanks is expected to be flange-mounted pressure as level transmitters. Enclosed tanks containing harsh chemicals will utilize non-contacting ultrasonic type level instruments. Level measurement technology for basins or holding tanks where foaming is anticipated will be radar type or submersible pressure probe level instruments, while basins with no foaming will utilize ultrasonic type level instruments.

Pressure Instrumentation: Pressure instrumentation will consist of digital pressure transmitters, dial-type gauges, and switches will be provided for monitoring equipment and process variables and to provide equipment protection. Digital pressure transmitters will utilize diaphragms to isolate the pressure element from process fluid. Pressure elements will be mounted to 3-way valve manifolds for calibration, testing, and mounting of dial-type pressure gauges.

Temperature Instrumentation: Temperature instrumentation will consist of dial type gauges, temperature switches, and digital temperature transmitters. All instrumentation will be installed with thermowells. Temperature gauges will be indicating dial type stainless steel bimetal thermometers. Temperature switches will have a field-adjustable trip point and provide a dry contact relay output. Digital temperature transmitters will utilize a Resistance Temperature Detector (RTD) to detect process temperature through a thermowell. The RTD will be measured by a digital temperature transmitter which will relay the temperature to the PCS by a 4-20mA dc output.

Analyzer Instrumentation: Analyzers will be utilized to measure water quality of process fluids. Analyzers are available in a variety of form factors such as offline sample systems, pipe insertion probes, or channel insertion probes. Preferred form factors will be pipe insertion probes or channel insertion probes, but the form factor will ultimately be selected based on accuracy required for the process. All analyzer instruments will be manufactured by the same company where possible.

10.5 CONTROL MODES AND CONTROL BASIS

In general, all process equipment will be operated in one or more of the following modes:

Local Manual: The equipment is manually controlled from a local control station or from the MCC (if no local control station exists).

Local Automatic: The equipment is automatically controlled locally by the packaged equipment PLC or through hardwired interlocking scheme.

Remote Manual: The equipment is controlled manually through the PLC based upon commands issued from an OIT. Such commands are received by the local PLC and converted into physical outputs to the field devices.

Remote Automatic: The equipment is controlled automatically through the PLC based upon measured process parameters, or calculated values received from field devices, or remote PLCs and upon commands and set points issued from an OIT. Such commands, set points, and process values are received by the local PLC. The local PLC will adjust the equipment accordingly, through physical outputs, to meet the process set point. Some equipment may have more than one remote automatic mode of control.

The control mode will be selectable where applicable based on local/off/remote and hand/off/auto switches located at the devices, MCC, and device control panels. Selector switch position feedback will be wired to the PLC, allowing an operator using an HMI to know whether a device is available for remote control from the HMI.

In addition to hardwired equipment safety interlocks and permissives, where such interlocks and permissive signals are monitored by the PCS, the PLC will discontinue the control output to equipment concurrent with the equipment's interruption by the hardwired circuit. Examples include low-water cutoff, pump high discharge pressure, etc.

10.6 CONTROL SYSTEM DESIGN STANDARDS

P&IDs: Preliminary P&ID drawings have been developed for the major processes on this project and are included with this BDR. Drawing format follows standard Black & Veatch drawing procedures. Drawings will be schematic in nature and will not show every fitting or miscellaneous valve. The device tag numbering convention will be based on the ISA standards. Valves smaller than 4-inches will generally not be provided with tag numbers on the drawings, except for valves requiring power and/or control. Pipeline size, process stream, and material will generally be indicated on the P&ID.

Device Tag Numbers and Instrument Loop Numbers: Each major individual process equipment will be assigned an equipment tag number in accordance with the tagging scheme as detailed on the P&ID legend sheets.

10.7 PROCESS CONTROL STRATEGY

The following section presents the Process Control Philosophies for the Project. This will be utilized to generate specification Section 13550 "Software Control Block Descriptions" in detailed design.

Note: Valve, equipment, and instrument tag numbers are in the process of being finalized and may change from what is reflected in this document. Tag numbers will be corrected and current in the Control Descriptions Specification to be submitted in the 60% Submittal.

10.7.1 Influent Flow Monitoring

Two (2) influent flow meters are included in the influent piping upstream of the headworks

10.7.1.1 Associated Equipment and Instrumentation

Wastewater Influent Flowmeter # 1 (Small Main Influent Pipe)	FIT-0040
Wastewater Influent Flowmeter # 2 (Large Main Influent Pipe)	FIT-0041
In-plant Recycles Flowmeter	FIT-0042

10.7.1.2 Flow Calculations

The Morro Bay Wastewater Influent Wastewater Flow is calculated as the sum of the flow readings from the two wastewater influent flowmeters, as shown in Equation (1).

$$Influent\ Wastewater\ Flow, Q_{WW-INF} = Q_{WW-FIT0040} + Q_{WW-FIT0041} \quad (1)$$

The influent wastewater flow ($Q_{WW\text{-}INF}$) will be used to calculate the following:

- Daily Hourly Flows;
- Daily Total Influent Wastewater Volume.

The total influent flow to the treatment processes in the Morro Bay WRF, which includes in-plant recycles, is calculated as shown in Equation (2).

$$Influent\ Total\ Flow, Q_{TOT-INF} = Q_{WW-INF} + Q_{FIT-0042} \quad (2)$$

The *Total-Influent* flow ($Q_{TOT\text{-}INF}$) will be used to calculate the following:

- Daily Total-Influent Hourly Flows;
- Daily Total-Influent Wastewater Volume.

10.7.2 Headworks

Two package headworks systems which include coarse screening, screenings conveyance, grit removal and grit separation/classification are included in the treatment process.

10.7.2.1 Associated Equipment and Instrumentation

Coarse Screen # 1	SCR-0001
Coarse Screen # 1 Differential Level Sensor	SCR1.LDIT-0001
Coarse Screen # 1 Upstream High-High Level	SCR1.LSHH-0007
Coarse Screenings Washer-Compactor # 1	WCMP-0001
Coarse Screen # 2	SCR-0002
Coarse Screen # 2 Differential Level Sensor	SCR2.LDIT-002
Coarse Screen # 2 Upstream High-High Level	SCR2.LSHH-0002
Coarse Screenings Washer-Compactor # 2	WCMP-0002
Grit Basin # 1	GRT-0001
Grit Pump # 1	GRT1.P-0001

Grit Separator/Classifier # 1	GRT1.SC-0001
Grit Basin # 2	GRT-0002
Grit Pump # 2	GRT2.P-002
Grit Separator/Classifier # 2	GRT2.SC-0002

10.7.2.2 Coarse Screening

Local Control Panels are provided by the Coarse Screen System supplier for independent control of each of the coarse screens and associated equipment. Control information provided herein is for information only and is a general description of operating philosophy. This description is subject to change to conform to the system suppliers' standards and typical operating approach.

The coarse screens may be operated in manual or automatic mode as described below. Details of the control are to be determined by the system provider.

- Local Mode. In local manual mode, screen operation can be initiated from the coarse screen local control panel.
- Remote Manual Mode: In remote manual mode, coarse screen operation can be manually initiated and stopped from the plant SCADA.
- Remote Auto Mode: Automatic screen operation is based on differential level and/or time between cleaning events.
  - For differential level control, the water level is measured upstream and downstream of the screens. When a preset differential level is reached, a raking event starts at a preset low speed setpoint. In the event a high-high level is reached, the screen speed will increase to the high speed setpoint. The rake high speed control has an operator adjustable delay timer. Screen operating levels will be common to both screens and adjustable at the SCADA (with manager password).
  - For timer control, a programmable timer is used to initiate raking events. During periods of low flow, the rake may not reach levels high enough to trigger an event. A 24 hour programmable timer can be set to periodically operate the rake to ensure screenings stay fresh.

10.7.2.2.1 Washer Compactor

Washer compactor operation is interlocked with the screen rake.

- Local Mode. The washer compactor operation can be controlled locally using the Forward and Reverse switches.
- Remote Manual Mode: The washer compactor operation can be initiated from the SCADA.
- Remote Auto Mode: In the Auto position, the compactor starts when the screen rake is initiated. The spray water solenoid valves open and the compactor runs forward for a preset time period. Compacted material is discharged into a screenings discharge chute that holds a screenings bag. When full the bag is dropped into the screenings container.

10.7.2.3 Grit Removal

Local Control Panels are provided by the Grit Removal System supplier for independent control of each of grit basin and separator/classifier and associated equipment. Control information provided herein is for information only and is a general description of operating philosophy. This description is subject to change to conform to the system suppliers' standards and typical operating approach.

10.7.2.3.1 Grit Pumps

- Local Manual Mode. The air or water scour valves are operated using the local Open/Close selector switches. To operate the grit pumps manually, the pump will start and run continuously while Hand is selected. To stop the pump, return the selector switch to Off or press and latch the LOS push-button. To operate the dewatering screws manually, select Hand using the local COH selector switch. The dewatering screw will start and run continuously while hand is selected. To stop the screw, return the selector switch to Off or press and latch the LOS push-button. To operate the screw flushing water valves manually, select Hand using the local COH selector switch. The valve is then operated using the local Open/Close selector switch.
- Remote Manual Mode: The grit removal system on Computer -Manual control, select Computer for each of the water scour valves, grit pumps, dewatering screws, and flushing water valves using their respective COH switches. Through SCADA, switch each valve, pump, and screw conveyor to manual and select the desired state, Open-Close for valves and Start-Stop for pumps and dewatering screws.
- Remote Auto Mode: In the Auto position, the grit basin agitator runs continuously. A grit extraction cycle runs periodically to remove grit slurry from the hopper, classify, and dewater it. The grit extraction cycle is initiated based on the volume of treated water or a time interval, both operator adjustable settings. The grit extraction cycle:
  - Water valves open for a set time to fluidize the grit and allow it to be pumped.
  - The grit pumps turn on for an adjustable duration. The auger starts and stops simultaneously with the grit pumps, along with the high pressure spray. The conveyor starts simultaneously with the grit pump and stops after a set time period after the grit pump stops.

10.7.3 Influent Composite Sampler

The composite sampler samples and chills the water used in routine analyses.

10.7.3.1 Associated Equipment and Instrumentation

Influent Composite Sampler	SMPLR-0001

10.7.3.2 Sampling Strategies

- Local Manual Mode: TBD
- Remote Manual Mode: In remote manual mode, the operator may use the sampler SCADA to turn on/off the sampling pump.
- Remote Auto Mode: Automatic sampling operation is based on flow-proportioned composite sampling or time-based composite sampling.

- For flow proportioned composite samples, the sampler pumps a volume proportional to the influent wastewater flowrate at a given time for set uniform time intervals.
- For time-based composite samples, the sampler pumps a uniform volume of sample into a collection vessel at regular time intervals.

10.7.4 Peak Flow Diversion to the SAFE System

10.7.4.1 Associated Equipment and Instrumentation

SAFE Diversion Box Water Level	LIT-0006
BNR-MBR Influent Flowmeter	FIT-0009
BNR-MBR Influent Flow Control Valve	V-0030

10.7.4.2 BNR-MBR Flow Management

The flow to the BNR-MBR Process will be controlled using the BNR-MBR Influent Flow Control Valve (V-0030), the BNR-MBR Influent Flowmeter (FIT-0009), the total influent flow to the treatment process ($Q_{TOT-INF}$) and the BNR-MBR Process Capacity ($Q_{MAX.BNR-MBR}$) using the strategy shown in Table 10-1 below.

Table 10-1. Control Strategy for BNR-MBR Flow Management

MAXIMUM BNR-MBR PROCESS CAPACITY, $Q_{BNR-MBR.MAX}$ =	**1.88 MGD.**
Total Influent Flow to the Treatment Process (QTOT-INF)	BNR-MBR Influent Flow Control Strategy
≤ $Q_{MAX.BNR-MBR}$	$Q_{BNR-MBR.INF} = Q_{TOT-INF}$
> $Q_{MAX.BNR-MBR}$	$Q_{BNR-MBR.INF} = Q_{BNR-MBR.MAX}$

10.7.4.3 Flow Calculations

The BNR-MBR Process Influent Flow ($Q_{BNR-MBR.INF}$) is calculated using the BNR-MBR Influent Flowmeter reading FIT-0009.

The BNR-MBR influent flow ($Q_{BNR-MBR.INF}$) will be used to calculate the following:

- Daily BNR-MBR Hourly Flow Totals;
- Daily Total BNR-MBR Influent Volume.

10.7.4.4 Level in the SAFE Diversion Box

The level in the SAFE diversion box is monitored using LIT-0006 and reported on the SCADA.

10.7.5 Fine Screening

10.7.5.1 Associated Equipment and Instrumentation

Fine Screen # 1	SCR-0003
Fine Screen # 1 Differential Level Sensor	SCR1.LDIT-0003
Fine Screen # 2	SCR-0004
Fine Screen # 2 Differential Level Sensor	SCR1.LDIT-0004
Fine Screenings Conveyer	CNV-XXXX

10.7.5.2 Fine Screens Operation

Local Control Panels are provided by the Fine Screen System supplier for independent control of each of the fine screens and associated equipment. Control information provided herein is for information only and is a general description of operating philosophy. This description is subject to change to conform to the system suppliers' standards and typical operating approach.

The fine screens may be operated in manual or automatic mode as described below. Details of the control are to be determined by the system provider.

- Local Manual Mode.: TBD
- Remote Manual Mode: Local control panel initiates operation of screen drum, washer/compactor, and conveyor. Operators manually select which unit(s) operate and leave them running continuously. Control valve utilizes flow meter to maintain the MBR treatment flow capacity, maximum flow of 1.88 mgd through the fine screens. The valve is controlled directly by the Plant PLC and can be remotely or manually set to a position.
- Remote Auto Mode: Automatic screen operation is based on differential level and/or time.
  - For differential level control, the water level is measured upstream and downstream of each screen. The basket starts to rotate when a preset differential level is exceeded due to screen surface blinding. The rotating screen drum lifts the screenings and drops them into the centrally arranged trough. Screenings removal from the drum is supported by a scraper brush and a spray nozzle bar. Plant recycled water is supplied by a solenoid valves. In the event plant recycled water pressure is low a pressure switch generates an alarm. A screw conveyor in the trough rotates with the drum and transports the screenings through a closed and inclined pipe. The conveying screw transports, dewaters and compacts the screenings, without any odor nuisance, and discharges them into the dumpster. Screened wastewater is combined in a pipeline that discharges to the MBR.
  - For timer control, a programmable timer is used to initiate cleaning events. During periods of low flow the rake may not reach levels high enough to trigger an event. A 24-hour programmable timer can be set to periodically operate the drum to ensure screenings stay fresh.

10.7.5.2.1 Washer/Compactor

Washer compactor operation is interlocked with the drum screen.

10.7.5.2.2 Conveyor

The conveyor is integrated with the washer compactor. A time delay setting maintains the conveyor powered for a set time period after the compactor stops running.

10.7.6 BNR System

10.7.6.1 Associated Equipment and Instrumentation

BNR RAS DeOx Mixer	MXR-0003
BNR Splitter Box pH	AIT-0071
BNR # 1 System	
BNR # 1 Anoxic Zone Mixer	MXR-0001
BNR # 1 Aerobic Zone 1 Dissolved Oxygen	AIR-0068
BNR # 1 Aerobic Zone 1 Air Flow Meter	FIT-0067
BNR # 1 Aerobic Zone 1 Air Flow Control Valve	V-0046
BNR # 1 Aerobic Zone 2 Dissolved Oxygen	AIT-0073
BNR # 1 Aerobic Zone 2 Air Flow Meter	FIT-0070
BNR # 1 Aerobic Zone 2 Air Flow Control Valve	V-0047
BNR # 1 Aerobic Zone 2 MLSS	AIR-0075
BNR # 1 Aerobic Zone 2 Ammonia-N	AIT-0076
BNR # 1 Surface Wasting Valve	V-XXXX
BNR # 1 MBR Feed Pump	P-XXXX
BNR # 1 MBR Feed Pump Flowmeter	FIT-XXXX

BNR # 2 System	
BNR # 2 Anoxic Zone Mixer	MXR-0002
BNR # 2 Aerobic Zone 1 Dissolved Oxygen	AIR-0068
BNR # 2 Aerobic Zone 1 Air Flow Meter	FIT-0067
BNR # 2 Aerobic Zone 1 Air Flow Control Valve	V-0046
BNR # 2Aerobic Zone 2 Dissolved Oxygen	AIT-0073
BNR # 2 Aerobic Zone 2 Air Flow Meter	FIT-0070
BNR # 2 Aerobic Zone 2 Air Flow Control Valve	V-0047
BNR # 2 Aerobic Zone 2 MLSS	AIR-0075
BNR # 2 Aerobic Zone 2 Ammonia-N	AIT-0076
BNR # 2 Surface Wasting Valve	V-XXXX
BNR # 2 MBR Feed Pump	P-XXXX
BNR # 2 MBR Feed Pump Flowmeter	FIT-XXXX
RAS Suspended Solids Meter	AIT-XXXX
BNR Surface Wasting Flowmeter	FIT-XXXX
BNR WAS Flowmeter	FIT-XXXX
BNR WAS Wetwell Level Transmitter	LIT-XXXX
BNR WAS Wetwell High-High Level Switch	LSHH-XXXX
BNR WAS / Surface Waste Pump # 1	P-0001
BNR WAS Pump # 2	P-0002

10.7.6.2 BNR System Mixers

The mixers can be operated in Manual or Remote modes as described below. The mixer shall stop in any mode upon moisture detection or motor winding high temperature. The mixer status is displayed at the SCADA.

- Manual Mode.
  - Start/stop is provided by a selector switch at the Mixer. In local mode, the mixer runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The Mixers can be started/stopped from the SCADA.
- Remote Auto Mode:
  - The mixer on/off is controlled from the SCADA.

- When in in auto mode, the mixer can be controlled using operator adjustable set-points for the interval between mixer operation and duration of mixer operation.

10.7.6.3 BNR System Supplemental Alkalinity Addition

Alkalinity (sodium hydroxide) is dosed following fine screening based on an operator adjustable pH target and the measured pH in the BNR splitter box.

- Local Manual Mode. Not applicable
- Remote Manual Mode: The dosing pump on/off and operator adjustable speed are controlled on the HMI.
- Remote Auto Mode: When in auto mode, process control is used to maintain the pH in the BNR aerobic zone at an operator adjustable acceptable setpoint.

10.7.6.4 BNR Aeration Control

Aeration Control can be achieved using Local or Remote modes as described below. Local Manual and Remote Manual modes is primarily designed for troubleshooting and valve evaluation operations.

- Local Manual Mode. In local mode, the valves controlling each aeration grid are operated using open-close-stop switches mounted on the valves actuators.
- Remote Manual Mode: In remote manual mode, the valve position can be controlled from the SCADA.
- Remote Auto Mode: In remote-auto mode, two air flow control modes are available. The aeration control mode can be selected by the operator from the SCADA. The air flow control valve to each drop-leg will be controlled based on the operator selected DO control mode.
  - Fixed DO control mode
    - Feedback process control maintains a continuous, uniform DO setpoint in each aerobic zone. The DO setpoint is operator adjustable at the HMI.
    - DO Set points for Aerobic Zones 1 and 2 in each BNR System are:
      - AX.SWING (i.e., DO = 0) or
      - A value in the range of $DO_{AE\text{-}MIN}$ and $DO_{AE\text{-}MAX}$, indicated in Table 10-2.

Table 10-2. Min and Max Aerobic Zone DO Set Points in Fixed DO Control Mode

Min Operator Selectable DO Set Point	$DO_{FDO.AE\text{-}MIN}$	0.2 mg/L
Max. Operator Selectable DO Set Point	$DO_{FDO.AE\text{-}MAX}$	1.5 mg/L

    - When AX.SWING mode operation is selected (i.e., DO Set point = 0). The aeration is turned on intermittently based on the operator adjustable timer setpoints indicated in Table 10-3. In this mode, the air flow will be the minimum air flowrate.

Table 10-3. Operator Adjustable Intermittent Aeration in AX.SWING Mode

Interval between aeration events	$T_{AIR\text{-}BUMP.INT}$	30 – 360 min

Duration of aeration event	$T_{AIR-BUMP.ON}$	1 – 5 min

- Integrated DO-Ammonia control mode.
  - Feedback process control maintains an operator-adjustable (with password) ammonia setpoint in aerobic zone 2 of each BNR System through cascaded control of the DO setpoint and valve position. The ammonia and DO setpoints have firm acceptable ranges.
  - The Integrated DO-Ammonia control strategy is summarized in Table 10-4. All the variables and ranges noted in Table XX are operator adjustable (ONLY with a password). Default values will be pre-programmed as part of the startup and commissioning process.

Table 10-4. Integrated DO-Ammonia Control Strategy and Setpoints

Zone 2 NH_x-N	Zone 1 DO Set Point	Zone 2 DO Set Point
≤ $NHxN_{LSP}$ (anticipated range: 5.0 – 6.0 mg-N/L)	AX.SWING	$DO_{Z2\_NHXN.LSP}$ (anticipated range: 0.2 – 0.4 mg/L)
> $NHxN_{HSP}$ ($NHxN_{LSP}$ + ΔNHxNControl) (anticipated ΔNHxNControl = 0.2 mg-N/L	$DO_{Z1\_NHXN.HSP}$ (anticipated range: 0.2 – 0.3 mg/L)	$DO_{Z2\_NHXN.HSP}$ (anticipated range: 0.2 – 0.5 mg/L)

- The following apply to ALL Modes:
  - A minimum and maximum total airflow is maintained. These limits are required to keep the blowers in their operating range through seasonal variations. The minimum and maximum air flow for each blower shall be operator adjustable (with password) at the SCADA, initially set at 60% and 100% respectively of each blower's capacity.
  - While control is inhibited, all controller resets shall be inhibited to prevent reset windup.
  - If at minimum airflow for greater than an operator entered setpoint time, the airflow setpoint from the PIDs above shall be overridden and the airflow shall be set at the mixing air flow for an operator entered setpoint time.
  - While the lag blower is starting or stopping, the position of the air flow control valves shall be maintained until an adjustable time following startup or shut-down of the lag blower.

10.7.6.5 MBR Feed Pumps and RAS Management

Management of the MBR feed pumps and RAS system is described in Section 10.7.8.

10.7.6.6 SRT and Wasting Management

SRT management in the BNR-MBR system is affected through controlled WAS wasting (from the RAS piping) and Mixed Liquor Surface Wasting (from the BNR tanks). These systems are described here. Note that in accordance with expressed operator preferences, no automated SRT control is incorporated.

10.7.6.6.1 WAS Wasting from RAS

- Local Manual Mode. The WAS Pump No. 2 may be manually controlled at the pump.
- Remote Manual Mode: In remote manual mode, the WAS Pump can be controlled at the SCADA.
- Remote Auto Mode: Two WAS wasting control modes are available. The mode of operation is operator adjustable at the SCADA.
  - Fixed WAS Flow Set Point
    - Feedback process control maintains a continuous, uniform WAS flowrate.
  - Daily WAS Volume Set Point
    - Feedback process control determines the required WAS flowrate to achieve the operator target 24-hour wasting volume.
- The flow and daily total volume of WAS is monitored and recorded.

10.7.6.6.2 Mixed Liquor Surface Wasting

- Local Manual Mode. TBD.
- Remote Manual Mode: The surface wasting valve for each BNR system can be operated from the SCADA.
- Remote Auto Mode: In auto mode, ***the*** surface wasting valve in each BNR system is operated intermittently based on the operator adjustable timer setpoints indicated in Table 10-5. Default values will be pre-programmed as part of startup/commissioning.

Table 10-5. Operator adjustable surface wasting operation

Interval between surface wasting events	$T_{SURFWAS.INT}$	30 – 360 min
Duration of surface wasting	$T_{SURFWAS.ON}$	1 – 5 min

- If the high-high level is reached in the WAS / Scum wetwell, the surface wasting valve schedule is ignored (i.e., additional wasting does not occur) until the high-high level signal is eliminated.

The flow and daily total volume of mixed liquor wasted from both BNR systems is monitored and recorded.

10.7.6.7 Monitoring the BNR Systems

The data shown in Table 10-6 will be continuously monitored and recorded at the SCADA for each BNR System.

Table 10-6. BNR System Monitoring Data at the SCADA

SUBSYSTEM	PARAMETER(S)	STATISTICS PROVIDED
BNR Splitter Box	pH	▪ Daily 15-min MIN, Hourly Min ▪ Daily Average, ▪ Daily 15-min MAX, Hourly Max

SUBSYSTEM	PARAMETER(S)	STATISTICS PROVIDED
BNR Systems 1 & 2	Status	▪ Operational/ ▪ Not Operational
	Inventory (also total system Inventory)	▪ Current Value (using 15-min avg. MLSS) ▪ Daily Average (calculated) ▪ 3-day Rolling Average ▪ 7-day Rolling Average
Zone 1	DO	▪ Current Value (15-min rolling avg.) ▪ Daily 15-min MIN, Hourly Min ▪ Daily Average, ▪ Daily 15-min MAX, Hourly Max
Zone 2	DO, MLSS, NHx-N	▪ Current Value (15-min rolling avg.) ▪ Daily 15-min MIN, Daily Average, ▪ Daily 15-min MAX, Hourly Max
RAS	Status	▪ RAS Mode
	Flow, RAS.SS	▪ Current Value (15-min rolling avg.) ▪ Daily 15-min MIN, Hourly Min ▪ Daily Average, ▪ Daily 15-min MAX, Hourly Max
WAS	Status	▪ Wasting Mode & related Set Points
	Flow, Inventory	▪ Current Value ▪ Daily 15-min MIN, Hourly Min ▪ Daily Average, ▪ Daily 15-min MAX, Hourly Max

10.7.7 BNR Process Aeration Blower Control

10.7.7.1 Associated Equipment and Instrumentation

Process Air Blower # 1	BL-0001
Process Air Blower # 2	BL-0002
Process Air Blower # 3	BL-0003
Process Aeration Header Pressure	PIT-XXXX

10.7.7.2 Blower Control

In all control modes, the blower shall be hardwired interlocked to not start against a closed discharge valve and shall shutdown on high temperature or high discharge pressure.

- Local Manual Mode.
  - The blower on/off is controlled from the blower LCP.
  - Once the START button is pushed, the blower shall run continuously until the STOP button is pushed.
  - The blower speed is adjustable from the VFD.
- Remote Manual Mode.
  - The blower ON/OFF can be controlled from the SCADA using operator manual commands.
  - Blower speed shall be adjusted based on the speed input entered at the SCADA.
- Remote Auto Mode.
  - The blower is controlled by a PI type control function to maintain a pressure control setpoint in the process aeration header. The pressure set point will be operator adjustable (with a password). A default value will be pre-programmed during startup/commissioning.
  - A most open valve (MOV) algorithm is employed that selects the most open valve which is used to control the adjustment (see items 4 and 5 below) of the process aeration header pressure setpoint (see item 1 below).
    1. The lead blower runs continuously with the speed controlled by a pressure controller, to maintain a pressure setpoint.
    2. As demand increases and total air flow demand remains at the maximum for an operator-adjustable time period, a lag blower starts. Once running, the lead and lag blowers modulate together to maintain the setpoint discharge header pressure.
    3. The blower speed modulates to control header pressure to maintain the setpoint. When the total air flow demand falls below the capacity of the lead blower for an adjustable period of time, the lag blower shutdown is initiated. Once the lag blower has shut down, the speed of the lead blower is controlled to maintain the setpoint pressure.
    4. If the position of the most open basin air flow control valve exceeds an operator entered maximum position, the setpoint header pressure increases 0.1 PSI. This requires the air flow control valve to travel toward the closed position to maintain the setpoint airflow. The system stabilizes for an operator adjustable time period. If the valve remains above the maximum setpoint position, another increase of 0.1 PSI to the air pressure setpoint is made.
    5. If the position of the most open air flow control valve becomes less than the operator entered minimum position, the setpoint header pressure decreases 0.1 PSI. This requires the air flow control valve to travel toward the open position to maintain the setpoint airflow. The system stabilizes for an operator adjustable time period. If the valve remains at a position less than the minimum position, another decrease of 0.1 PSI to the air pressure setpoint is made.

10.7.8 MBR System

10.7.8.1 Associated Equipment and Instrumentation

BNR # 1 MBR Feed Pump	P-XXXX
BNR # 2 MBR Feed Pump	P-XXXX
MBR Basin # 1	
MBR Basin # 1 Isolation Valve	V-XXXX
MBR Basin # 1 Drain Isolation Valve	V-XXXX
MBR Basin # 1 Level	LIT-XXXX
MBR Basin # 1 Low-Low Level Switch	LSLL-XXXX
MBR Basin # 1 High-High Level Switch	LSHH-XXXX
MBR Basin # 1 Sodium Hypochlorite Isolation Valve	V-XXXX
MBR Basin # 1 Citric Acid Isolation Valve	V-XXXX
MBR Basin # 1 Scour Air Isolation Valve	V-0067
MBR Basin # 1 Filtrate Pump	P-0003
MBR Basin # 1 Filtrate Flowmeter	FIT-0097
MBR Basin # 1 Filtrate Turbidity	AIT-0098
MBR Basin # 1 RAS Channel Level	LIT-XXXX
MBR Basin # 1 RAS Channel Level Control Valve	V-XXXX
MBR Basin # 1 RAS Flowmeter	FIT-XXXX
MBR Basin # 2	
MBR Basin # 2 Isolation Valve	V-XXXX
MBR Basin # 2 Drain Isolation Valve	V-XXXX
MBR Basin # 2 Level	LIT-XXXX
MBR Basin # 2 Low-Low Level Switch	LSLL-XXXX
MBR Basin # 2 High-High Level Switch	LSHH-XXXX
MBR Basin # 2 Sodium Hypochlorite Isolation Valve	V-XXXX

MBR Basin # 2 Citric Acid Isolation Valve	V-XXXX
MBR Basin # 2 Scour Air Isolation Valve	V-0067
MBR Basin # 2 Filtrate Pump	P-0003
MBR Basin # 2 Filtrate Flowmeter	FIT-0097
MBR Basin # 2 Filtrate Turbidity	AIT-0098
MBR Basin # 2 RAS Channel Level	LIT-XXXX
MBR Basin # 2 RAS Channel Level Control Valve	V-XXXX
MBR Basin # 2 RAS Flowmeter	FIT-XXXX
BNR-MBR System Drain Pump	P-0008
BNR-MBR System Drain Pump Flowmeter	FIT-0126
MBR Filtrate Ammonia-Nitrogen	AIT-0120
MBR Filtrate Turbidity	AIT-0121
MBR System Air Scour Blower # 1	BL-0001
MBR System Air Scour Blower # 2	BL-0002
MBR System Air Scour Flowmeter	FIT-0033
MBR System Air Scour Header Pressure	PIT-0034

10.7.8.2 MBR System Control Overview

The MBR System will be managed by the MBR System Suppliers standard controls and logic. Control information provided herein is for information only and is a general description of the operating strategy of the system. This description is subject to change to conform to the MBR system suppliers' standards and typical operating approach. The MBR System Controls will manage the following sub-systems:

- MBR Basin Operation Management;
- MBR Feed Pumps;
- MBR Filtrate Pumps;
- MBR Air Scour; and
- MBR Cleaning (maintenance and recovery) Operations.

10.7.8.3 MBR System Basin Operation Management

The number of MBR Basins in Operation will be determined based on the following inputs:

- BNR-MBR System influent flow which is measured using FIT-0009 (c.f., Section 10.7.4 above);
- The operational limits placed on the Membrane Cassettes by the Membrane System Supplier (e.g., Transmembrane Pressure, Operating Flux). This is determined and set by the Membrane System Supplier;
- Mechanical and System constraints of equipment (e.g., minimum pump flowrates).

An overview of the MBR Basin Operation Management strategy applicable to Morro Bay WRF is shown in Figure 10-1.

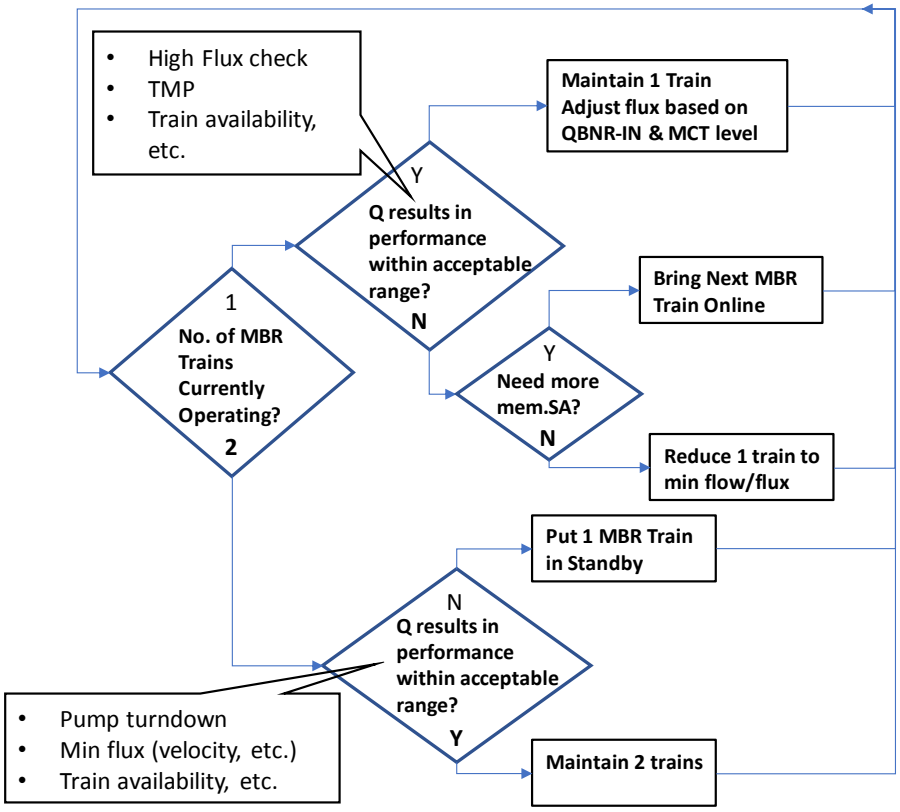

Figure 10-1. Overview of MBR System Basin Operation Management

10.7.8.4 MBR Feed Pumps Control

MBR Feed Pumps can be operated in Local and Remote modes as described below. Local and Remote-Manual modes are primarily for equipment verification and testing. The normal control mode is Remote-Auto mode managed by the MBR System PLC.

- Local Manual Mode.
  - The MBR Feed Pump can be Started and Stopped using the Local Control Station in the field.
  - The pump speed is managed from the VFD.

- The pump runs continuously until the STOP button is pushed or hard-interlocks result in the pump being stopped (e.g., low level in the MBR Feed Channel).

- Remote Manual Mode:
  - In remote manual mode, the pump operation and speed are controlled from the SCADA.
- Remote Auto Mode:
  - The MBR Feed Pumps are controlled to maintain a target level flow into each MBR basin and trimmed based on the level in the MBR Tanks.

10.7.8.5 MBR Filtrate Pumps Control

MBR Filtrate Pumps can be operated in Local and Remote modes as described below. Local and Remote-Manual modes are primarily for equipment verification and testing. The normal control mode is Remote-Auto mode managed by the MBR System PLC.

- Local Manual Mode.
  - The MBR Filtrate Pump can be started and stopped using the Local Control Station in the field.
  - The pump speed is managed from the VFD.
  - The pump runs continuously until the STOP button is pushed or hard-interlocks result in the pump being stopped (e.g., low level in the MBR Basin).
- Remote Manual Mode:
  - In remote manual mode, the pump operation (ON/OFF and Direction) and speed are controlled from the SCADA.
- Remote Auto Mode:
  - In Remote-Auto mode, the total filtrate flow is determined based on the BNR-MBR System influent flow which is measured using FIT-0009 (c.f., Section 10.7.4 above) using Equation (3).
  - The Filtrate to Influent Factor (FtoI_Factor) shown in Equation (3) is an operator adjustable (with password) flow correction factor (0.00 to 1.00, typical value in the range of 0.98 – 1.00) which allows the operations staff to set a target flow relative to the flow into the BNR-MBR system. The initial and typical value for this factor will be pre-programmed during startup/commissioning.
  - The Filtrate Flow per MBR basin in operation is calculated as shown in Equation (4).

$$Total\ MBR\ Filtrate\ Flow\ Set\ Point, Q_{MBR.FILT-TOT} = Q_{FIT-009} * FtoI\_Factor \quad (3)$$

$$MBR\ Basin\ Filtrate\ Flow\ Set\ Point, Q_{MBR.FILT-BASIN} = \frac{Q_{MBR.FILT-TOT}}{N_{MBR-BASINS}} \quad (4)$$

10.7.8.6 MBR Air Scour

MBR Air Scour Blowers can be operated in Local and Remote modes as described below. Local and Remote-Manual modes are primarily for equipment verification and testing. The normal control mode is Remote-Auto mode managed by the MBR System PLC.

- Local Mode. The electrically controlled wasting valve may be opened using the switch located on the actuator and the blowers are operated at the Blower LCP.
- Remote Manual Mode:
  - In remote manual mode, the air scour valves and blower can be operated from the SCADA.
- Remote Auto Mode:
  - In Remote-Auto mode (which is the typical mode of operation) – the MBR Air Scour Function is managed by the MBR System Supplier based on the Suppliers' Specific scouring algorithm.

10.7.8.7 Membrane Cleaning System

MBR Cleaning cycles are manually initiated by the operator from the SCADA and controlled by the MBR System control

10.7.8.8 RAS Channel Level Control

The sludge level in the MBR RAS channel is managed at a pre-programmed level to minimize the drop over the RAS Weir from the Membrane Basins.

The RAS Flow from each basin is monitored and recorded on the SCADA.

10.7.9 Outfall Pumping and Disinfection

10.7.9.1 Associated Equipment and Instrumentation

Outfall Balancing Tank Level	LIT-0002
Outfall Balancing Tank High Level	LSH-XXXX
Outfall Balancing Tank High-High Level	LSHH-XXXX
Outfall Pump # 1	P-0001
Outfall Pump # 2	P-0002
Outfall Pump # 3	P-0003
Outfall Pump #4	P-0004
Outfall Pumping System Flow	FIT-0007
Ocean Outfall Residual Chlorine	AIT-0008
Sodium Hypochlorite Metering Pump # 1 (for Ocean Outfall Disinfection)	P-XXXX
Sodium Hypochlorite Metering Pump # 2 (for RO Concentrate Disinfection)	P-XXXX
Sodium Bisulfite Metering Pump	P-XXXX

10.7.9.2 Outfall Pumps Operation

The Outfall Pumps can be operated in Local Manual or Remote modes as described below. The pumps shall stop in any mode upon moisture detection or motor winding high temperature or LOW-LOW level in the Outfall Balancing Tank. The pump status is displayed at the SCADA.

- Local Manual Mode.
  - Start/stop is provided by a selector switch at the Pumps.
  - In local mode, the pump runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The Outfall pumps can be operated from the SCADA.
- Remote Auto Mode:
  - The Outfall Pumps are controlled based on the level in the Outfall Balancing Tank.
  - In the event of a high-high level, the pumps will be operated continuously until the low-level set point is achieved.

10.7.9.3 Flow Calculations

The Morro Bay Wastewater Ocean Discharge Effluent Flow is calculated as the sum of the flows measured using the Outfall Pumping System Flowmeter (FIT-0007) and the RO Concentrate Flowmeters (c.f., Section 10.7.11) The Ocean Discharge Effluent Flow ($Q_{OC.DISCH}$) will be used to calculate the following:

- Daily Hourly Ocean Discharge Flows; and
- Daily Total Ocean Discharge Volume.

10.7.9.4 Pumped Flow Disinfection

The pumped flow is disinfected using sodium hypochlorite fed using the sodium hypochlorite dosing pumps. The pumps can be operated in Local and Remote modes as noted below.

- Local Manual Mode.
  - Start/stop is provided by a selector switch at the Pump.
  - In local mode, the pump runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The sodium hypochlorite feed pump can be operated from the SCADA.
- Remote Auto Mode:
  - The sodium hypochlorite pump for disinfection of the pumped flow to the ocean outfall is controlled to achieve a target operator adjustable (with password) sodium hypochlorite dose ($D_{NaOCl\_POutfall}$).

- The sodium hypochlorite feed flow is calculated as shown in Equation 5. The Unit/Formula correction factors integrate the sodium hypochlorite solution strength (C_{NaOCl_STOCK}) and unit conversion factors to get a calculated target NaOCl in gallons per minute.

$$NaOCl\ Flow\ for\ pumped\ outfall\ flow, Q_{NaOCl,P\_Outfall} = Q_{FIT-007} * D_{NaOCl\_POutfall} * Unit/Formula\ Correction\ Factors \quad (5)$$

10.7.9.5 RO Concentrate Flow Disinfection

The RO concentrate flow is disinfected using sodium hypochlorite dosing pumps. The pumps can be operated in Local and Remote modes as noted below.

- Local Manual Mode.
  - Start/stop is provided by a selector switch at the Pump.
  - In local mode, the pump runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The sodium hypochlorite feed pump can be operated from the SCADA.
- Remote Auto Mode:
  - The sodium hypochlorite pumps are controlled to achieve a target operator adjustable (with password) sodium hypochlorite dose (D_{NaOCl_ROConc}).
  - The sodium hypochlorite feed flow is calculated as shown in Equation 6. The Unit/Formula correction factors integrate the sodium hypochlorite solution strength (C_{NaOCl_STOCK}) and unit conversion factors to get a calculated target NaOCl in gallons per minute.

$$NaOCl\ Flow\ for\ pumped\ outfall\ flow, Q_{NaOCl,ROConc} = (Q_{FIT-0081} + Q_{FIT-0091} + Q_{FIT-0101}) * D_{NaOCl\_ROConc} * Unit/Formula\ Correction\ Factors \quad (6)$$

10.7.9.6 Ocean Outfall Flow Dechlorination

The flow directed to the ocean outfall is dechlorinated using sodium bisulfite fed using the sodium bisulfite dosing pumps. The pumps can be operated in Local and Remote modes as noted below.

- Local Manual Mode.
  - Start/stop is provided by a selector switch at the Pump.
  - In local mode, the pump runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The sodium bisulfite feed pump can be operated from the SCADA.
- Remote Auto Mode:

- The sodium bisulfite pumps are controlled using a feedback control strategy based on a target operator adjustable (with password) bisulfite to residual chlorine ratio ($R_{NaBis\_ResidCl}$) and the chlorine residual measured using AIT-0008.
- The sodium bisulfite feed flow is calculated as shown in Equation 7. The Unit/Formula correction factors integrate the sodium bisulfite solution strength (C_{NaBis_STOCK}) and unit conversion factors to get a calculated target $NaHSO_4$ in gallons per minute.

$$NaHSO_4\ Flow\ for\ pumped\ outfall\ flow, Q_{NaBis} = (Q_{FIT-0007} + Q_{FIT-0081} + Q_{FIT-0091} + Q_{FIT-0101}) * C_{Cl-AIT0008} * R_{NaBis\_ResidCl} * Unit/Formula\ Correction\ Factors \quad (7)$$

10.7.10 Effluent Composite Sampler

The composite sampler samples and chills the water used in routine analyses.

10.7.10.1 Associated Equipment and Instrumentation

Effluent Composite Sampler	SMPLR-XXXX

10.7.10.2 Sampling Strategies

- Local Manual Mode.
- Remote Manual Mode: In remote manual mode, the operator may use the sampler SCADA to turn on/off the sampling pump.
- Remote Auto Mode: Automatic sampling operation is based on flow-proportioned composite sampling or time-based composite sampling.
  - For flow proportioned composite samples, the sampler pumps a volume proportional to the influent wastewater flowrate at a given time for set uniform time intervals.
  - For time-based composite samples, the sampler pumps a uniform volume of sample into a collection vessel at regular time intervals.

10.7.11 RO System

10.7.11.1 Associated Equipment and Instrumentation

RO Feed Tank # 1 Level	LIT-0132
RO Feed Tank # 1 Low-Low Level	LSLL-0135
RO Feed Tank # 1 High-High Level	LSHH-0134
RO Feed Tank # 2 Level	LIT-0136
RO Feed Tank # 2 Low-Low Level	LSLL-0139
RO Feed Tank # 2 High-High Level	LSHH-0138
RO Feed Conductivity	AIT-0012
RO Feed Turbidity	AIT-0014

RO Feed Oxidation-Reduction Potential	AIT-0016
RO Feed Free Chlorine	AIT-0018
RO Feed Monochloramine / Ammonia	AIT-0020
RO Feed pH	AIT-0022
RO System # 1	
RO Feed Pump # 1	P-0005
RO Cartridge Filter # 1	FLC-0001
RO Unit # 1 Feed Valve	V-0086
RO Unit # 1 Booster Pump	P-0008
RO Unit # 1 Stage 1 Conductivity	AIT-0045
RO Unit # 1 Stage 2 Conductivity	AIT-0052
RO Unit # 1 Permeate Conductivity	AIT-0078
RO Unit # 1 Permeate Flow	FIT-0077
RO Unit # 1 Permeate to AOP Valve	V-0190
RO Unit # 1 Permeate to Outfall Valve	V-0189
RO Unit # 1 Concentrate Flow	FIT-0081
RO Unit # 1 Concentrate Conductivity	AIT-0082
RO System # 2	
RO Feed Pump # 2	P-0006
RO Cartridge Filter # 2	FLC-0002
RO Unit # 2 Feed Valve	V-0117
RO Unit # 2 Booster Pump	P-0009
RO Unit # 2 Stage 1 Conductivity	AIT-0056
RO Unit # 2 Stage 2 Conductivity	AIT-0062
RO Unit # 2 Permeate Conductivity	AIT-0088
RO Unit # 2 Permeate Flow	FIT-0087
RO Unit # 2 Permeate to AOP Valve	V-0216
RO Unit # 2 Permeate to Outfall Valve	V-0189
RO Unit # 2 Concentrate Flow	FIT-0091
RO Unit # 2 Concentrate Conductivity	AIT-0092

RO System # 3	
RO Feed Pump # 3	P-0007
RO Cartridge Filter # 3	FLC-0003
RO Unit # 3 Feed Valve	V-00148
RO Unit # 3 Booster Pump	P-0010
RO Unit # 3 Stage 1 Conductivity	AIT-0066
RO Unit # 3 Stage 2 Conductivity	AIT-0072
RO Unit # 3 Permeate Conductivity	AIT-0098
RO Unit # 3 Permeate Flow	FIT-0097
RO Unit # 3 Permeate to AOP Valve	V-0240
RO Unit # 3 Permeate to Outfall Valve	V-0189
RO Unit # 3 Concentrate Flow	FIT-0101
RO Unit # 3 Concentrate Conductivity	AIT-0102

10.7.11.2 RO System Control Overview

The RO System will be controlled by the RO System Suppliers standard controls and logic. Control information provided herein is for information only and is a general description of the operating strategy of the system. This description is subject to change to conform to the RO system suppliers' standards and typical operating approach. The RO System Controls will manage the following sub-systems:

- RO Feed Tanks System;
- RO High Pressure Feed Pumps;
- Cartridge Filters;
- RO Units;
- CIP Makeup and Neutralization Systems;
- RO Flush System

10.7.11.3 RO Feed System

The MBR permeate pumps discharge to the two RO feed tanks. The tank levels are measured, displayed locally and transmitted to PLC. The tank has switches that are used to activate the High-High (HH) and Low-Low (LL) Levels. RO feed pumps will convey water from the RO feed tanks through the cartridge filters and through the RO membranes. RO pretreatment chemicals including: sodium hypochlorite and antiscalant are added to the RO feed supply line. A locally mounted flow meter measures, displays and transmits to PLC. After chemical has been added a sample pump pulls a portion of the flow from the feed line and discharges it to the RO Feed

Analytical Panel where conductivity, turbidity, ORP, free chlorine, pH, ammonia, and monochloramine are measured, displayed and transmitted to the PLC.

10.7.11.4 RO Unit Operation

10.7.11.4.1 Number/Selection of RO Units in Operation

The RO system consists of three RO Units which are independently operated and controlled. RO Units will be started and stopped based on preset trigger levels in the RO feed tanks. At a given time, 0, 1, 2, or 3 RO units will be called into service operation. RO units will be called into and out of service based on the following conditions.

- @ HH Tank Level (W ft) all three RO units will operate.
- @ Midway Tank Level (X ft) two RO units will operate.
- @ Low Tank Level (Y ft) one RO unit will operate
- @ LL Tank Level (Z) zero RO units will operate

The RO unit with lowest runtime will be called into service when required.

10.7.11.4.2 RO Feed Pump Control

The RO high pressure pumps will be used to convey water from the RO feed tanks through the cartridge filter to the RO units. The RO high pressure feed pumps (with VFD) shall be controlled to achieve a permeate flow set point of that RO unit (sum of the permeate flow from each stage of the RO unit). One feed pump is dedicated to Stage 1 of each RO unit. The RO units shall automatically be brought into and out of service as described above. Concentrate control valves shall be controlled to achieve a set flow rate based on the target recovery of that unit. A booster pump is used to increase second stage feed flow to balance the flux between first stage and second stage by controlling the permeate flow of the first stage. Pressure is measured on the RO permeate (ROP) and RO concentrate (ROC). Conductivity is measured on the ROP of each stage, displayed locally and transmitted to PLC. The ROP flow rate is measured locally displayed and transmitted to PLC. Pressure is monitored locally, displayed and transmitted to PLC.

ROP pressure is monitored, displayed locally and transmitted to the PLC. In the event of high pressure, a pressure switch generates an alarm at the PLC and the RO system is shut down. A flow meter measures, displays and transmits the RO Unit ROP to PLC. ROP outlet piping three locations. During a normal operation ROP is directed to the UV system for disinfection/advanced oxidation through a flow control valve. Valve controls are set locally. In Local valve position is set using the Open and Close selector switch; in Remote control is passed to the PLC that controls the RO System. Flow not directed to the UV system is a split between the Outfall Pump Station (OPS) and the RO CIP System. Note that RO train ROP to the outfall is combined in a single line to the OPS.

10.7.11.4.3 RO Sequencing

10.7.11.4.3.1 Pre-Operative Feed Water RO Unit Bypass

A pre-operative bypass shall be executed when the first unit is brought into service with all other units remaining offline. During this procedure flow shall bypass all the RO units, allowing feed

water parameters to stabilize at a set point and chemical flows to stabilize before feed water is admitted to the membranes.

10.7.11.4.3.2 Post-Operative Feed Water RO Unit Flush

An automatic post-operative feed water flush cycle which shall be initiated automatically upon shutdown of the plant, unless the Operator selected no feed flush option. The purpose of the post-operative feed water flush cycle is to ensure that concentrate is flushed from the membranes to prevent fouling of the membranes, corrosion and scale accumulation.

10.7.11.4.3.3 Post-Operative Permeate Water RO Unit Flush

The membrane flush system is used to remove salt and scale buildup at the RO membrane surface that normally occurs during the membrane permeation process upon normal shutdown of the RO train. By flushing the membranes with RO permeate, any concentrated salts are washed from the membranes, minimizing possible scaling during system shutdown time periods. The flushing system is automatically energized during the normal RO system shutdown cycle or can be manually started by the facility operator.

10.7.11.4.4 RO Flushing System

A portion of the ROP is directed to the RO Flush Tank for use in flushing the membranes. An automatic valve is located on the flushing feed to admit permeate when the tank is low. Valve open and close can be set at the PLC.

The tank level is measured, displayed locally and transmitted to PLC. The tank has switches that are used to activate the High-High and Low-Low Levels.

The tank supplies the RO flush pumps which discharge the ROP through the cartridge filer and then through the RO system. . Pump controls are set locally. In the On position the pump runs continuously; in the Off position the pumps does not run. Pump duty selection (duty, standby, or out of service) and pump start and stop levels are set from the configuration screen. In the event the Duty pump fails the Standby pump runs. When a pump is selected as out of service the pump is taken out of the control loop. The Duty pump starts at a preset low tank level and stops when the high level setpoint is reached. Discharge pressure is shown locally on the pump discharge. Pressure is monitored on the cartridge filter supply and is displayed locally and transmitted to PLC.

10.7.11.4.5 RO CIP Makeup Tank

RO CIP solution is formulated in the RO CIP Makeup Tank. High pH and low pH cleaning solutions are prepared using sodium hydroxide and citric acid, respectively. Make up water is provided from the RO permeate header. The ROP line includes a flow meter and flow control valve to measure the makeup water volume added to the tank. The tank includes a site gauge to determine CIP level, a LL switch and a high HL. On low level an alarm is generated to notify the Operator. The HL switch signals that an overflow event is imminent.

The CIP Pumps draw from either of the CIP Makeup Tanks and discharge flow through CIP cartridge filters to the RO membrane elements. The majority of the CIP solution is recycled through the ROC piping back to the CIP Make up tank. A small portion of the CIP solution passes through the membranes and is returned to the CIP Makeup Tank.

10.7.11.4.6 RO Neutralization Tank

The Neutralization Tank is used to neutralize spent CIP cleaning solutions prior to discharge. The spent cleaning solution returns to the Neutralization Tank through the RO CIP return line. Depending on the pH of the spent cleaning solution citric acid or sodium hydroxide is added to the neutralization tank and mixed until the target pH is achieved. Mixer controls are located at the MCC and include a control selectors switch (Local-Off-Remote [LOR]), and reset pushbutton. In the Local position the pump runs continuously when the local control switch is in Start and stops when the switch is in Stop. Placing the local control switch in LO locks out the mixer. The neutralization tank includes a site gauge to determine, a low-level switch and a high-level switch. On low level an alarm is generated to notify the Operator. The high-level switch signals that an overflow event is imminent. The tank is equipped with overflow piping and drain valve which is used to direct neutralized cleaning solution to the RO CIP Containment Area. A pH analyzer and level sensor are located on the overflow line. Both are displayed locally and transmitted to PLC.

10.7.11.5 Associated Chemical Feed Systems

Sodium hypochlorite and antiscalant will be dosed to the feed of the RO system. A brief description of the dosing control philosophy for each chemical is provided below.

10.7.11.5.1 Sulfuric Acid

Sulfuric acid shall be injected in the RO feed downstream RO feed tanks and upstream of the sodium hypochlorite injection point described below. The purpose of the sulfuric acid addition at this location is to suppress the pH of the RO feed to inhibit scaling of sparingly soluble salts. Dosing will be based on the flow signal from the RO influent flow meter and the pH measured in the influent header post the sodium hypochlorite dosing point.

The RO MCP is programmed for a target pH using an operator defined setpoint; default value per the RO and antiscalant manufacturer projection results. The RO MCP is programmed with minimum and maximum pH alarms setpoints to ensure the target treatment goal is achieved. Sulfuric acid dosing will maintain the pH within those limits. The RO MCP shall communicate the pH alarm to the PCS.

Sulfuric acid shall also be injected upstream of the UV-AOP system to suppress pH level for optimal chloramine AOP reaction efficiency. This dose will be set by the operators to maintain a target adjusted pH value.

10.7.11.5.2 Sodium hypochlorite

Sodium hypochlorite shall be injected in the RO feed downstream RO feed tanks and upstream of the sodium hypochlorite injection point described below. Primary dosing will be based on the feed flow signals from the in service RO units. Sodium hypochlorite dosing will be secondary controlled off measured free chlorine residual. The MCP/LCP is programmed with maximum free chlorine alarm setpoint to protect the RO elements from potential damage due to chlorine oxidation.

10.7.11.5.3 Antiscalant

Antiscalant shall be injected in the RO feed downstream of the sodium hypochlorite injection point described above. Dosing will be based on the feed flow signals from the in-service RO units and user set points for target antiscalant concentration (default 3-5 mg/L).

10.7.11.6 Normal Operation

Normally the system operates in Remote Auto. The RO high pressure feed pumps will be controlled to maintain target permeate flow rate. The operator will enter target permeate flow rate and recovery value. Based on these inputs the target RO concentrate flow will be calculated and controlled using flow control valves. The RO units will cycle on and off based on the level measured in the RO feed tanks.

10.7.12 UV AOP System

10.7.12.1 Normal Operation

Under normal operating conditions the UV AOP system operates in Remote Auto through the PCS. UV reactors are designated as Duty, Standby, or Out-of-Service. In general, the UV AOP system will be controlled using a monitoring algorithm for the calculation of 1,4-Dioxane LRV as a function of several inputs such as flow rate, UV transmittance (UVT), UV intensity, lamp status, free chlorine concentration and pH. The specific monitoring algorithm shall be developed by the equipment supplier and shall include computational fluid dynamic (CFD) modeling to validate the accuracy of the algorithm for the calculation of 1,4 Dioxane reduction. A description of the user operator interface is provided below.

10.7.12.1.1 UV AOP Control OIT Description

The UV AOP will continuously monitor the LRV achieved for the target contaminant (i.e. 1,4 Dioxane). The UV AOP system will normally be operated to provide a target LRV that is maintained above the minimum LRV required for regulatory compliance. The target LRV provides an operating buffer above the required LRV so that changes in the process variables (i.e. flow, UVT, etc.) that cause minor fluctuations in the target contaminant LRV provided by the UV AOP system does not result in off-specification water production. The UV AOP system shall allow for operator selection of both the required and target LRV for the target contaminant. The UV AOP system shall continuously monitor the LRV of the target contaminant and alarm if the LRV falls below either the target LRV setpoint (low priority alarm) or the required LRV setpoint (high priority off-specification alarm). Monitoring of pathogen LRVs is not anticipated to be required as the UV dose required for AOP far exceeds that for disinfection; however, this will be vetted with DDW during the final design.

10.7.12.2 Associated Chemical Feed Systems

Sodium hypochlorite (and optional future sulfuric acid) dosing will occur upstream of the UV system. A brief description of the dosing control philosophy associated with each chemical is provided below.

10.7.12.2.1 Sulfuric Acid (optional future system)

Sulfuric acid shall be injected in the UV influent header just upstream of the sodium hypochlorite injection point described below. The purpose of the acid addition at this location is to ensure the free chlorine is in the hypochlorous acid form which is a slow hydroxyl radical scavenger compared to hypochlorite ion which occurs at higher pH values. Dosing will be based on the flow signal from the duty UV reactor and the pH measured in the influent header post the sodium hypochlorite dosing point.

The UV MCP/LCP is programmed for a target pH using an operator defined setpoint; default value per the equipment supplier's requirements. The UV MCP/LCP is programmed with minimum and maximum pH alarms setpoints to ensure the target treatment goal is achieved. Sulfuric acid dosing will maintain the pH within those limits. The UV MCP shall communicate the pH alarm to the PCS. In the event the flow signal from the duty UV reactor is lost, sulfuric acid dosing will be scaled based on the sum of the ROP flow signals.

10.7.12.2.2 Sodium Hypochlorite

Sodium hypochlorite shall be injected in the UV influent header downstream of the sulfuric acid dosing location. Dosing will be based on the flow signal from the duty UV reactor and free chlorine residual. Primary control of the sodium hypochlorite dosing pump will be based on the free chlorine residual as calculated as the difference between total chlorine measured upstream and downstream of the sodium hypochlorite injection point. Secondary control of the sodium hypochlorite dosing pump will be based on free chlorine measured at the inlet to the duty UV reactor.

The UV MCP/LCP is programmed with minimum and maximum free chlorine alarm setpoints to ensure the target treatment goal is achieved and to protect the UV reactors from potential damage due to chlorine oxidation. Sodium hypochlorite dosing will maintain the free chlorine concentration within those limits. The UV MCP shall communicate the free chlorine alarm to the PCS. In the event the flow signal from the duty UV reactor is lost, sodium hypochlorite dosing will be scaled based on the sum of the ROP flow signals.

10.7.13 SAFE System

10.7.13.1 Associated Equipment and Instrumentation

SAFE-Settle Level	LIT-XXXX
SAFE-Filter System	
SAFE-Filter Influent Valve	V-0001
SAFE-Filter Level	LIT-0002
SAFE-Filter Motor Drive	M-XXXX
SAFE-Filter Drain Valves	V-0002 V-0003
SAFE-Filter Backwash Valves	V-004 V-005
SAFE-Filter Scum Valve	V-007
SAFE-Filter Recirculation Valve	V-006
SAFE-Filter Backwash Pump	P-0002
SAFE-Filter Solids Waste Pump	P-0001
SAFE-Filter Influent Flow	FIT-0001

10.7.13.2 SAFE System Control Overview

The SAFE System will be managed by the SAFE-Filter System Suppliers standard controls and logic. Control information provided herein is for information only and is a general description of the operating strategy of the system. This description is subject to change to conform to the SAFE-Filter system suppliers' standards and typical operating approach.

10.7.13.3 SAFE-Settle Monitoring

- The level in the SAFE-Settle Tank is monitored and recorded on SCADA.
- When the level is greater than pre-programmed level (corresponding to the SAFE-Settle Overflow Weir Level) – a "Flow to SAFE-Filter" notification will be indicated on the SCADA.

10.7.13.4 SAFE-Filter Controls

The SAFE-Filter is operated based on the System Suppliers typical control algorithm.

- Filtration
  - In Filtration mode, filtration occurs without interruption while the disk filters are submerged. Filtered water collects in a centertube and exits through an effluent wier.
- Filter Backwash
  - When the headloss in the SAFE-Filter exceeds a pre-programmed set point (system supplier specific), the filter will backwash.
  - The headloss setpoint is overridden in the event that a pre-determined interval between backwashes is exceeded.
- Solids Wasting
  - Solids wasting from the bottom of the SAFE-Filter is triggered based on a pre-programmed number of backwash cycles between solids wasting.
- Floatables / Scum Wasting.
  - After a preset number of backwashes, the water level is allowed to rise above the preset high level and the scum flows over the scum removal weir. Scum wasting water is directed to the plant drain.

10.7.13.5 SAFE System – Discharge Flow SAFE Flow Monitoring

- The SAFE-Filter Influent Flow (QSAFE.INF) is calculated using the SAFE-Filter Influent Flowmeter reading FIT-0001. The SAFE-Filter Influent Flow will be used to calculate:
  - Daily Total SAFE Filter Influent Volume.

10.7.14 Scum / WAS Wetwell and Pumps Operation

10.7.14.1 Associated Equipment and Instrumentation

Scum / WAS Wet Well Level	LIT-XXXX

Scum / WAS Wet Well High-High Level	LSHH-XXXX
Scum / WAS Wet Well Foam Control Spray Water Valve	V-0049
Scum / WAS Wet Well Pump	P-0001
Combined Scum / WAS Wetwell and WAS Flow Meter	FIT-0078

10.7.14.2 Scum / WAS Wetwell Foam Spray

Foam spray knocks down foam within the WAS / Scum Tank.

- Local Manual Mode. N/A
- Remote Manual Mode: In remote manual mode, the operator can turn on/off the spray
- Remote Auto Mode:
  - In auto mode, the foam spray is based on frequency of run (minutes) and duration of run (minutes).

If the high-high-high level is reached in the WAS Scum Tank, the spray schedule is overridden and does not occur.

10.7.14.3 Scum / WAS Wetwell Pump

The Scum / WAS Wetwell Pump can be operated in Local Manual or Remote modes as described below. The pump shall stop in any mode upon moisture detection or motor winding high temperature. The pump status is displayed at the SCADA.

- Local Manual Mode.
  - Start/stop is provided by a selector switch at the Pumps.
  - In local mode, the mixer runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The Scum / WAS Tank pump can be operated from the SCADA.
- Remote Auto Mode:
  - The Scum / WAS Wetwell Pump is controlled based on the level in the WAS / Scum Tank.
  - In the event of a high-high level, the pump will be operated continuously until the low-level set point is achieved.

10.7.15 Sludge Holding Tanks

10.7.15.1 Associated Equipment and Instrumentation

Sludge Holding Tank # 1 Systems

Sludge Holding Tank # 1 Mixer	MXR-0001
Sludge Holding Tank # 1 Sludge Level	LT-0020

Sludge Holding Tank # 2 Systems

Sludge Holding Tank # 2Mixer	MXR-0001
Sludge Holding Tank # 2 Sludge Level	LT-0020
Sludge Holding Tank Blower # 1	BL-0001
Blower # 1 Discharge Pressure	PIT-0009
Sludge Holding Tank Blower # 2	BL-0002
Blower # 2 Discharge Pressure	PIT-0018

10.7.15.2 Sludge Holding Tanks Mixing

The sludge holding tank mixers can be operated in Manual or Remote modes as described below. The mixers shall stop in any mode upon moisture detection, motor winding high temperature or a pre-programmed low-sludge level. The mixer status is displayed at the SCADA.

- Manual Mode.
  - Start/stop is provided by a selector switch at the Mixer Control Box. In local mode, the mixer runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The Mixers can be started/stopped from the SCADA.
- Remote Auto Mode:
  - The mixer on/off is controlled from the SCADA.
  - When in in auto mode, the mixer can be controlled in:
    - Intermittent Operation using operator adjustable set-points for the interval between mixer operation and duration of mixer operation; or.
    - Continuous Operation.

10.7.15.3 Sludge Holding Tanks Aeration

The sludge holding tanks aeration can be operated in Manual or Remote modes as described below. The blowers shall stop in any mode due to low discharge pressure, or a pre-programmed low-sludge level. The blower status is displayed at the SCADA.

- Manual Mode.
  - Start/stop is provided by a selector switch at the Blower local control panel. In local mode, the blower runs continuously until the STOP button is pushed.
- Remote Manual Mode.
  - The blowers can be started/stopped from the SCADA.
- Remote Auto Mode:
  - The blower on/off is controlled from the SCADA.
  - When in in auto mode, the blower can be controlled in:

- Intermittent Operation using operator adjustable set-points for the interval between mixer operation and duration of mixer operation; or.
- Continuous Operation.

10.7.16 Sludge Dewatering

10.7.16.1 Associated Equipment and Instrumentation

Dewatering Sludge Feed Pump No. 1	P-0001
Dewatering Sludge Feed Pump No. 2	P-0002
Dewatering Sludge Feed Flow Meter	FIT-0035
Belt Filter Press	BFPS-0001
Belt Filter Press Influent Control Valve	V-0005
Screenings Conveyors	

10.7.16.2 Dewatering Sludge Feed Pumps

Two dewatering sludge feed pumps each equipped with variable frequency drives (VFDs) transfer stabilized sludge from the sludge holding tanks to the belt press. Pressure is displayed locally on the pump suction and discharge of the pumps. In the event of low suction pressure or high discharge pressure the dewatering sludge feed pump shuts down. The pumps discharge to common discharge line where the flowrate is measured, displayed locally and transmitted to the PLC.

- Local Manual Mode. In Local Manual Mode, the pumps run continuously with the speed set manually at the VFD. In the Off position, the pumps do not run.
- Remote Manual Mode: In Remote Manual Mode, the pumps run continuously with the speed set manually at the VFD. In the Off position, the pumps do not run.
- Remote Auto Mode: In the Remote Auto mode, power is transferred to the PLC and the SCADA interface used to set controls. In Remote Auto the BFP LCP controls pump operation.

10.7.16.3 Polymer Feed System

Polymer is added to the sludge feed to enhance coagulation. Dosage is based on the sludge feed rate and is set through SCADA.

- Local Manual Mode:
- Remote Manual Mode:
- Remote Auto Mode: In remote auto mode, dosage is based on the sludge feed rate and is set through SCADA. The polymer feed system is called to run by the belt filter press LCP.

10.7.16.4 Belt Filter Press

The belt press runs continuously for the duration of the sludge processing event. The belt press, sludge feed and polymer feed system operate in Remote Auto through the Master Control Panel. The automated startup and shutdown sequences for the components are managed by the MCP. The polymer dosage and belt speed are adjusted by the Plant Operator.

- Local Manual Mode:
- Remote Manual Mode:
- Remote Auto Mode: In Remote Auto Mode, the dewatering LCP controls dewatering operating using a control selector switch. In the On position, the dewatering system starts by starting the cake conveyors and opening the dumpster gates. The plant service water solenoid valve opens to supply the two belt press washwater boxes. The drive motors start, which moves the belts through the wash boxes to wet the belt. The PSW line has a low pressure switch that shuts down the belt press in the event there is insufficient water pressure to clean the belts. The polymer feed system is then called to operate (the polymer metering pump must be in Auto control). The dewatering system does not run if the control selector switch is in the Off position. An Estop is also located on the Dewatering LCP and will stop the dewatering option if the button is pushed.

10.7.16.5 Cake Conveyance

An inclined screw conveyor transports cake to the dual-port dumpster distribution screw conveyor. Motorized gates are located on the bottom of the shaftless conveyor that permits the cake to fall into the dumpster. Each conveyor is controlled from a LCP using a control selector switch.

- Local Manual Mode. In Local Manual Mode, the conveyors are controlled using Start and Stop switches; in Off the conveyors do not run.
- Remote Manual Mode*:* In Remote Manual Mode, control is passed to the PLC and operation set through the SCADA interface.
- Remote Auto Mode: In Remote Auto Mode, the conveyors are controlled as part of the dewatering start and stop sequence.

10.7.17 Calcite Contactor System

10.7.17.1 Associated Equipment and Instrumentation

Calcite Filter No. 1

Calcite Filter No. 2

PDS No. 1

PDS No. 2

Flush Pump

Backwash Holding Tank Effluent Flow Meter FE-0009

10.7.17.2 Calcite Vessels

UV effluent shall pass through a vessel containing calcite which will dissolve into the water and add hardness, alkalinity and increase the pH to protect downstream equipment from corrosion. The system is designed to permit full plant flow through the online (duty) vessel. A second vessel is used in a standby role when the duty vessel requires while cleaning. UV effluent flowing through the online vessel dissolves some of the media to a neutral pH (about 7.0) and delivers stabilized water to the Product Water Tank (PWT). The differential pressure is measured across the media

bed in each vessel. At a preset high differential pressure a switch is energized which generates an alarm to SCADA.

- Local Manual Mode. Manually operated valves are used to position one tank for duty and one for standby. The differential pressure is measured across the media bed in each vessel. At a preset high differential pressure a switch is energized which generates an alarm to SCADA. The Operator then switches vessels to maintain UV effluent remineralization. The offline vessel is configured to discharge to the BHT and the Flush Pump is energized.
- Remote Manual Mode: N/A
- Remote Auto Mode: N/A

10.7.17.3 Flush Pump

- Local Manual Mode. The Flush Pump is controlled locally from the local control panel (LCP). With the control selector switch in the Local position the pump is controlled using the Start/Stop handswitch. In the Start position the pump runs continuously; in the Off positon the pump does not run. In the Stop position the pump does not run. With the control selector switch in the Off position the pump does not run;
- Remote Manual Mode: TBD
- Remote Auto Mode: In Remote Auto Mode, the pump control is transferred to the PLC and operation is set through SCADA. Pump speed can be adjusted locally or through SCADA. Pump discharge pressure is displayed locally. The pump will shut down on high temperature or motor overload. Pump status, operating mode and alarms are transmitted to SCADA thru the PLC. On high differential pressure the offline vessel shall be placed online and the originally online vessel shall be have the inlet and PWT outlet line shut. The BHT outlet line shall be opened and the Flush Pump run for a period of 20 minutes.

10.7.17.4 Backwash Holding Tank (BHT)

BHT level is measured and displayed locally and the level transmitted to SCADA. In the event of a high tank level an overflow directs the water to the ground. A motorized tank drain is used to drain the tank contents to the sewer or storm drain. Controls are mounted on the valve actuator.

In the Open position the valves open; in the Off position the valve does not move; in the Closed position the valve shuts. Valve status, operating mode and alarms are transmitted to SCADA thru the PLC. A flow meter is located on the drain line and measures, displays locally and transmits the flowrate to SCADA.

- Local Manual Mode. With the control selector switch in the Local the valve is set using the position handswitch.
- Remote Manual Mode: N/A
- Remote Auto Mode: In the Remote position control is transferred to SCADA where the valve can be opened or closed.

10.7.18 IPR Product Water Pump Station

10.7.18.1 Associated Equipment and Instrumentation

Product Water Storage Tank Level	LIT-0001
Product Water Storage Tank High-High	LSHH-0004
Product Water Storage Tank Low-Low	LSLL-0003
FTE CL2 Analyzer	AIT-0005
FTE Conductivity Analyzer	AIT-0006
FTE pH Analyzer	AIT-0007
IPR Pump No. 1	P-0001
IPR Pump No. 2	P-0002
IPR Pump No. 3	P-0003
IPR Pump Pressure Transmitter	PIT-0007
IPR pH	AIT-0008
IPR Flow Meter	FIT-0009

10.7.18.2 Control Philosophy

10.7.18.2.1 Product Water Storage Tank

The Product Water Storage Tank stores the UV Effluent Prior to pumping the treated water to the groundwater well injection site. It has level sensors and alarms on high and low levels. There are no other controls on the Product Water Storage Tank.

10.7.18.2.2 IPR Pumps

The IPR pumps operate off of the Product Water Storage Tank based on level. The pumps send the Product Water to the groundwater well injection site. The pumps are operated directly by plant PLC system. The Operators select lead, lag, and lag-lag pumps, or set a put to be out of service. The PLC starts or stops pumps and adjusts speed uniformly to maintain either operator input flow setpoint or pressure setpoint. The pumps can be manually operated in the PLC to start/stop and set operating speed if needed. Normally the system operates in Remote Auto with all pumps in service and each pump selected for a duty role (lead, lag and lag-lag).

- Local Manual Mode. In Local Manual Mode, the pumps are operated locally using Start and Stop pushbuttons and the speed adjusted using a potentiometer. In the Off position, the pumps do not run.
- Remote Manual Mode: TBD
- Remote Auto Mode: In Remote Auto Mode, control is passed to SCADA. Pump pressure is displayed locally. Pump duty selection (lead, lag, and lag-lag pumps, or set a put to be out of service) is set from the configuration screen. In the event the lead pump fails the lag pump is promoted to the lead pump role; should the lag pump fail the lag-lag pump is promoted to the lag

pump role. When a pump is selected as out of service, the pump is taken out of the control loop. The pump start, stop and adjust speed to maintain the input flow setpoint or pressure setpoint. A pressure switch located on the pump discharge generates an alarm to SCADA and shuts down a pump. The product water pump discharge to a common manifold. Flow, discharge pressure and pH are measured, displayed locally and transmitted to SCADA.

10.7.19 On-site Recycled Water System

10.7.19.1 Associated Equipment and Instrumentation

Recycled Water Pump No. 1	P-0001
Recycled Water Pump No. 2	P-0002
Recycled Water Flow Meter	FIT-0005
Air Bladder Storage Tank and Pressure Gauge	PG-XXXX

10.7.19.2 Control Philosophy

10.7.19.2.1 Recycled Water Pumps

- Local Manual Mode. With the control selector switch in the Local position the pumps are operated using Start and Stop pushbuttons and the speed adjusted using a potentiometer; in the Off position the pumps to not run.
- Remote Manual Mode: TBD
- Remote Auto Mode: In the Remote position control is passed to SCADA. Pump pressure is displayed locally. Pump duty selection (lead, lag or set a put to be out of service) is set from the configuration screen. In the event the lead pump fails the lag pump is promoted to the lead pump role; the third pump is used as a standby pump. When a pump is selected as out of service the pump is taken out of the control loop. In Remote Auto the pump(s) start or stop and adjusts speed uniformly to maintain set distribution pressure. If distribution pressure continues to rise with one pump in operation at minimum speed, that pump will cycle off and allow the air-bladder tank to supply those low demands. The pump will automatically restart when distribution pressure dips indicating the air-bladder tank is not keeping up with demands. The pumps discharge to a common manifold where flow, discharge pressure and pH are measured, displayed locally and transmitted to SCADA