Prepared for

CALIFORNIA AMERICAN WATER

Section 3.0 Technical Proposal

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A. Overview and Description of the Project

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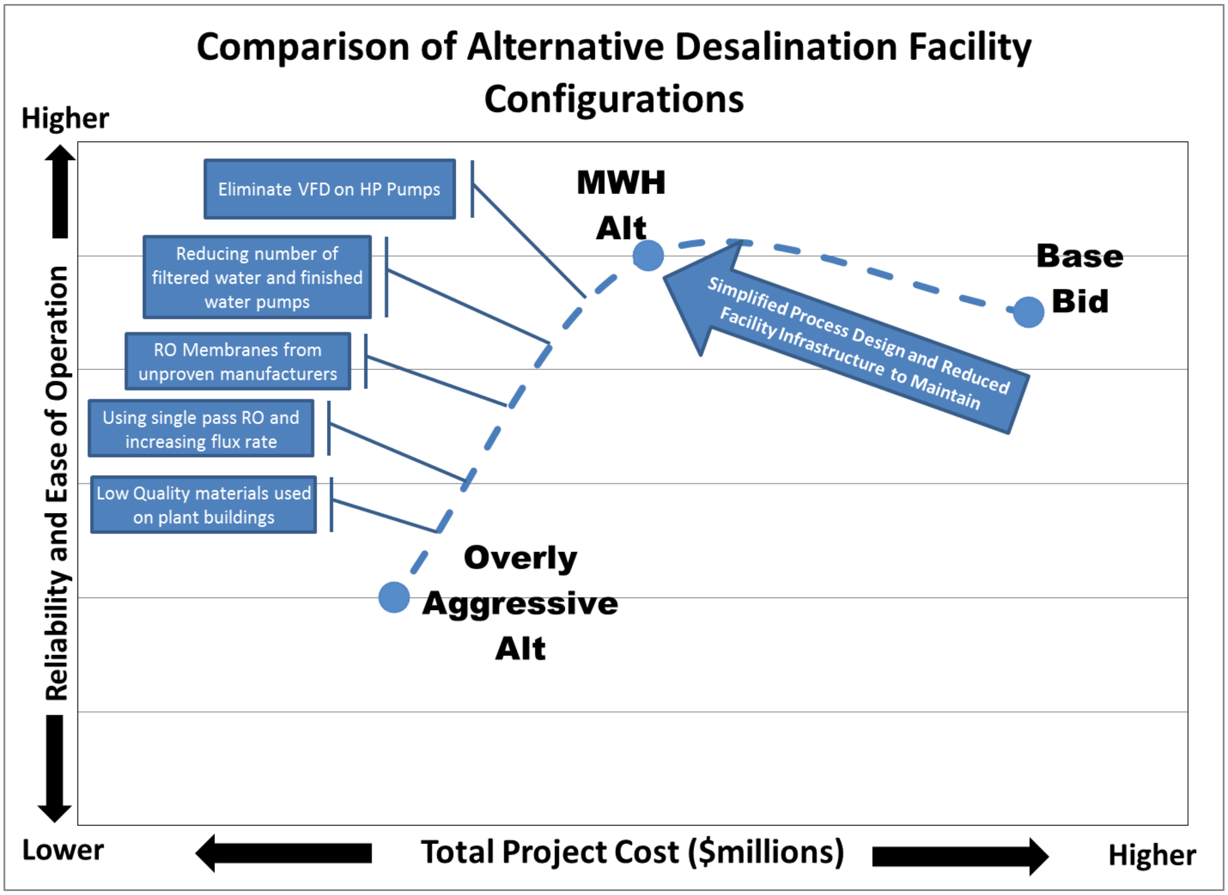
A. OVERVIEW AND DESCRIPTION OF THE PROJECT

This section of the proposal presents MWH's technical approach to design, construction, startup and commissioning of CAW's Desalination Infrastructure Project. While each of these project elements will be presented in its own section of this Overview, it should be noted that MWH views these elements as interrelated and interdependent. A project cannot have a successful Startup and Commissioning phase unless the design was fundamentally correct and the facilities were constructed in a quality manner. This belief was instrumental to the selection and structure of our project team and the approach we took to develop our proposed designs for the base and voluntary alternative proposals. Likewise, if MWH is selected, this philosophy will carry on as we work with CAW to complete the design, acquire the necessary permits, construct and commission the desalination infrastructure, and turnover the facilities to CAW for operation.

The individuals that make up our integrated design-build team bring a wide range of background and experience that span all facets of SWRO design, construction and operations. Some of these individuals' experience, for example Mike Price, are broad and range from design to operations. Dr. Mike Nelson's experience is more specific having provided professional services as the designer, builder, commissioner, owner and operator on more than 60 SWRO facilities. Others are narrower, but very deep such as Dr. Joe Jacangelo's expertise in advanced membrane technology. By leveraging the strengths of all the team members in an integrated and collaborative manner we are best able to meet the goal of CAW to deliver reliable, operator-friendly, cost-effective desalination infrastructure on or before our scheduled date of completion.

As we progressed our approach to achieve this goal, we developed a Value Curve (see graphic below) to illustrate how we made decisions that were in the best interest of the project. The figure illustrates the relationship between "Total Project Cost" representing both capital and operating costs shown on the X-axis, to "Reliability and Ease of Operation" shown on the Y-axis. The "Base Project" point on the curve represents the 9.6 mgd base project detailed in the CAW Request for Proposal. This project configuration was prescribed to a high-level of detail in the procurement documents and accounts for uncertainty associated with the available raw water quality, CDPH domestic water permit requirements, and the desire of CAW to create an "apples to apples" comparison of design-builders' proposals. While establishing the necessary components for reliable operation, its purpose was not to reduce overall project cost.

MWH's voluntary alternative for the 9.6mgd facility is shown on the figure as "MWH Alt." Our integrated design-build team evaluated ways to reduce both capital and operating costs while improving quality and reliability. For example, by simplifying the pretreatment process (described in detail later in this section) we have decreased the number of systems to be operated and maintained, thus increasing the ease of overall facility operation and significantly reducing the risk of biofouling.



During our development of the voluntary alternative design, we considered and rejected numerous concepts that would reduce capital and operating costs, but would have significant negative impact on reliability and/or ease of operation. These items included:

- **Eliminating VFDs on High Pressure RO Feed Pumps** – Approximately $2 million in capital costs and about 3% of annual energy costs could be saved by using constant speed high pressure RO feed pumps. In this case, the filtered water pumps would adjust to maintain a pressure setpoint on the suction side of the high pressure pumps. This is technically feasible as long as feedwater salinity and temperature are relatively constant, which we believe will be the case once the slant wells are in operation. However, constant feed pumps would make starting the RO system much more difficult and would not provide uniform flow among the online RO trains.
- **Using RO Membranes from Unproven Manufacturers** – MWH has been approached by membrane suppliers offering new products that are claimed to require less power for seawater desalination but at higher cost per element or with a shorter warranty period. Upon more detailed evaluation, most of them also require more of the first pass permeate to be treated in the second pass because the first pass permeate quality isn't as good as the Toray membranes MWH is proposing to install. Therefore, MWH has elected to provide proven membranes at a reasonable supply cost and reasonable power consumption.
- **Using Low-Quality materials on Plant Buildings** – If the plant were constructed just a few miles inland, less expensive materials could be used throughout the plant. However, with the salty ocean air always present, material selection and conditioning of makeup air are important to ensure the longevity and reliability of the plant. Throughout the plant, MWH has selected equipment and materials that will not deteriorate prematurely.

- **Using a Single-Pass RO System** - Our projections indicated that the 0.5 mg/L boron limit and production requirements could be met, operation would be simpler, and the capital cost would be less than a two pass system, but a single pass system would require feed pressures up to 1,200 psi, and other ions such as chloride and bromide would likely exceed the limits set forth in the RFP. Furthermore, **CAW indicated in our one-on-one technical review meeting that a single pass system would not be considered as an acceptable alternative**.
- **Increasing First Pass Recovery to 50 to 55 percent** – MWH has conducted a number of RO modeling projections with varying first pass fluxes and recoveries. A higher percentage of first pass recovery is possible and would save approximately $25,000 per year on raw water pumping. However, it would need to run at a lower flux on the first pass, meaning more membranes and more capital cost. This option could still be considered by CAW should additional energy savings be preferred over lower capital cost.
- **Increasing the Second Pass Flux of up to 24 gfd** – Many seawater desalination plants are designed and operated with second pass systems running at fluxes higher than the 18 gfd allowed in the RFP. MWH considered proposing this, but the reduction in membrane elements was relatively small compared to the entire plant.
- **Using 440 sq.ft. Membrane Elements** – Although they could reduce the required number of pressure vessels by 10%, they would **increase power consumption** by approximately 500,000 kwh per year. That would result in a $0.8 million increase in NPV over 20 years.
- **Reducing Number of Filtered Water and Finished Water Pumps** – Appendix 2 of the RFP requires four pumps for each application, two at 50 percent of full capacity and two at 25 percent of full capacity, and the smaller pumps must be equipped with VFDs. MWH considered proposing three pumps at 50 percent of full capacity and all with VFDs. This would reduce capital costs, space, and number of valves and pieces of equipment to maintain, and it could save on pumping costs, depending on the operating points. However, if CAW intends to operate all the RO trains very often, having only three pumps reduces the reliability, and we elected to proceed with four pumps in both applications.

If all these concepts were to be included in the facility configuration, the project would realize some level of capital cost reduction. However, the tradeoff for the marginal reduction in capital and O&M cost would come at the price of higher risk and uncertainty of future maintenance cost, reduced ability to accommodate fluctuations in raw water quality, lower operational reliability, and reduced useful life of the facility. This alterative configuration is not recommended my MWH and is shown on the figure as the "Overly Aggressive Alt" point on the value curve.

MWH's approach to design, construction, and commissioning of the desalination infrastructure project is to work collaboratively with CAW to achieve the maximum point along the Value Curve. The details of our approach follow in this section.

B. Scope of Geotechnical Investigation

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It is MWH's standard practice to thoroughly review available geotechnical information to assess foundation requirements and associated risks for every project we design and construct. For the CAW Desalination Infrastructure project MWH assembled an in-house technical committee comprised of our lead structural engineer, geotechnical engineer, and earthwork construction superintendent to review the site characteristics and develop our approach to design and construction of the project improvements. Our efforts included review of the project's Draft Geotechnical Baseline Report prepared by URS dated June 20, 2013, site visits by the project team, consultation with local earthwork contractor, and consideration of the allocation of risk between CAW and the design builder as prescribed in Section 3.4 of the Draft Design-Build Agreement for the Monterey Peninsula Water Supply Project Desalination Infrastructure.

Understanding of Project Site Geotechnical Conditions

The project site is located in the northern Salinas Valley within the Coast Range Geomorphic Province. The Salinas Valley is filled with a thick sequence of marine and non-marine sedimentary rock and alluvium. MWH has sited the project facilities along the southern portion of the property. The southern portion of the site is located on gently sloping older dune deposits ranging in elevation from about 80 feet to 115 feet (MSL). The near-surface sands exhibited variable relative densities ranging from loose to dense to a depth of approximately 12 feet. In order to provide uniform foundation support of the building and other at-grade structures, the near-surface soils will be over-excavated and either re-compacted or replaced with compacted structural fill as required. Based on the depth to groundwater and the density of the soils, the potential for liquefaction in the southern half of the site is considered "low."

Additional Geotechnical Investigation and Field Support Services

After consideration of the available information, the anticipated building and treatment structures contemplated in the project, and our approach to design and construction, we do not feel that additional geotechnical field investigation or laboratory testing is necessary. However, we have retained AGS, Inc., a minority business geotechnical firm, to provide consultation during design and construction of the proposed facilities. In this role, AGS will confirm the actual geotechnical conditions encountered are consistent with those anticipated in the GBR, and recommended any modifications to foundation design or construction methods to mitigate any adverse conditions if found.

C. Basis of Design Report Submitted with Proposal

C. Basis of Design Report
Submitted with Proposal

Basis of Design Report – Base Project

EXECUTIVE SUMMARY

This document comprises the Basis of Design Report (BoDR) in support of the development of California American Water's (CAW) Monterey Peninsula Water Supply Project (Project), from the perspective of the MWH Constructors, Inc. (MWH) Design-Build Team. This BoDR, along with development drawings and other supporting information, serves as the basis of our proposal and fixed fee pricing.

MWH has prepared this Basis of Design Report (BoDR) to comply with the suggested Baseline Project as presented in the Request for Proposal (RFP) and Appendices (including #2 – Design and Construction Requirements). The BoDR also identifies how our proposed design (and anticipated operation and maintenance [O&M] and electrical power usage) would be impacted by a reduction in the finished water treatment/production capacity to 6.4 mgd, as identified in the RFP.

As presented in our original Statement of Qualifications (SOQ), the experience MWH has gained from our involvement in some of the most significant seawater desalination projects throughout the world has given us great technical knowledge that can be leveraged for the benefit of CAW. Cost efficiency combined with long term reliability, securing water supplies and providing drought resistant water supplies, and reducing and recovering energy are some of the key factors behind how MWH approaches the design-build of any treatment plant, and that experience will be applied to the design and construction of the Project.

1.0 INTRODUCTION

This document comprises the Basis of Design Report (BoDR) in support of the development of California American Water's (CAW) Monterey Peninsula Water Supply Project (Project), from the perspective of the MWH Constructors, Inc. (MWH) Design-Build Team. This BoDR, along with development drawings and other supporting information, serves as the basis of our proposal and fixed fee pricing.

This BoDR focuses on the suggested Baseline Project (9.6 million gallons per day [mgd] firm finished water treatment/production capacity) as presented in the Request for Proposal (RFP) and Appendices (including #2 – Design and Construction Requirements) in order to demonstrate compliance and to share our concepts and plan for implementing this challenging project. This BoDR also addresses non-voluntary alternatives identified in the RFP including post-reverse osmosis (RO) disinfection and post-stabilization. References are also made to voluntary alternatives which have been developed by MWH for consideration by CAW. The BoDR also identifies how our proposed design (and anticipated operation and maintenance [O&M] and electrical power usage) would be impacted by a reduction in the finished water treatment/production capacity to 6.4 mgd, as identified in the RFP.

This BoDR also provides the information necessary to develop O&M cost estimates and life-cycle cost analyses.

The improvements associated with this Project include:

- Raw water piping (from the property line)
- Granular media filtration system (filters, backwashing supply, spent backwash water clarification and recycle facilities)
- Filtered water storage and pumping system
- RO system
- Product water stabilization system
- UV disinfection system
- Finished water storage and disinfection
- Finished water pumping system and piping (piping to the property line)
- Salinas Valley desalinated water return pumping system and piping (piping to the property line)
- Concentrate equalization, aeration and disposal system (piping to the property line)
- Chemical storage and feed facilities
- Electrical facilities including power supply
- Standby power facilities
- Process control and instrumentation system
- Buildings, inclusive of all mechanical, electrical, and special systems:
    - Administration facilities
    - Granular media filtration building
    - Reverse osmosis building
    - UV disinfection building
    - Chemical storage and feed facilities
    - Electrical switchgear buildings
- Project Site improvements
- All other improvements necessary for a fully functional facility.

A process flow diagram and a hydraulic profile for the 9.6 mgd Base Project and the 6.4 mgd Reduced Capacity Base Project are provided in **Appendix A**.

2.0 GENERAL PROJECT DESIGN CRITERIA

This section presents pertinent design criteria for the Project. These design criteria serve as the guide for facilities and equipment sizing, and to guide the layout of the facility.

2.1 Plant Capacity

The RFP requires a firm finished water treatment/production capacity of 9.6 mgd, as well as consideration of maximum capacity with all treatment trains in service. The RFP also requires consideration of a reduction in finished water capacity of 6.4 mgd, depending on the timing and capacity of the Groundwater Replenishment (GWR) Project. These two capacities are considered in this BoDR.

The RFP also requests consideration of a potential future maximum capacity of 12.8 mgd for to provide a basis for design of fixed capacity components, and to identify space planning requirements for variable capacity components. This wide range in capacities also results in a wide range of plant influent seawater flows to be pre-treated. A summary of important capacity values is presented in **Table 2-1** based on an RO production efficiency of 44%. Firm capacity is with one of the treatment trains or the largest item of equipment out of service. Maximum capacity is with all treatment trains in service.

Table 2-1: Summary of Plant Capacity

Firm Finished Water Capacity (mgd)	Maximum Finished Water Capacity (mgd)[1]	Firm Influent Capacity (mgd)	Maximum Influent Capacity (mgd)
6.4	8.0	14.6	18.2
9.6	11.2	21.9	25.5
12.8	14.4	29.2	32.8

[1] The chemical feed pumps, UV system, and finished water pumps must be designed for the maximum finished water capacity.

The baseline plant layout/design for 6.4 mgd or 9.6 mgd will provide spatial allowances to expand various process buildings in the future to achieve a higher capacity up to 12.8 mgd. With all the trains on line after expansion, the maximum finished water capacity will be 14.4 mgd. Therefore, all yard piping has been sized for that production capacity or accommodation has been made for the connection of additional flow. Space will not be allocated inside buildings to accommodate future expansion. Instead, the buildings will need to be enlarged for the additional facilities needed for expansion.

2.2 Future Facilities

In addition to planning for a potential future capacity increase to 12.8 mgd, it is also requested to identify an area on the Project Site where an alternative pretreatment process(es) can be located, for example dissolved air flotation (DAF) and gravity granular media filtration along with associated residuals handling processes, should an open ocean seawater intake be required. Our proposed site layout allocates this additional space to the northwest of the proposed pretreatment facilities.

2.3 Equipment Life Expectancy

Appendix 2 of the RFP identified the expected life of selected facility assets and MWH has developed a design that meets or exceeds these expectations.

Table 2-2: Equipment Life Expectancy

Equipment	Years
Process Equipment	
RO Equipment	25
Granular Media Filters	15
Electrical Power Equipment	30
Instrumentation and Control Equipment	20
Tankage	
Chemical Bulk Storage Tanks	25
Chemical Day Tanks	15
Finished Water Storage Tanks	50
Earthen Reservoirs	25 (Life of Liner)
Buildings/Structures	
Reinforced Concrete Structures	75
Administration Facilities	50
Stand Alone Electrical Switchgear Buildings	30
Piping and Valves	
Finished Water	
Piping	50
Valves	25
Saline Water	
Piping	25
Valves	15
Chemical Piping and Valves	15

2.4 Staffing

The design proposed by MWH is based on the assumption that the treatment facility will be staffed on a 24/7/365 basis. It is understood that this plant will be operated at or near capacity throughout the year and therefore requires careful attention from operations and maintenance staff. A key goal for this design-build project is to provide for a reliable, efficient and safe facility, including appropriate monitoring and controls, such that partially-attended operation can be considered in the future. MWH has considerable experience in the region having designed Sacramento County Water Agency's Vineyard Surface Water Treatment Plant which is the first large surface water treatment plant to receive approval from CDPH to be operated remotely.

2.5 Sustainable Design, Construction and Operation in Building Technology

We understand that CAW has elected to forego a formal Leadership in Energy & Environmental Design (LEED®) certification process for this facility, but that many of the desired design and construction features that qualify for LEED® certification are desirable. MWH has included numerous sustainable features in our proposed design including efficient use of energy in process equipment as well as for lighting and HVAC of appropriate systems/buildings. Waste minimization and pollution prevention are key themes of our construction methods and operational design practices.

Realizing that ocean water reverse osmosis desalination systems are large energy consumers, MWH experts review options for energy reduction and recovery as a standard practice. MWH-designed desalination plants incorporate energy recovery devices to take residual energy from the RO process and convert it into useful power to assist in the desalination process. Other techniques for energy reduction and recovery are also evaluated and combined for significant energy savings.

For the Corona Del Mar Water Treatment Plant, a key component to this design-build project was the design and construction of a new 9,100-sf lab/administration/control building, which was certified as LEED® Gold. GWD is one of the first water districts in California to receive this achievement on one of its buildings. Additional examples of MWH's proven approach to sustainable design were presented in our Statement of Qualifications.

2.6 Spill Protection/Secondary Containment for Liquids

Our design complies with CAW's requirements for spill protection and secondary containment. Groundwater is protected from process fluids including all seawater, RO concentrate, RO chemical waste and treatment chemicals. Saline fluid waste is separated from non-saline wastewater to minimize the salinity of sanitary wastes. A curbed pump area is provided for saline fluid waste; this water is collected and pumped to the concentrate equalization basin. Tank overflows from the Filtered Water Storage Tank and the Flush Tank are directed to the Spent Backwash Water Basin or the distribution system, respectively. All tanks are provided with level monitoring plus independent high-level switches and alarms. The Finished Water Storage Tanks are not provided with secondary containment.

All chemical storage tanks and feed systems are located within concrete curbs/walls to provide secondary containment in the event of leaks. All buried chemical piping is provided with secondary containment per Attachment 1 provided with Appendix 2 of the RFP. Liquid spill containment is provided at all liquid chemical off-loading stations.

2.7 Site Arrangement – Integrated vs. Campus Layout

Our proposed site layout (see Drawing Nos. C-1 through C-5 for the 9.6 mgd Base Project and the 6.4 mgd Reduced Capacity Base Project) locates the administration facilities, the RO processes and the primary chemical facilities in separate buildings (i.e., campus layout), but in close proximity to each other to enable access by walking between each building. Other treatment/process functions are also within walking distance of the administration facilities, but further away than the RO and chemical facilities. A campus layout provides better flexibility for future expansion and/or process modifications than does an integrated building layout. Although a campus layout requires slightly more walking for the operators, we believe this is a very efficient layout which will provide good service to CAW and the operations/maintenance staff.

2.8 Safety

Our proposed layout and facility design emphasizes safety and exceeds Occupational Safety and Health Administration (OSHA) standards. Use of ladders is minimized except for access to the tops of chemical tanks. We have diligently avoided the use of vaults and other confined spaces. Access to equipment meets all industry norms.

2.9 Redundancy

Our design provides process, equipment and mechanical redundancy such that the plant can operate at design capacity (firm capacity) with any single process unit out of service, including chemical feed systems and chemical feed piping.

2.10 Process Overflows

All processes have overflows which safely direct excess flow away to protect structures, personnel and the environment. All key tanks and process storage elements will have independent high-level switches/alarms, as well as level monitors.

The Filtered Water Storage Tank will overflow to the filter wastewater basins, which will be recycled to the head of the plant. The Flush Tank (combined permeate tank) will overflow to the MRWPCA outfall. The RO CIP Tank will overflow to the CIP sump, which will send waste to the neutralization tanks. Prior to discharge, overflows will be collected in the plant drain lift station and then pumped to the MRWPCA outfall.

2.11 Coastal Marine Environment and Corrosion Control

In a seawater desalination plant, there are many areas within the plant that have the potential for accelerated corrosion. To ensure that functional use of facilities affected by a particular environment is maintained for the design life, materials of construction and protection techniques must be selected suitable to the specific environment. Our design has carefully considered the corrosion potential due to the coastal marine environment, and our use of metallic materials has been avoided as much as possible. Providing CAW with a facility that has a long service life and with long-term aesthetic appeal is paramount to our design philosophy.

For materials that are permanently exposed to seawater or RO concentrate via submergence or splashing, duplex or super duplex stainless steel is recommended for metallic materials (PREN $\geq$ 40 for super duplex and PREN $\geq$ 28 for duplex). MWH will use concrete with Type II, V dual certified cement. High-range water reducing admixtures and Xypex Admix C-5000 will also be used to increase the workability and provide uniform cement distribution throughout the mix.

2.12 Saline Water and Corrosion Control

Fiberglass reinforced pipe (FRP) or high density polyethylene (HDPE) has been selected for use for the majority of piping through the treatment facility. These pipe materials are suitable for use in saline environments and on saline waters to assist in the prevention of corrosion.

3.0 RAW WATER QUALITY

Raw water quality data were provided in the Request for Proposals, Appendix 2 – Attachment 2 and is summarized in **Table 3-1**. These values were used to design the base project. In addition, the water quality estimates that were used to complete Proposal Form 17 are also shown in **Table 3-1**.

Table 3-1: Raw Water Quality, Provided in RFP

Parameter	Units	Design Value (mg/L seawater) **Provided by CAW**		**MWH Expectation** (mg/L seawater)	Design Value (mg/L seawater) **Calculated by MWH**[1]				
		Average	Design Maximum	Design Maximum	WQ 1	WQ 2	WQ 3	WQ 4	WQ 5
Applicable for the Pretreatment System									
Color	color units	-	9	-	-	-	-	-	-
Turbidity	NTU	-	10	2	-	-	-	-	-
Total Organic Carbon	mg/L	-	4	-	-	-	-	-	-
Iron, total	mg/L	-	2	0.1	-	-	-	-	-
Manganese, total	mg/L	-	0.2	0.01	-	-	-	-	-
Applicable for the Reverse Osmosis System									
Salinity	PSS	33.57	37	35.0 (Design Point)	24	28	32.2	34.6	38
Specific Gravity[2]		1.025	1.028	-	1.018	1.021	1.024	1.026	1.028
Total Dissolved Solids (TDS)[3]	mg/L	34,406	38,019	-	24,421	28,577	32,968	35,489	39,075
Temperature	°C	12	8 to 20	11 to 15 (Maximum Range)	-	-	-	-	-
Chloride	mg/L	19,030	21,000	-	13,507	15,806	18,235	19,629	21,613
Sodium	mg/L	10,604	11,700	-	7,527	8,808	10,161	10,938	12,043
Sulfate	mg/L	2,667	2,900	-	1,893	2,215	2,556	2,751	3,029
Magnesium	mg/L	1,262	1,400	-	896	1,048	1,209	1,302	1,433

Parameter	Units	Design Value (mg/L seawater) **Provided by CAW**		**MWH Expectation** (mg/L seawater)	Design Value (mg/L seawater) **Calculated by MWH**[1]				
		Average	Design Maximum	Design Maximum	WQ 1	WQ 2	WQ 3	WQ 4	WQ 5
Calcium	mg/L	405	500	-	287	336	388	418	460
Potassium	mg/L	392	570	-	278	326	376	404	445
Bicarbonate	mg/L	105	150	-	75	87	101	108	119
Carbonate	mg/L	16	-	-	-	-	-	-	-
Bromide	mg/L	71	110	-	50	59	68	73	81
Silica	mg/L	1.3	30	-	0.92	1.08	1.25	1.34	1.48
Barium	mg/L	0.013	0.16	-	0.009	0.011	0.012	0.013	0.015
Strontium	mg/L	7.81	15	-	5.5	6.5	7.5	8.1	8.9
Fluoride	mg/L	1.28	2	-	0.9	1.1	1.2	1.3	1.5
Boron	mg/L	4.8	5.4	-	3.4	4.0	4.6	5.0	5.5
pH	mg/L	8	8.3	-	8	8	8	8	8

1. The water qualities designated as WQ 1 – WQ 5 are based on the salinities provided in Proposal Form 17, Table 1 of the RFP. The provided salinities were converted to TDS, taking into account the variation in specific gravity with changes in salinity. The individual constituents were estimated by multiplying the Average constituent values by a ratio of the estimated TDS to the Average TDS. For example, to determine the WQ 1 chloride level, the Average chloride (19,030 mg/L) was multiplied by 24,421 mg/L over 34,406 mg/L, to give a WQ 1 chloride value of 13,507 mg/L.
2. All specific gravity values were calculated by MWH, based on the given salinity.
3. All TDS values were calculated by MWH, based on the given salinity and specific gravity corresponding to that salinity.

4.0 FINISHED WATER QUALITY

Finished water quality requirements for the Project were provided in the RFP and are summarized in **Table 4-1**.

Table 4-1: Finished Water Quality, Provided in RFP

		Pretreatment Effluent		Combined RO Permeate		Finished Water After Stabilization	
Parameter	Units	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]
General and Inorganic							
Total Dissolved Solids (TDS)	mg/L						300
Turbidity[3]	NTU	0.15	1.0	0.1	0.5	0.5	1.0
Silt Density Index (SDI)[3,4]	min^{-1}	3	4				
Boron	mg/L			0.5	0.7	0.5	0.7
Chloride	mg/L			60	100	60	100
Bromide	mg/L			0.3	0.5	0.3	0.5
Sodium	mg/L			35	60	35	60
Iron, total	mg/L	0.06	0.10				
Manganese, total	mg/L	0.03	0.05				
Product Water Stabilization[5,6]							
Hardness, total	mg/L as $CaCO_3$					40 to 100	–
pH	pH units					7.7 to 8.7	–
Alkalinity, total	mg/L as $CaCO_3$					40 to 100	–
Langelier Saturation Index (LSI)	–					0 to 0.2	–
Calcium Carbonate Precipitation Potential (CCPP)	mg/L					0 to 5	–
Zinc Orthophosphate	mg/L as PO_4					Set by Owner within the range of 1.0 to 3.5 mg/L	3.5
Disinfection and Disinfection Byproducts (DBPs)							
Total Chlorine Residual	mg/L as Cl_2					Set by Owner for a target of 2 mg/L, within the	3.5 mg/L

Parameter	Units	Pretreatment Effluent		Combined RO Permeate		Finished Water After Stabilization	
		Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]
						range of 1.5 to 2.5 mg/L	
Trihalomethanes, total (TTHM)[7]	µg/L					40	64
Haloacetic Acids, total of 5 (HAA5)[7]	µg/L					30	48
Total Nitrosamines[7,8]	ng/L					5	8
Bromate	µg/L					5	8

1. The average of the measured concentrations shall be below the Maximum Average Concentration at all times. This footnote does not apply to (a) turbidity or SDI, or (b) finished water total hardness, pH, alkalinity, LSI or CCPP; separate footnotes apply to these parameters. Maximum Average Concentration cannot be exceeded during the applicable period, which shall be (i) daily for continuous samples and samples collected every 15 minutes; and (ii) for the duration of the Acceptance Test, for samples collected daily or weekly.
2. No measurement shall exceed this value, at any time.
3. Measured values must be less than the “maximum average” concentration 95% of the time.
4. The maximum SDI limit applies unless more stringent requirements apply based on the SWRO membrane supplier warranty.
5. The Owner will set the conditions for product water stabilization to minimize corrosion in the existing distribution system. Conditions will likely not be set for all of these parameters concurrently.
6. Finished Water shall be within the “target range” at all times, where the target range is the target concentration set by the Owner, plus or minus the allowed variance shown in Appendix 7.
7. TTHM, HAA5, and total nitrosamine concentrations shall be determined using the Simulated Distribution (SDS) test method in Standard Methods (Method 5710C). Samples of the finished water where it enters the distribution system shall be collected, with no adjustment of chlorine residual or pH, and held at the temperature of the finished water at the time of collection (±2ºC) for a 48-hour holding time.
8. Total Nitrosamines includes the 6 nitrosamine compounds on the EPA’s UCMR2-List 2; NDEA, NDMA, NDBA, NDPA, NMEA and NPYR.

5.0 RAW WATER PUMPING

Others are responsible for the design and construction of the raw water supply and conveyance systems including: 1) slanted slant seawater wells and pumps, 2) raw water pipeline to the Project site boundary, and 3) electrical, controls and communications between the raw water pumps and the Project facilities. MWH will be responsible for design-build of the raw water pipeline (and the fiber optic cable) from the property boundary to the pretreatment facilities as well as integration of the control of the slant well pumps. The raw water pipe size is 48 inches and is based on future expansion to 12.8 mgd (29.2 mgd feedwater flow) and 14.4 mgd (38.2 mgd feedwater flow) with all trains running. The raw water supply pumps will be able to deliver the proper flow/volume of water using a HGL at the Project site of 155 feet MSL.

6.0 PRE-TREATMENT SYSTEM WITH GRANULAR MEDIA FILTRATION

The RFP and Appendix 2 require the use of pre-treatment filtration to remove iron and manganese which may be present in the seawater supply from the slant wells. Also, consideration of the potential need to coagulate/filter suspended solids (turbidity) in the influent supply must also be given. The baseline pre-treatment system includes pressure filtration using multiple granular media filter vessels with filtered water stored in two tanks which are discussed below. Sodium hypochlorite may be added to the influent supply to provide oxidation and disinfection benefits. The filter media is to be backwashed using filtered water stored in the tanks and the waste filter washwater is to be equalized, clarified and recycled using a washwater recovery system as discussed below. The granular media filters also need to provide filter-to-waste capabilities which will also be equalized and recycled.

This section of the proposal addresses the baseline plant capacity of 9.6 mgd finished water production capacity as well as the 6.4 mgd capacity. Space is allocated on the site for possible 12.8 mgd pre-treatment capacity, as well as for an alternative pretreatment system if an open ocean seawater intake is determined to be necessary versus the anticipated slant wells.

6.1 Design Criteria

The pretreatment system is size to provide sufficient flow to the RO system in order to meet either the 9.6 mgd or 6.4 mgd demand. The design flows for the raw water and pre-treatment systems are summarized in **Table 6-1**.

Table 6-1: Pre-Treatment Design Flows

Description	Proposed	Units
RO System Efficiency	44%	percent
Pretreatment Capacity (9.6 mgd Design)	24.1*	mgd
Pretreatment Capacity (6.4 mgd Design)	16.1*	mgd

1. Includes 10 percent washwater recycle.

An influent flowmeter will be installed prior to the granular media filters and upstream of the recycle return line. The flowmeter will be above-ground with appropriate hydraulic conditions to meet accuracy requirements. A flow meter on the washwater return pipe will also be provided.

A sodium hypochlorite injection system with a static mixer will be included. The static mixer and chemical injection port will be above-grade. An emergency eyewash/safety shower will be located near the chemical injection ports.

Table 6-2: Granular Media Filtration – Design Criteria

Description	Proposed	Units
Number of Filters (9.6 mgd Finished Water Capacity)	14 (12+2)	each
Number of Filters (6.4 mgd Finished Water Capacity)	10 (8+2)	each
Maximum Flow per Unit	2.0	mgd
Diameter	8	ft
Length (Straight Side)	44	ft
Filtration Rate (Finished Water Capacity plus Washwater Recycle)	3.94	gpm/sf
Filter Media – Sand		
Depth	12	inches
Effective Size	0.45 – 0.55	mm
Filter Media – Anthracite		
Depth	18	inches
Effective Size	0.65 – 0.85	mm
L/d Ratio	1,218	
Underdrain	Lower Plenum with Slotted Nozzles	
Pressure Filter Vessel		
Configuration	Single Cell	
Materials of Construction	Steel with Neoprene Rubber Lining	
Personnel Access	Two (2) Flanged Hatches (24" diameter)	
Media Inspection Port	Two (2) six-inch flanged nozzles	
Drain	3	Inch
Backwash Supply		
Number of Pumps	2 (1+1)	each
Design Bed Expansion	30	%
Maximum Backwash Rate	15.3	gpm/sf
Flow	5,400	gpm @ 40 ft
Flow Control	Modulating Valve	
Backwash Pump Horsepower (each)	75	HP
Filter Backwash Waste		
Number of Backwashes Per Day	2	each
Backwash Volume Per Backwash	140	gallons/sf
Maximum Daily Washwater Volume	1.2	MG
Filter to Waste Volume Per Backwash	20,820	gallons
Maximum Daily Filter to Waste Volume	0.5	MG
Maximum Daily Flow to Wastewater Basins	1.7	mgd

Description	Proposed	Units
Number of Wastewater Basins	2	each
Wastewater Basin Volume (Each)	170,000	gallons
Materials of Construction	Lined Earthen Basin	
Recycle Pumping		
Type	Submersible with VFD	
Number of Pumps	3 (2+1)	each
Flow (9.6 mgd Finished Water Capacity)	765	gpm @ 75 ft
Flow (6.4 mgd Finished Water Capacity)	550	gpm @ 75 ft
Recycle Pump Horsepower (9.6 mgd Finished Water Capacity, each)	20	HP
Recycle Pump Horsepower (6.4 mgd Finished Water Capacity, each)	15	HP

6.2 Filter Media

The RFP and Appendix 2 recommends a 30-inch deep dual media of anthracite over sand to achieve optimal filtration performance, using 12-inches of 0.45-0.55 mm effective size sand under 18-inches of 0.65-0.85mm effective size anthracite. The media shall be supported by graded gravel. While the RFP recommends an underdrain system constructed of a PVC header encased in concrete using replaceable, non-metallic flow distribution nozzles, MWH has proposed a lower plenum with slotted nozzles for underdrain. This type of underdrain is easier to fabricate and install (there is no onsite concrete placement), easier to repair (nozzle replacements are common with age), and this is a common method of construction for horizontal pressure filters (rubber lining is applied and then slotted nozzles are placed). In addition, this type of underdrain is better for water and air distribution, and consistently provides a maldistribution of flow during backwash that is well below 10%. While this type of underdrain is less expensive than the PVC header encased in concrete, there is also no change to the media profile. This type of media and support system will be used within each filter vessel at the rated capacity of 2 mgd per filter at a maximum filtration rate of 4.0 gpm/sf. The filter media will be pre-conditioned with permanganate solution prior to initial service to establish a manganese dioxide (MnO_2) coating for manganese removal.

6.3 Pressure Filter Vessels

The granular media filters will be single-cell and manufactured of steel in accordance with ASME unfired pressure vessel and will be code-stamped. The filter vessels will be lined with an NSF-listed neoprene rubber lining to protect against corrosion by seawater; minimum ¼-inch thick Enduraflex black, soft neoprene lining.

Each filter shall have a special exterior coating system to protect against the coastal marine environment.

Each filter will be provided with two (2) flanged hatches (24-inch diameter) with self-supporting davit. Each filter will be provided with two (2) media inspection ports (6-inch flanged nozzles) located top-dead-center. Each filter will be provided with a 3-inch drain connection.

6.4 Air Wash or Surface Wash

The baseline pressure filter design uses a water-only backwash system for cleaning the filter media. Each filter vessel will be provided with an appropriately-sized nozzle with blind flange to accommodate future air wash system.

6.5 Filter to Waste

Each filter will be equipped with filter-to-waste (FTW) capability, and the FTW flow will be measured and adjustable up to the maximum flow rate of the filter. Filter effluent turbidity will be monitored during FTW. The FTW handling system shall allow for a maximum duration of 15 minutes. The FTW water will be piped to the washwater equalization and recycle system as discussed below.

6.6 Washwater Collector

The washwater collector system (influent distributor) will be non-metallic and located at least 18-inches above to surface of the filter media.

6.7 Underdrain Maldistribution

The filter underdrain will be non-metallic. Maldistribution of flow will not exceed 10%.

6.8 Air Release

Each filter will be equipped with an air-release valve to vent trapped air/gas.

6.9 Wastewater Sampling

A sampling tap will be provided on the washwater effluent pipe from each filter.

6.10 Filter Instrumentation

Each filter will have its own effluent flowmeter and modulating flow control valve to allow filters to be operated in either constant-rate mode or declining rate mode. Each filter will have a loss-of-head differential pressure transmitter. Each filter will have its own effluent turbidimeter.

6.11 Valves

All valves associated with the pressure filter operations will be butterfly-type with valve position indicators. All open-close actuators will be pneumatic and all modulating valves shall have electric actuators with a local control assembly. Each filter will have a local control panel for the pneumatic valves to allow open-close operation during maintenance.

6.12 Housing

The head-ends of all granular media filters, with face piping and valves and other instrumentation, will be enclosed in the Granular Media Filtration Building, with the remainder of each filter being outdoors.

6.13 Backwash and Backwash Supply

Backwash water supply for the granular media filters will come from the filtered water storage tanks as described below. Two (2) backwash pumps will be installed in a "1+1" installation with a rated capacity of 5,400 gpm to provide for at least 30% filter bed expansion with the 8' diameter by 44' long horizontal granular media filters. The backwash pumps will be horizontal, end-suction pumps installed on an outdoor concrete pad adjacent to the four (4) filtered water pumps that deliver water to the RO cartridge filters, which are discussed below.

The backwash supply system will be equipped with a flowmeter and electrically-actuated butterfly valve to provide the desired range of flows during the backwash cycle (low rate-high rate-low rate). Only one (1) filter will be washed at a time. The backwash sequence will be automated and can initiate based on run time, headloss or turbidity. The backwash sequence can also be operator-initiated. The FTW sequence will also be automated and can terminate based on time, volume or filtered water turbidity.

6.14 Filter Backwash Waste Settling and Recycle

The waste backwash water and the FTW water from each filter will be diverted to the washwater handling system for clarification and recycle. The **maximum** daily washwater volume to be handled for 9.6 mgd finished water capacity will be 1.7 mgd based on 200 gal/sf unit backwash plus filter to waste volume and two (2) filter washes per day . The total daily backwash plus filter to waste volume is less than 10 percent of the maximum plant influent flowrate of 21.9 mgd. However, the recycle pumps are sized for 10 percent of the influent rate in the event that extended backwashes are needed. If the plant is operating at less than full capacity, the recycle flowrate will be maintained less than 10 percent at all times.

For the 6.4 mgd finished water capacity, the corresponding waste volumes and recycle rates will be proportionally less than the values in the paragraph above.

Two (2) lined, earthen washwater equalization/clarification basins will be installed using similar materials and construction techniques as discussed in Section 10.2 for the Concentrate Equalization Basins. Each washwater basin will have a nominal maximum working volume of 170,000 gallons, which is the same for the 9.6 mgd finished water production capacity and for the alternative 6.4 mgd finished water production capacity. This volume provides for at least one (1) year of solids storage as well as to provide optimal solids settling. These basins will normally act as flow-through clarification basins with influent flow entering from one end and effluent flow being drawn through a floating decanter to the recycle/decant structure at the other end of the basin. Redundant level monitoring and high-level switch/alarms are provided in each basin. The basin influent piping will provide for a chemical injection port to add polymer as a settling aid, if needed to optimize basin performance.

The basins are designed to provide for annual sludge removal from the bottom using a vactor-truck system. Solids removal and dewatering, prior to off-site disposal, is understood to be provided by a contractor to be furnished by the Owner.

6.15 Recycle Pumping

The overflow/decant from the washwater basins will be collected in a sump at the end of the basins. Three submersible recycle pumps will be installed in a 2+1 installation with a rated capacity of 765 gpm each to be able to recycle up to 10% of the maximum plant influent flow of 21.9 mgd for the 9.6 mgd finished water production capacity (550 gpm each for the 6.4 mgd capacity alternative). Each pump will have a VFD drive. The combined recycle return piping will have an above-ground flowmeter to ensure that recycle flow is never greater than 10 percent of plant influent flow and a turbidimeter will also be installed for continuous monitoring to ensure that recycled turbidity is less than 2 NTU. The pump operation will be controlled based on basin levels along with flow control. The electrical motor starters are located inside the Electrical Switchgear Building.

7.0 FILTERED WATER STORAGE TANKS

The filtered water storage and pumping element of the Project provides many functions for the project including flow balancing and backwash storage prior to pumping the pre-treated seawater to the cartridge filters upstream of the RO system. The Second Pass RO concentrate stream is also recycled to this tank. Two separate sets of pumps will use the tanks as a wet well including: 1) RO feed pumps and 2) backwash supply pumps. Water flows under pressure from the pressure filter system into the storage tanks. Since the pre-treated water is saline seawater, special attention much be made to material selection to minimize corrosion impacts.

7.1 Design Criteria

CAW requires two 300,000 gallon Filtered Water Storage Tanks to operate in parallel when both tanks are in service for both the 9.6 mgd and 6.4 mgd capacity alternatives, with inlet piping as identical as possible to obtain a reasonably-equal flow to each tank. During infrequent periods when a tank will be inspected, cleaned and maintained, only one tank will be in service, and the tanks' inlet and outlet piping design accommodates these requirements. With a single tank in service, the plant's operating conditions may need to be adjusted (compared to two tanks in service) to maintain minimum tank level.

The RFP and Appendix 2 require that the Filtered Water Storage Tanks be constructed of bolted steel with a glass-fused lining (AWWA D103) to maximize protection of the metal from the corrosive effects of seawater. The tank roofs' shall be a self-supporting aluminum dome. Each tank shall be provided with an anti-vortex baffle at the outlet(s) to minimize air entrainment. Each tank shall be provided with a sanitary lip (removable) to minimize the potential of accumulated of solids at the bottom of the tank from washing into the tank outlet.

Each Filtered Water Storage Tank will be provided with:

- Level monitoring and high-level switches/alarms.
- An independent drain to the Concentrate Equalization Basin.
- Three points of access (2 on sidewall and 1 at top) that can be secured.
- Its own overflow system (with check valve) to handle the maximum influent flow (24 mgd).
- Security devices to prevent climbing the tank by unauthorized personnel.
- Anti-tamper vents.

Overflow from each tank will be directed to the Spent Backwash Water Basin.

Design criteria for the Filtered Water Storage Tanks are summarized in **Table 7-1**.

Table 7-1: Filtered Water Storage Tanks – Design Criteria

Description	Proposed	Units
Number of Tanks (9.6 mgd and 6.4 mgd Finished Water Capacity)	2	each
Volume (Each)	300,000	gallons
Materials of Construction	Coated Bolted Steel with Aluminum Dome Roof and Glass-Lined Sidewall Panels	
Level Control	Continuous with Independent High Level Switch	

8.0 FILTERED WATER PUMP STATION

The filtered water stored in the two Filtered Water Storage Tanks will be pumped through the cartridge filters at the head end of the RO process and provide minimum pressure to the RO process. These pumps will be co-located outdoors on a concrete pad with the backwash supply pumps for the granular media filters as discussed above. The electrical motor starters are located inside the Electrical Switchgear Building. Power metering will be provided for these pumps.

Four (4) pumps total will be installed (3+1) as described in **Table 8-1**.

Table 8-1: Filtered Water Pumps – Design Criteria

Description	Proposed	Units
50% Design Capacity		
Number of Pumps	2	each
Type	Horizontal, End-Suction	
Materials of Construction	Super Duplex Stainless Steel	
Drive	Constant Speed	
Flow Rate (9.6 mgd Finished Water Capacity)	7,600	gpm @ 140 ft
Pump Horsepower (9.6 mgd Finished Water Capacity)	350	HP
Flow Rate (6.4 mgd Finished Water Capacity)	5,100	gpm @ 140 ft
Pump Horsepower	250	HP
VFD	No	
25% Design Capacity		
Number of Pumps	2	Each
Type	Horizontal, End-Suction	
Materials of Construction	Super Duplex Stainless Steel	
Drive	Variable Speed	
Flow Rate (9.6 mgd Finished Water Capacity)	3,800	gpm @ 140 ft
Pump Horsepower (9.6 mgd Finished Water Capacity)	175	HP
Flow Rate (6.4 mgd Finished Water Capacity)	2,5500	gpm @ 140 ft
Pump Horsepower (6.4 mgd Finished Water Capacity)	125	HP
VFD	Yes	

9.0 REVERSE OSMOSIS SYSTEM

RO is a state-of-the-art technology used in large-scale desalination of ocean waters, which typically contain total dissolved solids (TDS) upwards of 35,000-42,000 mg/L. The RO system will be used to remove salts and nutrients from seawater in order to match the water quality goals established in Section 4.0 Finished Water Quality.

Filtered water from the Filtered Water Tanks will be pumped through 5-micron cartridge filters, which will be located upstream of first pass feed pumps. From the cartridge filters, the filtered water will flow to the RO First Pass High Pressure (HP) pumps, which will pressurize the feedwater to the First Pass seawater RO (SWRO). SWRO feed pressure requirements will depend upon a number of factors including source water temperature, feedwater salinity, recovery, extent of membrane fouling and membrane compaction. In order to minimize the size of the first pass feed pumps, an energy recovery device (ERD) will utilize residual pressure in the first pass concentrate to pressurize a portion of the first pass feed flow. Permeate from the lag (end) elements of the six first pass trains will be collected in a single header and sent to the three second pass RO trains. The second pass is required to meet the finished water quality goals established in Section 4.0. The second pass feed pumps will provide pressure to the second pass brackish water RO (BWRO). Permeate from the lead (front) elements of the first pass will go directly to UV System. Permeate from the second pass will supply the Flush Tank. Most of the BWRO permeate will overflow to the UV System but a portion will be used for RO permeate flushes, RO cleans-in-place (CIP), and as carrier water. Concentrate from the first pass (after passing through the ERD) will be sent to the concentrate outfall line. Concentrate from the second pass will be returned to the filtered water tank.

All materials in the RO system that are in direct contact with water shall be NSF 61 certified.

9.1 Manufacturers

MWH Treatment (formerly Biwater) will serve as the RO equipment manufacturer (ROEM). MWH Treatment meets all requirements as stated in Proposal Form 1, Attachment 4. All equipment being proposed for the RO system will be provided by manufacturers listed in Appendix 2, Attachment 4.

9.2 RO Model Runs

RO model runs were conducted using the proprietary software, Toray Design Systems 2.0, last updated in February 2013. To determine the requisite number/type of elements and minimum/maximum required feed pressures for each pass, a number of design conditions were evaluated, as shown in **Table 9-1**. Toray model runs are included **Appendix B**. Results from the Toray models were input into a spreadsheet model provided by Energy Recovery Inc. (ERI), in order to determine the model and number of energy recovery devices required for each RO train. ERI results are included as **Appendix C**.

In addition, a number of additional models were run using new membranes, varying salinity and temperature in order to determine the range of electricity utilization. Those results are presented as Proposal Form 17, Tables 1 and 2.

Models focused on finished water quality demonstrate compliance with the maximum average and not-to-exceed combined RO permeate concentrates for constituents of concern (boron, chloride, bromide and sodium). These results and model runs are included in Proposal Form 18, Table A7-14.

Table 9-1: RO Model Runs

Case Name	Inputs	Determined…
Worst Case Water Quality	Worst-case feed WQ Warmest temperatures Old membranes (Year 5, where average membrane age will be 4 years)	The number and type of elements needed to meet all finished water requirements.
Max Feed Pressure	Worst-case feed WQ Coldest temperatures New membranes (Year 5, where average membrane age will be 4 years)	The maximum required feed pressure.
Min Feed Pressure	Best-case feed WQ Warmest temperatures New membranes (0.25 yrs)	The minimum required feed pressure.
Design Case - New	Design Average Salinity Design Average Temperature New membranes (0.25 yrs)	The normal operation of the system with new membranes.
Design Case - Old	Design Average Salinity Design Average Temperature Old membranes (Year 5, where average membrane age will be 4 years)	The normal operation of the system with old membranes.

9.3 Cartridge Filters

Cartridge filters are commonly utilized as additional protection for the RO membrane elements to capture any final particles of suspended solids that may enter the feed stream. In addition, cartridge filters are required as part of many RO membrane manufacturers' warranties. Horizontal filters will be provided for each RO train. The design meets all access requirements established in the RFP. The design criteria for the cartridge filters are shown in **Table 9-2**.

Table 9-2: Cartridge Filter Design Criteria

Description	Proposed	Units
Maximum Effluent Turbidity	0.5	NTU
Effluent SDI	≤ 2 min^{-1} 95% of the time, < 4 min^{-1} at all times	
Pressure vessel standard	ASME Boiler and Pressure Vessel Code, Section VIII	
Filter Orientation	Horizontal	
Vessel Material	AL-6XN stainless steel (must meet or exceed ASME Section VIII Code for high pressure vessels)	
Vessel Design Pressure	150	psi
Vessel O-rings/gaskets	Buna-N	
Filter Element Rating	5	micron
Filter Efficiency (minimum)	90%	
Filter Type	String-wound depth cartridges	
Filter Materials	Polypropylene (FDA Grade and ANSI/NSF 61 certified	
Filter O-rings	Buna-N	
Filter Outside Diameter	2.44	inch
Filter Inside Diameter	1	inch
Filter Flow Configuration	Outside-In	
Filter Element Length	40	inch
Maximum Design Loading Rate	4	gpm / 10” length
Maximum Pressure Differential of Clean Filter Elements at Design Loading Rate	4	psi
Differential Loading Rate to Trigger Filter Replacement	20	psi
Filter Replacement Interval	Not less than 2 months	
Feed Flow, Total	10	mgd
Number of Filters (9.6 mgd Design)	7 (6 + 1)	units
Number of Filters (6.4 mgd Design)	5 (4 + 1)	units
Maximum Flow per Unit	3.6	mgd
Elements per Unit	169	elements

9.4 RO System Trains

Each SWRO Train will be an identical, independent train consisting of a first pass feed pump, three first pass skids/modules (single stage with pressure vessels, valves, manifolds and interconnecting piping), energy recovery device (ERD), and ERD booster pump. Lag permeate from the SWRO trains will be collected in a single header and sent for further treatment by the BWRO Trains. Each BWRO Train will be an identical, independent train consisting of a second pass feed pump, and a second pass skid (two stages). The design criteria for the RO trains are shown in **Table 9-3** and **Table 9-4.**

Table 9-3: RO Train Design Criteria – 9.6 MGD

Description	Proposed	Units
Design Combined Permeate Flow	9.6	mgd
Minimum Combined Permeate Flow (2 SWRO Trains, 1 BWRO Train in Operation)	3.2	mgd
Number of SWRO Trains	7 (6+1)	Trains
Number of BWRO Trains	3 (3+0)	Trains
Materials (bolds, nuts, washers, anchors, support systems)	316 SS	
Chloride Tolerance – Feed[1]	24,000	mg/L Chloride
Chloride Tolerance – Concentrate[2]	43,000	mg/L Chloride
Max Number of Stacked Vessels	6	Vessels
Frames and brackets	Epoxy coated carbon steel	

1. Includes first pass SWRO, feed pump, ERD, ERD booster pump, cartridge filters, and all parts in contact with raw seawater.
2. Includes ERD, first pass concentrate piping, first pass concentrate systems and any and all parts in contact with SWRO concentrate.

Table 9-4: RO Train Design Criteria – 6.4 MGD

Description	Proposed	Units
Design Combined Permeate Flow	6.4	mgd
Minimum Combined Permeate Flow (2 SWRO Trains, 1 BWRO Train in Operation)	3.2	mgd
Number of SWRO Trains	5 (4+1)	Trains
Number of BWRO Trains	2 (2+0)	Trains
Materials (bolds, nuts, washers, anchors, support systems)	Same as Above	
Chloride Tolerance – Feed	Same as Above	mg/L Chloride
Chloride Tolerance - Concentrate	Same as Above	mg/L Chloride
Max Number of Stacked Vessels	Same as Above	Vessels
Frames and brackets	Epoxy coated carbon steel	

9.5 First Pass SWRO

The first pass in each train will utilize seawater RO (SWRO) membranes remove the majority of dissolved constituents found in the raw seawater. The design criteria for the First Pass SWRO are shown in **Table 9-5**.

Table 9-5: First Pass SWRO Design Criteria

Description	Proposed	Units
SWRO Lead Permeate Flow, per train	1.0	mgd
SWRO Lag Permeate Flow, per train	0.7	mgd
Recovery	45%	percent
Average flux rate	8.6	gfd
Maximum feed pressure[1]	1,000	psi
Vessels per Train	69	Vessels
Allowance for extra vessels[2]	7	Vessels
Elements per pressure vessel	7	elements
Chemical compatibility	Sulfuric acid Threshold Inhibitor	
Concentrate Disposal	Concentrate Equalization Pond	

1. Occurs during the following conditions: Maximum feed water quality from Table 1 in Appendix 2, Attachment 2 in the RFP; temperature of 8 °C; and Year 5 (average element age of 4 years).
2. Frames will accommodate space and piping for an additional 10% of membranes.

9.6 Second Pass BWRO

Lag permeate from the SWRO trains will be collected and sent to the BWRO trains, in order to meet finished water quality goals. The design criteria for the Second Pass BWRO are shown in **Table 9-6**. A redundant Second Pass BWRO train is not required because the maximum average water quality criteria can be met with one train offline.

Table 9-6: Second Pass BWRO Design Criteria

Description	Proposed	Units
BWRO Permeate Flow, per train	1.2	mgd
Recovery	90%	percent
Average flux rate	14	gfd
Vessels per Train – 1st Stage BWRO	20	Vessels
Vessels per Train – 2nd Stage BWRO	8	Vessels
Allowance for extra vessels - BWRO[1]	3	Vessels
Elements per pressure vessel	7	elements
Maximum feed pH	10	pH
Chemical compatibility	Sodium Hydroxide Threshold Inhibitor	
Concentrate Disposal	Recycled to first pass SWRO feed	

1. Frames will accommodate space and piping for an additional 10% of membranes.

9.7 RO Membrane Elements

The RO elements in the first pass will be Toray TM820R-400 elements. These are Toray's high flow seawater membranes. The second pass membranes are TM720-440 membranes; Toray's low pressure brackish water RO membranes. Desalcott Plant at Point Lisas Industrial Estates in Trinidad, operated by WASA of Trinidad and Tobago, has successfully used TM820 and TM720 elements since 2002.

Each element shall be factory tested by the manufacturer, under the manufacturer's standard published test conditions, and shall meet the performance stated in the manufacturer's standards. Owner reserves the right to have their representative observe factory testing at any time during regular testing. Each element shall meet or exceed the specified salt rejection defined in the membrane manufacturer's data sheets. Certified test data shall be provided to and accepted by the Owner prior to shipment.

- Certified test data shall include:
    - Element serial number
    - Feed flow
    - Recovery
    - Productivity
    - Rejection

The design criteria for the RO elements are shown in **Table 9-7**.

Table 9-7: Membrane Element Design Criteria

Description	Proposed	Units
First Pass Salt Rejection	99.5%	percent
First Pass Boron Rejection	95% at pH 8	percent
Second Pass Salt Rejection	99.7%	percent
Element size (first and second pass)	8	inch diameter
Element Square Footage (First Pass)	400	square feet/element
Element Square Footage (Second Pass)	440	square feet/ element

9.8 RO Pressure Vessels

The RO pressure vessels shall be pressure rated and stamped in accordance with the ASME Boiler and Pressure Vessel Code – Fiberglass Reinforced Pressure Vessels. Pressure vessels shall be coated with an ultraviolet light resistant coating. Each vessel shall be tested at the manufacturer's facility. A certified copy of the test data shall be submitted and approved by the Owner prior to shipment.

The design criteria for the RO pressure vessels are shown in **Table 9-8**.

Table 9-8: RO Pressure Vessel Design Criteria

Description	Proposed	Units
SWRO Pressure Vessels Rated Working Pressure	1,200	psi
BWRO Pressure Vessels Rated Working Pressure	400	psi
Feed Port Location	Vessel sidewall	
Concentrate Port Location	Vessel sidewall	
First Pass Vessel Port Material	Super Duplex Stainless Steel	
Second Pass Vessel Port Material	High Grade Stainless Steel	

9.9 RO First Pass High Pressure Pumps

The RO First Pass HP pumps will be capable of supplying sufficient pressure to the Pass 1 RO skids under a range of conditions, as discussed in Section 9.2, RO Model Runs. In order to accommodate these varying conditions, the high pressure pumps must utilize variable frequency drives (VFD).

Each RO First Pass HP pump shall be factory testing, at a dedicated test facility, complying with the latest version of the Hydraulic Institute/American National Standard for Rotodynamic Pumps for Hydraulic Performance Tests (HI Standard 14.6). The measurement accuracy shall be Grade 1 as defined by HI Standard 14.6. Pump performance test acceptance grade shall be 1E.

Factory testing shall be performed on actual equipment to be furnished to the job site and shall be performed at a minimum of five flows.

Pump tests shall verify initial performance of new pumps and shall include measurements of:

- Flow
- Head
- Power input to the pump or test motor
- NPSH

Test reports shall include:

- Test data sheets
- Performance test logs
- Equipment performance curves
- Separately indicate equipment guaranteed operating points, including efficiency

Certified factory testing for the RO First Pass HP pump motor shall include:

- Dielectric test on armature
- Insulation resistance
- No load current at rated voltage
- Efficiency and power factor calculated at 100% of full load, at full load speed
- Locked rotor current
- Overspeed test
- Winding resistance
- Balance
- Bearing inspection

The design criteria for the RO First Pass HP pumps are shown in **Table 9-9**.

Table 9-9: RO First Pass HP Pumps Design Criteria

Description	Proposed	Units
Pump Type	Horizontal Multistage Centrifugal	
Efficiency at Design Point	81%	percent
Material of Construction	Super Duplex Stainless Steel	
Variable Frequency Drive (VFD)	Yes	
Installed Units (9.6 mgd Design)	7 (6+1)	units
Installed Units (6.4 mgd Design)	5 (4+1)	units
Flow per Unit	1.7	mgd

As discussed in Section 0, below, the size of the RO First Pass HP pumps is minimized by the utilization of energy recovery devices.

9.10 RO Second Pass Pumps

Permeate from the First Pass will not provide sufficient pressure to operate the Second Pass; therefore the Second Pass skids must be provided with additional pumps. Because the Second Pass has lower feed salinity and uses brackish membranes, the pressure demands on the Second Pass are much lower than the RO First Pass HP pumps. As with the RO First Pass HP pumps, the varying feed conditions (temperature and salinity) will affect the pressure requirements across the Second Pass, requiring the use of a VFD. Testing shall be as listed for the RO First Pass HP pumps.

The design criteria for the RO Second Pass Pumps are shown in **Table 9-10**.

Table 9-10: RO Second Pass Pumps Design Criteria

Description	Proposed	Units
Pump Type	Horizontal Centrifugal	
Efficiency at Design Point	72%	percent
Material of Construction	316 SSL	
Variable Frequency Drive (VFD)	Yes	
Installed Units (9.6 mgd Design)	3 (3+0)	units
Installed Units (6.4 mgd Design)	2 (2+0)	units
Flow per Unit	1.4	mgd
Max Pressure	300	psi

9.11 Energy Recovery Device

Energy recovery devices (ERDs) are used to capture the residual pressure available in the concentrate stream to pressurizing a portion of the feed flow, reducing the flow through the high pressure pumps, and therefore the overall horsepower of the high pressure pumps. See **Figure 9-1** for a schematic.

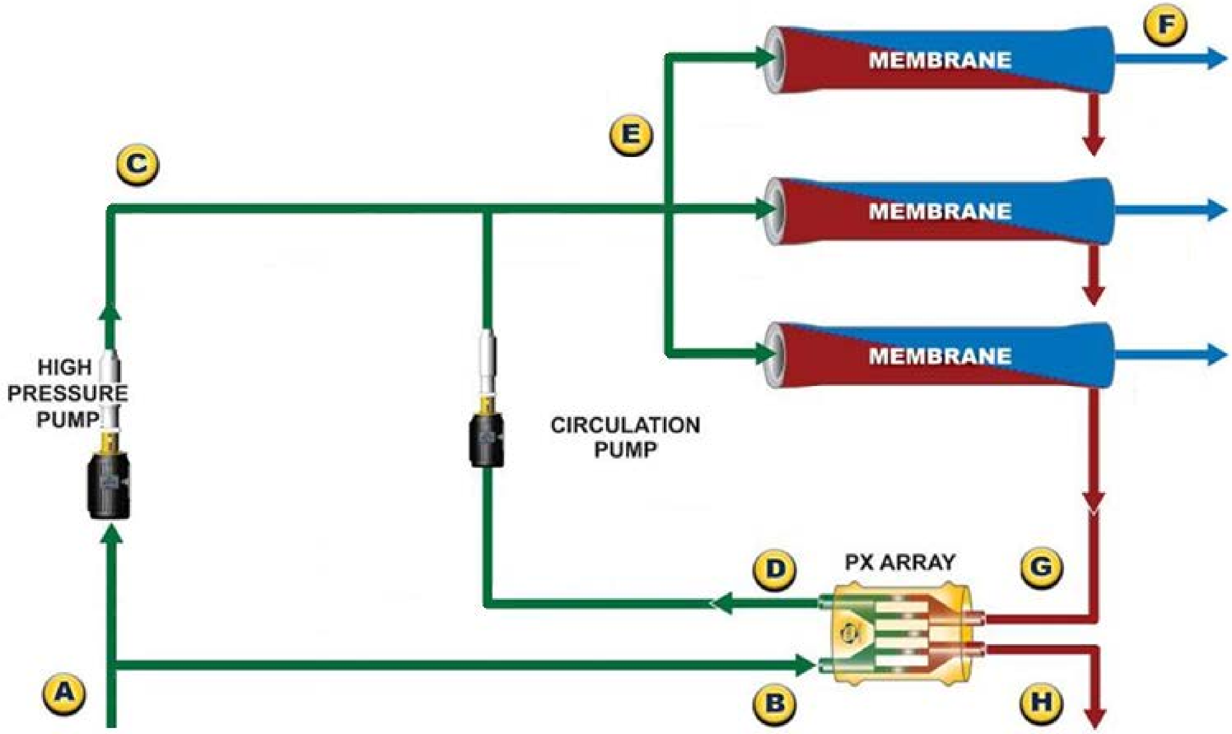


Figure 9-1: Positive Displacement Device (courtesy of Energy Recovery, Inc.)

The feed flow is split into two streams, Stream C is sent through the high pressure feed pumps and Stream B travels to the ERD. Low pressure feed water and high pressure concentrate enter the device and pressure energy is transferred from the concentrate to the feed water. Feed water leaves the device at high pressure and concentrate leaves at low pressure. Because the energy is transferred hydraulically, the efficiency is very high, up to 98%. To make up for friction losses through the RO membrane feed-concentrate channels and through piping, small booster (also called circulation) pumps are installed on Stream D. Some mixing between the First Pass Concentrate and Feed Water will occur, projected to be approximately 2.8%, based on the ERI model. Conductivity meters on the Feed Water entering and leaving the ERD will provide continuous monitoring of mixing.

A reference list for ERI is provided in **Appendix D**.

The design criteria for the ERD are shown in Table 9-11.

Table 9-11: ERD Design Criteria

Description	Proposed	Units
Type of ERD	Positive Displacement	
Number of ERD Units per Train	5	units
Expected Lifetime	25	years
Minimum Efficiency	95%	percent
Mixing	2.8%	percent
Feed Flow (Stream B) per Train	2.0	mgd
Pressure Provided (at max pressure conditions)	980	psi

In order to accommodate pressure losses from the RO membranes and pressure lost in the ERD units, small booster pumps are provided for ERD unit. Due to varying pressure requirements in Pass 1 RO, the ERD Booster Pumps will need to utilize a VFD. The design criteria for the ERD Booster Pumps are shown in **Table 9-12**.

Table 9-12: ERD Booster Pumps Design Criteria

Description	Proposed	Units
Material of Construction	Duplex Stainless Steel	
Pump Type	Horizontal Multistage Centrifugal	
Seal type	Mechanical	
Lubrication	Pumped fluid	
Efficiency at Design Point	67%	percent
Variable Frequency Drive (VFD)	Yes	
Installed Units (9.6 mgd Design)	7 (6+1)	units
Installed Units (6.4 mgd Design)	5 (4+1)	units
Flow per Unit	2.0	mgd
Max Boost Pressure	65	psi

9.12 RO System Piping and Valves

The RO system will generally be comprised of two types of piping, low pressure and high pressure. Information of the locations, designations, type of pipe and type of valves can be found in **Table 9-13**.

Table 9-13: RO System Piping and Valves

Type	Locations	Designation	Pipe	Valves 6” and Smaller
Low Pressure	Ahead of first pass pump, All permeate, First pass concentrate after ERD, CIP lines	18	FRP ASTM D2996, Filament-wound, socket and spigot ends, adhesive bonded	Plastic lined, flanged
High Pressure	After first pass pump, First pass feed after ERD, First pass concentrate ahead of ERD, After second pass pump, Second pass concentrate,	38	Duplex stainless steel	Duplex stainless steel

Interconnecting piping manifolds for the RO trains shall include connections to:

- Feed line
- Permeate line
- Concentrate line
- CIP feed line
- CIP return line
- Flush feed line
- Flush return line
- Waste lines

Backflow prevention will be provided for CIP waste, CIP recirculation and flush waste lines, per CDPH requirements.

Sample ports shall be provided as follows:

- Permeate sample ports on each vessel, such that a probe tube may be passed through for profiling and sampling within the vessel.
- Sample port panel for each train
  - Feed for each train
  - Concentrate for each train
  - Interstage for each train

For ease of maintenance, side ported vessels shall be used. Feed, concentrate and permeate manifolds shall be vertical. Piping shall be run at the ends or alongside the trains in easily accessible pipe trenches. All horizontal runs shall be located beneath trench grating. The system shall be designed such that permeate backpressure cannot exceed the concentrate pressure by more than 5 psi.

9.13 Flush System

Combined permeate (lead permeate from Pass 1 and permeate from Pass 2) will be sent to the Flush Tank. In order to provide proper sanitization of the Flush Tank, a biocide hookup will be provided on the inlet to the Flush Tank.

Two flush pumps will be capable of providing permeate to each First Pass and Second Pass skid and to the Clean-in-Place (CIP) system. The flush system is sized to flush the entire RO system, including the ERDs. The flush system will be plumbed to allow flushing of each train independently, allowing for individual train shutdown and separate flushing for the first and second passes. The first pass can be flushed either through the ERD or through the first pass pumps. Each train shall be provided with flush feed connections, automated flush supply and waste valves. Flush feed connections shall be placed in close proximity to the train itself, without excess piping.

Permeate flushes will occur automatically through the RO PLC whenever the system is shut-down or can be performed manually by the operators. There will be two shutdown flush modes, one when normal power is available, and one when only emergency power is available. During normal shutdown flush, where power is available to the ERD Booster Pump, flush water will be pumped to the low pressure inlet to the ERD. The ERD Booster Pump will continue to operate, pumping flush water from the ERD through the high pressure feed piping, the SWRO membranes, the high pressure concentrate piping, and then out through the spinning ERD units. Seawater will also be displaced from the RO First Pass HP pump during this process as flush water passes through the pump and to drain. The normal flush will provide a very effective flush of the entire RO system with no water hammer or pressure pulsations.

In the case where only emergency power is available, a pressure dump valve on the high pressure concentrate line to the low pressure concentrate discharge line will be opened. The start of the flush pump is delayed until the pressure in the concentrate line drops below the recommended dead head pressure of the flush pumps. At that point, the flush pumps will turn on and permeate will flow through the RO First Pass HP pumps, through the SWRO membranes and out the dump valve. Flush water will also be directed to the low pressure inlet to the ERD, where it will flow through the ERD and to the low pressure concentrate outfall. When pumped at a flowrate near the design concentrate flow rate, this will cause the PX to spin and displace the seawater. This will displace the seawater from the PX units. The HP piping between the SWRO skid and the ERD system, and ERD recirculation pump will not be flushed during the emergency flush.

The design criteria for the Flush Pumps are shown in **Table 9-14** and the design criteria for the Flush tank are shown in **Table 9-15**.

Table 9-14: Flush Pump Design Criteria

Description	Proposed	Units
Pump Type	Horizontal End Suction	
Variable Frequency Drive (VFD)	No	
Installed Units	2 (1+1)	units
Flow per Unit	1,400	gpm
Target Head	115	ft

Table 9-15: Flush Tank Design Criteria

Description	Proposed	Units
Type	Glass Lined	
Number of Tanks	1	each
Volume	120,000	gallons

9.14 Clean-in-Place System

Periodically, the RO membranes will require chemical cleaning to remove fine particulates and other fouling materials that accumulate on the surface of the membranes over time during the routine operation of the RO system. Fouling is evidenced by a decline in mass transfer coefficient (MTC) or an increase in feed-side pressure differential. Membrane elements should be cleaned whenever:

- The normalized permeate flow drops by 10%.
- The normalized salt content of the product water increases by 10%.
- The differential pressure (feed pressure – concentrate pressure) increases by 15% from the reference conditions (initial performance established during the first 24 to 48 hours of operation).
- More than 6 months has passed since a CIP was conducted.

The CIP solutions will be prepared by mixing cleaning chemicals with RO permeate in the RO CIP tank. Chemicals that are anticipated to be used in the typical chemical cleaning process are:

- EDTA
- Sodium hydroxide
- Citric acid
- Sodium bisulfite
- Sulfuric acid

If needed, Sodium Lauryl (Dodecyl) Sulfate is an additional cleaning option.

Chemicals will be added to the CIP recirculation line, which takes water from the CIP tank, passes it through the CIP pumps and returns it to the CIP tank. Additional mixing will be provided by a submersible mixer in the CIP tank. Once a solution of the desired temperature and chemical make-up is reached, the CIP solution will be sent to the section of RO to be cleaned. The CIP will involve several soak and recirculation steps, and each stage must be cleaned independently to avoid transfer of foulants from one stage to another (e.g. first pass, second pass first stage, and second pass second stage should each be cleaned independently); therefore the piping and valving are designed to allow for cleaning of each pass and each stage individually.

The CIP system shall be manually initiated. The CIP system shall be permanently installed and will include the CIP pumps, the CIP tank, tank heater, and a cartridge filter. While the RFP recommends the use of block and bleed valves shall be used at connections between the CIP system and each RO train in order to provide separation for CDPH compliance, MWH has proposed to use drop out pieces of pipe.

An LCP will be provided for the CIP system, located in the CIP area at four feet above the building floor. The LCP shall display:

- Temperature
- pH
- Pump status
- Flow
- Pressure

The design criteria for the CIP Pumps, Cartridge Filters and Tank are shown in **Table 9-16**, **Table 9-17**, and **Table 9-18**.

Table 9-16: CIP Pump Design Criteria

Description	Proposed	Units
Pump Type	Horizontal End Suction	
Variable Frequency Drive (VFD)	No	
Installed Units	1 (1+1)	units
Flow per Unit	2,650	gpm
Target Head	120	ft

Table 9-17: Cartridge Filter Design Criteria

Description	Proposed	Units
Number of Filters	1	UNITS
Maximum Flow per Unit	2,650	gpm
Cartridge Length	40	Inch
Filter Orientation	Horizontal	
Filter Element Rating	5	micron
Chemical Compatibility	Suitable for pH between 2 to 12	

Table 9-18: CIP Tank Design Criteria

Description	Proposed	Units
Chemical Compatibility	Suitable for storage of pH 2 to 12	
Type	Fiberglass Reinforced Plastic	
Number of Tanks	1	number
Volume	12,000	gallons
Heater Design Criteria	Raise CIP solution to 45 °C in 8 hours or less	
Heater Power	200 kW	
Mixer Type	Submersible	

9.15 Neutralization Tank

Waste from the RO CIPs will be sent to the Neutralization Tank to be neutralized with either sulfuric acid or sodium hydroxide, depending on the CIP solution used. Mixing will be provided by the Neutralization Pumps, which can either recirculate through the tank or discharge to a truck for offsite disposal. Neutralized waste will be sent to the waste water treatment plant. A level monitor and high level switch shall be provided to monitor the neutralization tank level and alarm on high level. The design criteria for the Neutralization Tank are shown in **Table 9-19**.

Table 9-19: Neutralization Tank Design Criteria

Description	Proposed	Units
Type	Fiberglass Reinforced Plastic / HDPE	
Number of Tanks	1	each
Volume	17,000	gallons

9.16 RO Membrane Storage and Preservation

The CIP system will also be used for membrane preservation. In the event that an RO train is not operated for more than 24 hours, the train must be flushed with the RO permeate flush system, and then preserved using the CIP system with a sodium bisulfite to prevent the formation of a biofilm on the membrane surface.

9.17 RO System Control and Instrumentation

The RO system shall be controlled by a programmable logic controller ("PLC") based control system, as follows:

- The PLC shall be Allen Bradley and shall communicate with treatment plant instrumentation and control system over data highway.
- An operator graphical interface will be provided to communicate with the system.
- At a minimum, the following information for the RO system feed (downstream of cartridge filter(s)) shall be provided:
    - Temperature
    - Conductivity
    - pH
    - Turbidity

- Flowrate
- Pressure
- ORP

The RO system shall be designed to operate at a constant permeate flow rate. At a minimum, the following information for each RO train shall be relayed to the main plant control system:

- Train Status
- First Pass Feed:
  - Pressure
  - Flowrate
- Second Pass First Stage Feed:
  - Pressures (before and after feed pump)
  - Flowrate
  - Temperature
  - Conductivity
  - pH
- Second Pass Second Stage Feed
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- First Pass Permeate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- Second Pass First and Second Stage Permeate:
  - Pressure
  - Flowrate
  - conductivity
  - pH
- Second Pass By-pass:
  - Pressure
  - Flowrate
- Combined Permeate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- First pass concentrate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- Second pass second stage concentrate:
  - Pressure
  - Flowrate

  - Conductivity
  - pH

- Combined concentrate:
  - Flowrate
  - Conductivity
  - pH
  - Turbidity
  - Temperature

- Differential Pressure (Train, Passes and Stage)
- Feed, Permeate, and Concentrate Valve Positions
- RO Feed Rate and Calculated Recovery Rate
- Alarm Condition for RO Feed Pumps and Energy Recovery Device
- Energy Recovery Device Flowrates, Pressures, and Conductivities of all streams

RO feed temperature, conductivity, and pH shall be monitored at a common influent location. The capability for real-time online normalization shall be provided, for at least specific flux, differential pressure, and conductivity. Sufficient sample points shall be provided on the process system to allow the operator to determine the performance of the RO system. Each stage of multistage trains shall be instrumented. As discussed in 9.12 RO System Piping and Valves, a common monitoring location for RO feed parameters will be provided.

9.18 Spare Parts

A spare parts list can be found in **Appendix E**.

9.19 Special Tools

Any special tools that are necessary for maintenance of the system or for the removal and replacement of membrane elements shall be provided.

A single element test unit shall be provided at the plant for testing of individual membrane elements. The single element test unit shall meet the following requirements:

- The unit shall include a 5-micron cartridge filter, high pressure feed pump, and one 8-inch single element pressure vessel, and instrumentation.
- The unit shall be capable of operating up to 1200 psi.
- A concentrate recycle line shall be included.
- Instrumentation shall be panel mounted, and include instruments for monitoring:
  - Raw feed pressure
  - Post-cartridge filter pressure
  - Permeate pressure
  - Pressure differential across the single element pressure vessel
  - Feed flow
  - Permeate flow
  - Recycle flow
  - Concentrate flow
  - Feed conductivity
  - Permeate conductivity
  - Concentrate conductivity

Sample ports shall be provided for at least the RO feed water (before and after the concentrate recycle line), permeate, and concentrate flows.

9.20 Factory Testing

Factory tests shall be conducted on all actual equipment to be furnished to the job site. Test reports shall be provided to the Owner documenting the performance of each piece of equipment. Equipment guaranteed operating points shall be indicated.

9.21 RO System 14-Day Run-In Test

The 14-Day Run-In Test (Run-In Test) for the installed membrane system shall be tested for 14 days; MWH shall be fully responsible for every aspect of the performance test. The testing protocol shall include, as a minimum, water quality sampling parameters, sampling locations, projected dates of the performance testing, laboratory for the water sample analysis, and time of sampling relative to time zero. Time zero for the membrane system performance testing is the time of the first sample.

As applicable to the equipment furnished, the ROEM shall state in writing that all necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities are ready for startup and intended operation.

After the Design-Build Improvements are operating, but prior to initiation of the 14-day run-in test, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to plant startup. This shall include verification of proper membrane element installation by conducting a conductivity profile on the pressure vessels of each RO train while the train is operating.

- MWH personnel shall conduct the profiles by sampling permeate from the sample valves on each pressure vessel within a given train.
- Those vessels not meeting pre-established conductivity criteria shall be opened up by MWH and examined for proper installation of end connectors and element interconnectors, damaged o-rings, misaligned concentrate seals, and other like causes.
- Any observed deficiencies shall be corrected by MWH and the vessel retested.

Minimum prerequisites prior to initiation of the 14-Day Run-In Test include the following:

- Successful completion of the performance tests for the reverse osmosis trains.
- Completion of membrane element loading and checkout for the reverse osmosis trains.
- Completion of initial startup operations, including successful completion of performance testing on remaining equipment items as specified herein.

Successful checkout of the RO system and performance testing of related ancillary systems shall constitute grounds for substantial completion of the RO system and allow it to proceed to the Acceptance Test.

The test shall be considered complete when, in the opinion of the Owner, the complete treatment system has operated in the manner intended at plant design capacity for 14 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere.

A significant interruption will require the test then in progress to be stopped and restarted after corrections are made. Significant interruption may include any of the following events:

- Failure of Design-Builder to maintain qualified on-site startup personnel as scheduled.
- Failure of any equipment item or treatment subsystems furnished by MWH to meet specified performance requirements for more than 2 consecutive hours.
- Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
- Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
- As may be determined by the Owner.

The following events will not be considered cause for significant interruption:

- Loss of feedwater delivered to the RO System for reasons beyond the control of MWH.
- Loss of power to the plant for reasons beyond the control of MWH.
- As may be determined by the Owner.

At the end of the 14-day run-in test, MWH's representative shall prepare a test report which shall include daily operating and normalized performance data for each day of the test, for each RO train and the system as a whole.

The membrane trains shall be tested under the following conditions. These conditions must be maintained during the entire performance test.

1. Membrane feed water quality shall be as listed in the Projected and Required Water Characteristics table.

2. Water recovery

    a. 45% in Pass 1

    b. 90% in Pass 2

    c. 44% Overall

3. Permeate Flow

    a. 694 Pass 1 Lead Permeate

    b. 463 Pass 1 Lag Permeate

    c. 834 Pass 2 Permeate

4. The use of threshold inhibitor in the first stage feed.

5. The use of sodium hydroxide in the second stage feed, if required to meet finished water quality requirements.

The following continuous data shall be collected hourly unless otherwise indicated:

6. Water Quality:
    a. First pass feed temperature
    b. First pass feed turbidity
    c. First pass feed Silt Density Index, once per day
    d. First pass feed conductivity
    e. First pass feed pH
    f. First pass lead permeate conductivity
    g. First pass lag permeate conductivity (feed to second pass)
    h. First pass concentrate conductivity
    i. First pass concentrate pH
    j. Second pass feed pH
    k. Second pass, first stage permeate conductivity
    l. Second pass, second stage permeate conductivity
    m. Interstage conductivity
    n. Second pass concentrate conductivity
    o. Second pass concentrate pH
7. Mechanical Data
    a. First pass feed pressure
    b. ERD discharge pressure
    c. First pass lead permeate pressure
    d. First pass lag permeate pressure
    e. First pass concentrate pressure (before ERD)
    f. First pass concentrate pressure (after ERD)
    g. Second pass feed pressure
    h. Second pass interstage pressure
    i. Second pass concentrate pressure

j. Second pass permeate pressure

k. First pass feed flow

l. First pass lead permeate flow

m. First pass lag permeate flow

n. First pass concentrate flow

o. Second pass concentrate flow

p. First pass feed flow control valve position

q. Second pass feed flow control valve position

r. First pass concentrate flow control valve position

s. Second pass concentrate flow control valve position

During two of the sampling events, the ROEM shall sample the permeate from each pressure vessel for conductivity. The samples may be analyzed with a properly calibrated field instrument instead of analysis at a laboratory.

The ROEM shall produce and submit a formal bound report for all testing activities. The report shall contain detailed test plans and results for all activities performed during testing. Results from all testing shall be tabulated, trended, and graphed as appropriate. Discussion of testing, along with conclusions and recommendations, shall be presented in the test report. Laboratory analysis data shall be bound into the report as appendices.

9.22 RO System Performance Warranty

MWH shall warrant all components of each RO train supplied against defects in materials and workmanship in accordance with Article 6 of the Design-Build Agreement. This warranty shall state the following provisions with no additional conditions or exceptions:

- Each RO train shall produce the minimum permeate flow rate (9.6 MGD or 6.4 MGD) at the overall recovery and design parameters (44% overall recovery) while treating water at or below the maximum feed water quality parameters provided Section 3, and meeting the product water quality parameters specified in Section 4.
- The maximum recovery per pass shall be 45 percent for the first pass, and 90 percent for the second pass.

MWH shall furnish a separate warranty for the RO membrane elements. This warranty shall be a pass-through type, directly between the manufacturer and the Owner. This warranty must be signed by an individual authorized to execute contracts on behalf of the membrane manufacturer and shall state the following provisions with no additional conditions or exceptions:

- The membrane elements supplied under these specifications shall be warranted by the manufacturer to be free of liens and encumbrances, and against defects in materials and workmanship for a period of twelve (12) months in accordance with Article 6 of the Design-Build Agreement.

- The manufacturer shall warrant the performance of the membrane elements for a period of three (3) years from completion of the Acceptance Tests described in Appendix 7 (the "Extended Membrane Warranty Period"). The manufacturer shall guarantee the membrane elements during the Extended Membrane Warranty Period in accordance with the performance requirements specified herein and the following prorated replacement conditions if the elements fail to meet the warranted performance:
  - The elements shall at all times during the Extended Membrane Warranty Period have a minimum flow of 90 percent of the minimum product flow specified on the membrane manufacturer's specification sheet for the elements furnished when tested at standard conditions as defined herein.
  - During the Extended Membrane Warranty Period, the element salt passage shall not exceed one hundred and fifty percent (150%) of the maximum salt passage specified on the membrane manufacturer's specification sheet for the elements furnished when tested at standard conditions as defined herein.

- At all times during the Extended Membrane Warranty Period, when the system is operated with feedwater consistent with the conditions applicable for the RO system in Table 1 in Attachment 2 of Appendix 2:
  - Each RO train shall require no more than 1000 psi feed pressure to the first pass to produce design permeate capacity.
  - The RO permeate from each train shall meet both the maximum-average and not-to-exceed concentrations for boron, chloride bromide and sodium listed in **Section 4.0**.

The warranty conditions specified above shall be valid under the following conditions:

- Each RO train has been operated as designed in terms of product water recovery, flux, array configuration, and feedwater pH.
- The feedwater does not contain chemicals that chemically or physically destroy the elements.
- The membrane elements are periodically cleaned with an effective cleaning solution to remove colloidal matter inherent in ocean water.
- The membrane elements are cleaned using standard cleaning solutions prior to performance testing for warranty purposes.
- Biological matter or sparingly soluble substances in the feedwater have not irreversibly fouled the membrane elements.

Should the RO train performance not meet the warranty requirements, the membrane element manufacturer shall provide sufficient replacement elements to achieve the specified train performance. The replacement elements will be provided at the current market price, less a credit of 1/36 of the purchase price for each unused month of the Extended Membrane Warranty Period. The manufacturer shall guarantee that future replacement elements will be sold to the Owner at a price not to exceed $650 per 8-inch 40-inch element at any time within three years from acceptance of each RO train.

9.23 RO Building Size

The only building footprint with a significant change due to the reduced production rate is the RO building. With two fewer SWRO Trains and one fewer BWRO Trains, the length of the building would be reduced by 77 feet. If the building is expanded in the future, additional SWRO Trains would be added to the northwest side of the building and additional BWRO Trains would be added to the southeast side of the building.

Table 9-20: RO Building Size

Production	Length (ft)	Width (ft)	Height (ft)
9.6 mgd	295	88	18
6.4 mgd	218	88	18

10.0 HANDLING OF TREATMENT RESIDUALS

The Project will produce a wide range of types and volumes of liquid and solid residuals which require handling and disposal. This section discusses these residuals and the MWH approach to addressing these within the Project guidelines.

10.1 Type of Residuals

The types of residuals to be handled and disposed of at the Project Site are summarized in **Table 10-1**.

Table 10-1: Residuals Summary

Residual Stream	Disposal Method	Frequency of Disposal
First Pass RO Concentrate	Pipeline to MRWPCA	Continuous
Second Pass RO Concentrate	Return to Filtered Water Feed Tank	Continuous
Spent Granular Media Filter Wastewater and Filter to Waste	Equalization and Settling Followed by Recycle	Continuous (Based on Frequency of Backwash)
Settled Solids from Granular Media Filtration	Concentration in Washwater Equalization Basins; Mechanical or Non-Mechanical Dewatering; Landfill Disposal	Not to Exceed Once per Year
Lime Sludge Blowdown	Comingle with Granular Media Filtration Waste	Periodic
CIP Waste, Neutralized	Neutralization Holding Tank; Trucking Offsite (to MRWPCA)	Intermittent
Sample Steams	Recycle to the Extent Possible by Routing to Washwater Equalization Basin	
Sanitary Waste	Leachfield	Continuous; Variable
Special Laboratory Waste	Discharge through Neutralization Holding Tank; Trucking Offsite (to MRWPCA)	Intermittent; Not to Exceed More than Twice per Year

10.2 RO Concentrate Disposal

Concentrate flows from the first pass RO systems will be conveyed to the MRWPCA site via a pipeline and disposed of via the existing MRWPCA outfall (pipeline beyond the Project Site boundary by others). In the event that the MRWPCA outfall does not have sufficient capacity, concentrate flow equalization may be required. An input signal will be provided to the control system from MRWPCA which regulates the maximum flow from the desalination plant. This signal will serve as an input to the concentrate discharge valve. If any back pressure is measured in this line, excess flow will be diverted to the concentrate equalization basin. Once the restriction is reduced, the concentrate equalization discharge pumps will evacuate the pond. While the concentration equalization pond will be constructed, the use of it is anticipated to be minimal. The design criteria for the Concentrate Equalization Lagoon are shown in **Table 10-2**.

Aeration of the concentrate will be accomplished with the use of an air compressor downstream of the concentrate pump discharge.

Concentrate flows from the second pass RO system will be recycled to the Filtered Water Feed Tanks.

Table 10-2: Concentrate Equalization Lagoon Design Criteria

Description	Proposed	Units
Number	1	each
Volume	3,000,000	gallons
Number of Pumps	2 (1+1)	each
Time to Drain Concentrate Equalization Lagoon	12	Hours
Flow	4,200	gpm @ 15 ft
Flow Control	VFD	
Pump Horsepower (each)	20	HP
Materials of Construction	Earth Embankment; Double Liner Containment with Leak Detection	

10.3 Dewatering of Settled Solids from Granular Media Filtration

As described above, settleable solids from the backwashing of the pre-treatment granular media filters (as well as a minor amount from the FTW process) will be collected in the two basins. After settling of solids has occurred, the clarified supernatant/decant will be recycled to upstream of the granular media filters. Settled solids will accumulate in the basins and then will be periodically removed, perhaps on an annual basis. A specialty contractor will be hired by CAW to remove the solids from the basins and then dewater the solids (either mechanically or non-mechanically) to meet the requirements of the location where dewatered solids will be disposed of. Only one basin will be cleaned at a time, to allow at least one basin to remain in service during removal/dewatering operations.

The MWH design provides power supply and utility water supply at the basins to support the contract dewatering process by others.

11.0 PRODUCT WATER STABILIZATION

The RO permeate needs to be chemically treated to achieve desired concentrations of hardness, alkalinity and TDS as well as optimal pH, in order to produce a finished water that is compatible with CAW's other drinking water supplies and that is low in corrosive properties. CAW's existing drinking water also has zinc orthophosphate added to it for corrosion control within the distribution system, and the Project needs to provide the ability to add phosphate as well as other chemicals to adjust hardness, alkalinity and pH. Finished water quality goals are presented in **Table 4-1**.

Chemicals planned to be added to the finished water to achieve stabilization of finished water quality include:

- Lime
- Carbon dioxide

Provisions will be made to add sodium hydroxide and zinc orthophosphate per CAW requirements.

The MWH's design of these chemical systems provides a wide range of dosing and operating capacity to achieve a wide range of finished water quality objectives. The RFP and Appendix 2 suggests two different treatment strategies (required alternatives to evaluate) to meet finished water quality goals, and these alternatives include:

1. Use of hydrated lime to add calcium (hardness) to the finished water as well as to increase pH
2. Use of calcite contactors to add calcium (hardness) to the finished water

After review of the information presented in Appendix 2, MWH has selected a lime slurry system for design.

To achieve the finished water stabilization goals for pH, alkalinity, and LSI a system must be designed to meet variable water conditions. Alkalinity requires an increase to between 40 and 100 mg/L as $CaCO_3$, which requires an addition of 30 to 75 mg/L as $Ca(OH)_2$. pH requires an adjustment to between 7.7 and 8.7, which requires an addition of 30 to 90 mg/L of CO_2.

For the tables below, the lowest cost operating strategy is proposed.

The following tables present the lime and carbon dioxide dosage and usage rates based on a minimum alkalinity and LSI conditions per the Finished Water Requirements (Appendix 2 – Attachment 3). Annual cost evaluation will be based on chemical usage (lb/day) for the 9.6 and 6.4 mgd flows. The carbon dioxide system will require a 7,200 lb/day carbon dioxide feeder. A side stream for carrier water and a pumping system requiring approximately 5 HP at 75 gpm (two [2] pumps operating in a 1+1 configuration). The same size pumps will be used for both the 9.6 and 6.4 mgd capacity alternatives.

Table 11-1: Estimated Post-Treatment Hydrated Lime (as $Ca(OH)_2$) Usage

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Peak Flow @ 9.6 mgd Capacity	11.2	30	2,802
Maximum Flow @ 9.6 mgd Capacity	9.6	30	2,402
Average Flow (Maximum Flow @ 6.4 mgd Capacity or Average Flow at 9.6 mgd Capacity)	6.4	30	1,601

1. Used for calculation of annual cost evaluation

Table 11-2: Estimated Post-Treatment Carbon Dioxide Usage

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Peak Flow @ 9.6 mgd Capacity	11.2	30	2,802
Maximum Flow @ 9.6 mgd Capacity	9.6	30	2,402
Average Flow (Maximum Flow @ 6.4 mgd Capacity or Average Flow at 9.6 mgd Capacity)	6.4	30	1,601

1. Used for calculation of annual cost evaluation

MWH is proposing to design and build a RDP Tekkm Hydrated Precision™ Lime System. The system will be designed to dilute the slurry to a predetermined concentration set point, and discharge the hydrated lime at the specified concentration and quantity. The design criteria for the Lime Slurry System are shown in **Table 11-3**.

Table 11-3: Lime Slurry System Design Criteria

Description	Proposed	Units
Storage Silos		
Number of Storage Silos	1	each
Storage Silo Capacity	90	tons
Diameter	14	ft
Height (Straight Side)	24	Ft
Dust Collector Type	Pulse-Jet	
Dust Collector Filter Area	340	sq ft
Dust Collector Filter Media	Polyester	
Dust Collector Motor	3	HP
Bin Activator Diameter	8	ft
Bin Activator Motor	3	HP
Reversing Lime Feeder		
Number of Reversing Lime Feeders	1	Each
Dosing Rate	2,600	lb/hr
Materials of Construction	Carbon Steel	
Motor	2	HP

Description	Proposed	Units
Prep Tanks		
Number of Prep Tanks	2	each
Volume of Prep Tanks (each)	200	gallons
Dosing Rate	300	lb/hr
Percentage of Lime Slurry	8	%
Materials of Construction	Carbon Steel	
Mixer Motor	2	HP
Air Requirements	10	CFM @ 90 psi
Water Supply	45	gpm
Slurry Aging Tank		
Number of Tanks	1	each
Volume of Tanks	400	gallons
Materials of Construction	Carbon Steel	
Mixer Motor	2	HP
Lime Slurry Pump		
Number of Pumps	2 (1+1)	each
Type	Horizontal Rubber Lined Slurry Pump	
Lime Slurry	10 – 20	%
Pumping Rate	75	gpm @ 60 TDH
Flow Control	VFD	
Pump Horsepower	7.5	HP
Dosing Rate	6 – 15	lb/hr

12.0 DISINFECTION REQUIREMENTS

Disinfection requirements for the Project are well-documented in the RFP and Appendix 2. There are two distinct disinfection alternatives for the Project which require different treatment methods, as described below.

12.1 Source Water Characterization

Until the proposed new slanted wells can be installed, tested and made operational, the evaluation of the source water per LT2ESWTR cannot be completed. If the source water is determined to be under the direct influence of surface water, then the potential for a higher level of disinfection exists (which may require installation of a UV disinfection system). Also, until the selected RO system is installed and the removal of salt/TDS can be demonstrated, the potential for a higher level of disinfection exists. Therefore, CAW requires that two alternative disinfection alternatives be evaluated 1) use of UV with free chlorine and 2) use of free chlorine without UV.

12.2 Disinfection Design Criteria – Case 1 (with UV Disinfection)

As required in the RFP and supported by the Appendices, we have developed design of the post-RO UV disinfection system (installed upstream of post-stabilization) for both the 9.6 mgd and 6.4 mgd capacity alternatives. The maximum flow through the UV system is 11.2 mgd for the 9.6 mgd case. The UV disinfection system is designed to provide 2-log *Giardia* and *Cryptosporidium* inactivation.

Listed in Section 13 are key features of our proposed UV disinfection system to demonstrate compliance with the RFP and Appendix 2. The design criteria for the Disinfection System (Case 1) are shown in **Table 12-1**.

Table 12-1: Disinfection Design Criteria (Case 1)

Description	Proposed	Units
Cryptosporidium Treatment Required	4	log
Meet with RO Membranes	2	log
Meet with UV Disinfection	2	log
Giardia Treatment Required	5	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	1	log
Meet with UV Disinfection	2	log
Virus Treatment Required	6	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	4	log

12.3 Disinfection Design Criteria – Case 2 (without UV Disinfection)

If the raw seawater supply is determined to be “not under the influence of surface water” and/or the RO system can remove >99% of the TDS/salt from the feedwater, then UV disinfection will not be required. 2-logs of *Cryptosporidium* removal will be achieved via RO. Disinfection following RO will include:

- Minimum 1.0-log inactivation of *Giardia* using free chlorine
- Minimum 4.0-log inactivation of viruses using free chlorine

The *Giardia* inactivation requirement with free chlorine is usually greater than the virus inactivation requirement, and the finished water storage tanks (referenced below) will provide the required chlorine contact time. The design criteria for the Disinfection System (Case 1) are shown in **Table 12-2**.

Table 12-2: Disinfection Design Criteria (Case 2)

Description	Proposed	Units
Cryptosporidium Treatment Required	2	log
Meet with RO Membranes	2	log
Giardia Treatment Required	3	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	1	log
Virus Treatment Required	6	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	4	log

13.0 UV DISINFECTION

As required in the RFP and supported by the Appendices, design of the post-RO UV disinfection system (installed upstream of post-stabilization) is developed with the goal of providing additional disinfection credits. The maximum flow through the UV system is 11.2 mgd for a normal operating flow of 9.6 mgd. The maximum flow through the UV system is 8.0 mgd for a normal operating flow of 6.4 mgd. There is no change in design between the two flow rates, and the system will operate in a 1+1 scenario. For buildout conditions, the maximum flow through the UV system is 14.4 mgd for a normal operating flow of 12.8 mgd. For buildout conditions, a third reactor will be installed, operating in a 2+1 scenario.

13.1 Design Criteria

UV disinfection system is designed in accordance with the USEPA UV Design Guidance Manual (2006). The design criteria for the UV Disinfection System are shown in **Table 13-1**.

Table 13-1: UV Disinfection System Design Criteria

Description	Proposed	Units
12.8 mgd Capacity		
Maximum Flow Rate	14.4	mgd
Operating Flow Rate	12.8	mgd
Number of Reactors	3 (2+1)	each
Number of Lamps per Reactor	8	each
Number of Ballasts per Reactor	4	each
9.6 mgd Capacity		
Maximum Flow Rate	11.2	mgd
Operating Flow Rate	9.6	mgd
Number of Reactors	2 (1+1)	each
Number of Lamps per Reactor	8	each
Number of Ballasts per Reactor	4	each
6.4 mgd Capacity		
Maximum Flow Rate	8.0	mgd
Operating Flow Rate	6.4	mgd
Number of Reactors	2 (1+1)	each
Number of Lamps per Reactor	8	each
Number of Ballasts per Reactor	4	each
Lamp Technology	Low Pressure High Output	
Minimum Inactivation (UVT) Cryptosporidium	2	log
Submergence	Continuous	
Location	UV Disinfection Building	

13.2 Lamp Technology

MWH has evaluated both low-pressure high-output (LPHO) and medium pressure (MP) systems. Although the LPHO systems have higher head loss, they offer significantly lower capital and life cycle costs compared to the MP systems. It will be a more cost effective solution to use an LPHO system and design the filtered water tanks at a lower elevation to accommodate a higher head loss across the UV system without needing to re-pump disinfected water.

13.3 Equipment Manufacturers

UV disinfection alternatives of four notable manufacturers were evaluated for cost effectiveness, including alternative "duty + standby" installations of "2+1" and "1+1". All vendors are capable of providing a "1+1" system that can successfully treat/disinfect a maximum flow of 11.2 mgd.

The manufacturer is Wedeco/Xylem who will provide 2 (two) years' worth of spare parts for LPHO-B2 system, including UV lamps, UV sensors, quartz sleeves, mechanical wipers, seals, ballasts and fuses. The manufacturer has agreed to provide an extended warranty and service contract for another year after the on year Project warranty. A minimum of 12 service visits over the one year Project warranty period and the extended warranty period.

13.4 Operational Requirements

The selected LPHO-B2 system has a warm-up period of 5 minutes and a cool-down period of 5 minutes. Lamps need to be inherently submerged during this startup or shutdown period. The system is recommended to have no more than 4 (four) starts per day. No cooling is needed during normal start-up or shut-down.

13.5 Mercury Content of UV System

For the selected system (LPHO-B2), each lamp contains no more than 50 mg of mercury, which equates to a maximum of 400 mg of mercury per reactor, or a total of 800 mg of mercury with two (2) reactors on site.

13.6 Intensity Sensor Verification and Calibration Methods

All supplied UV intensity sensors will be factory calibrated. During operation, calibration of duty UV intensity sensors is verified on site with a reference UV sensor at least monthly. The UV intensity sensor can be removed and inserted without dewatering the system. UV sensors that are not in calibration will be returned to the manufacturer for replacement or recalibration. The manufacturer has guaranteed a maximum of one (1) factory calibration annually. UV sensor calibration verification procedure is detailed in Section 6.4.1.1 of EPA UV Disinfection Guidance Manual (2006).

13.7 Dose Control Strategy

The proposed LPHO-B2 system will implement a calculated dose approach as the dose control strategy. This approach provides significant flexibility to minimize energy consumption by manipulating lamp power to accommodate flow and UVT variance. An empirical UV dose-monitoring equation developed during system validation is incorporated into the operating PLC, which can be set up to automatically adjust lamp power to produce a target UV dose based on the measured flow, UVT and UV intensity values.

13.8 Startup and Shutdown Sequence

It is understood that the 5% off-spec water allowance in the LT2SWTR for UV treatment is not allowed by CDPH, and that failure to achieve any UV performance standards for more than 15 consecutive minutes will trigger automatic plant shutdown (in a controlled fashion). System control will be set up with an automated startup and shutdown sequence that brings standby reactor on-line and lets it warm up to maximum lamp output before switching from operating reactor to duty reactor. The treated water storage tanks downstream of UV reactors operate in series and can be isolated and bypassed in case of receiving any off-spec water during startup and shutdown.

13.9 Power Supply

A battery backup uninterrupted power supply (UPS) will be included to provide 10 minutes of ride through upon power failure for UV reactors, controls and instrumentation. The UPS will be provided with a remote maintenance by-pass switch to allow isolation of the unit for servicing and testing. UPS status will be monitored through SCADA.

14.0 FINISHED WATER STORAGE

The finished water storage element of the Project provides many functions including disinfection and flow balancing prior to finished water pumping and conveyance. The detention time in the tanks may also serve to allow finished water quality/chemistry to stabilize after post-RO chemicals are added. Water flows under pressure from the RO system through the UV system (if constructed) and through the post-RO stabilization system before flowing into the storage tanks.

14.1 Design Criteria

CAW requires two 750,000 gallon tanks to operate in series when both tanks are in service for the 9.6 mgd capacity alternative. The same volume is required for the 6.4 mgd capacity alternative. During infrequent periods when a tank will be inspected, cleaned and maintained, only one tank will be in service, and the tanks' inlet and outlet piping design accommodates these requirements. With a single tank in service, the plant's operating conditions may need to be adjusted (compared to two tanks in service) to comply with disinfection requirements. The design criteria for the Finished Water Storage Tank are shown in **Table 14-1**.

Table 14-1: Finished Water Storage Design Criteria

Description	Proposed	Units
Number of Tanks	2	each
Volume of Tanks (each)	750,000	gallons
Diameter	76.5	ft
Height (Straight Side)	22	ft
Minimum Water Level	2	ft
Maximum Water Level	21.8	ft
Materials of Construction	Wire Wrapped Reinforced Concrete (AWWA D110)	
Level Control	Continuous with Independent High Level Switch	

14.2 CT Compliance

The free chlorine contact time provided in the tanks is adequate to meet the *Giardia* and virus inactivation requirements per the RFP and Appendix 2. MWH has proposed the use of baffles or another alternate method within the Finished Water Storage Tanks to achieve a baffling factor of 0.5; the basis for final design will be selected based on computation fluid dynamics (CFD) modeling. When one of the tanks is out of service for various reasons (infrequent occurrence), plant operations will likely need adjustments compared to a two (2)-tank operational scheme. CT compliance has been calculated based on control, not a fixed volume of water; this will allow CAW flexibility in operation. Operational adjustments may include:

- Maintaining a high water level in the tank with less variation in depth
- Increasing the chlorine residual
- Operating a lower production capacity

14.3 Controls and Appurtenances

Each finished water tank will be provided level monitoring and high-level switches/alarms. Each tank will have an independent drain without creating a cross-connection. Each tank to be provided with two points of access (sidewall and top) that can be secured. Each tank to be provided with its own overflow system to handle the maximum influent flow and with features to limit the opportunity for tampering. Each tank to be provided with vent(s) properly sized for inlet and outlet flows, screened, highly corrosion resistant and secured against tampering.

15.0 SALINAS VALLEY DESALINATED WATER RETURN PUMPING AND CONVEYANCE

A portion of the finished water will be pumped from the Finished Water Storage Tanks to the Salinas Valley groundwater basin via the Castroville Seawater Improvement Project (CSIP). The pumped water will be conveyed in a 1.2-mile, 12-inch diameter pipeline from the Project Site to the existing CSIP pond (80 acre-feet storage capacity) at the southern end of the MRWPCA regional WWTP. MWH will design-build the 12-inch pipeline from the finished water pump station to the property boundary.

Two (2) pumps will be installed in a "1+1" installation with a rated capacity of 850 gpm (1.2 mgd) each with a TDH of 30 feet. The pumps will be horizontal, end-suction pumps installed on an outdoor concrete pad adjacent to the four (4) finished water pumps that deliver water to the Monterey distribution system. Both pumps will be equipped with VFDs and all electrical equipment will be located inside the Electrical Switchgear Building. Power metering will be provided for these pumps.

The pump system will be equipped with electrically-actuated butterfly valves at the pump inlet, check valves on the pump outlet and manual isolation valves on the pump outlet. The common pump discharge line will be provided with an above-ground flowmeter. An on-line conductivity analyzer will be installed on the discharge line also. An air gap is provided on the discharge to eliminate backflow concerns. The design criteria for the Salinas Valley Desalinated Water Return Pumping and Conveyance System are shown in **Table 15-1**.

Table 15-1: Salinas Valley Desalinated Water Return Pumping and Conveyance Design Criteria

Description	Proposed	Units
Number of Pumps	2 (1+1)	each
Flow	850	gpm @ 30 ft
Flow Control	VFD	
Pump Horsepower (each)	10	HP
Type	Horizontal, End Suction	
Water Quality Monitoring	Conductivity	

16.0 FINISHED WATER PUMPING AND PRESSURE TRANSIENT CONTROL

The water stored in the two Finished Water Storage Tanks will be pumped to the Monterey distribution system via a 24-inch diameter pipeline with a maximum HGL of 425 feet. These pumps will be co-located outdoors on a concrete pad with the Salinas Valley supply pumps as discussed above. The electrical motor starters are located inside the Electrical Switchgear Building. Power metering will be provided for these pumps. MWH will design-build the 24-inch pipeline from the finished water pump station to the property boundary.

Four (4) pumps total will be installed as described below:

- Two (2) pumps at 50% design capacity, both with constant-speed (with soft-starters) drives (3,350 gpm each for the 9.6 mgd finished water capacity and 2,250 gpm each for the 6.4 mgd capacity alternative with a TDH of 350 feet)
- Two (2) pumps at 25% design capacity, both with VFDs (1,675 gpm each for the 9.6 mgd finished water capacity and 1,125 gpm each for the 6.4 mgd capacity alternative with a TDH of 350 feet)

The electrical and controls design allows for three (3) of these pumps to operate simultaneously including the two (2) large pumps plus one (1) small pump. Each small pump discharge line will have its own flowmeter and there will also be a larger flowmeter installed on the common pump discharge line. All flowmeters shall be above-ground. Each pump will be provided with a hydraulically-actuated (water) ball valve (pump control valve) with 2-speed closure time. The valves are designed for a maximum 14 fps velocity through a full-open valve. Opening/closing times will be determined via the transient study discussed below. Each pump will have a manually-actuated butterfly valve downstream of the pump control valve, as well as a manually-actuated valve on the discharge side of the pump. Other pump and piping appurtenances are included in the design such as air release valves, pressure gages and transmitters, motor controls and protective devices.

The finished water pumps will be horizontal, split-case centrifugal pumps installed adjacent to the two (2) Salinas Valley pumps which are discussed above. A mobile A-frame gantry is also being furnished with a manual chain, rated for the largest pump and motor.

For the baseline alternative at 9.6 mgd finished water production capacity, a single 25,000-gallon hydropneumatic surge tank will be installed and connected to the discharge of the finished water pumps, to protect against damage to the piping systems in case of un-planned pump shutdowns. The volume of the surge tank will not change for the 6.4 mgd finished water production capacity alternative. MWH will perform a hydraulic transient analysis of the proposed pumping and piping systems (including the downstream transmission and distribution systems) to recommend the appropriate transient control method(s) and system(s). An air compressor will be provided for surge tank operation. The design criteria for the Finished Water Pumping System are shown in **Table 16-1**.

Table 16-1: Finished Water Pumping Design Criteria

Description	Proposed	Units
Hydraulic Grade Line		
Maximum	425	feet
50% Design Capacity		

Description	Proposed	Units
Number of Pumps	1+1	each
Type	Horizontal, Split Case Centrifugal	
Drive	Constant Speed	
Flow (9.6 mgd Finished Water Capacity)	3,350	gpm @ 350 ft
Flow (6.4 mgd Finished Water Capacity)	2,250	gpm @ 350 ft
Horsepower (9.6 mgd Finished Water Capacity)	400	HP
Horsepower (6.4 mgd Finished Water Capacity)	250	HP
VFD	No	
25% Design Capacity		
Number of Pumps	2	Each
Type	Horizontal, Split Case Centrifugal	
Drive	Variable Speed	
Flow (9.6 mgd Finished Water Capacity)	1,675	gpm @ 350 ft
Flow (6.4 mgd Finished Water Capacity)	1,125	gpm @ 350 ft
Horsepower (9.6 mgd Finished Water Capacity)	200	HP
Horsepower (6.4 mgd Finished Water Capacity)	150	HP
VFD	Yes	
Flow Meters	One (1) on each small pump; One (1) common	
Surge Tank		
Number of Tanks	1	each
Volume	25,000	gallons
Type	Hydropneumatic	
Air Compressor Included	Yes	

17.0 YARD PIPING AND VALVES

MWH will comply with the requirements for yard piping outlined in the RFP and Appendices. The Design-Build Team will perform the analyses to specify required parameters for yard piping, such as routing, verification of materials of construction, pressure rating etc., necessary for successful completion of the project. The project team will verify minimum separation between the yard piping and any electrical services equipment, such as transformers and switchgear. Currently, this minimum separation is 25 feet. In addition, the project team will identify such parameters as minimum cover; minimum horizontal and vertical separation between the piping with different services; identification of permit requirements, if necessary; and others. A piping schedule has been developed as is presented in Drawing No. GI-3.

17.1 Raw/Saline Water

Raw water piping shall be HDPE. For below ground installation, pressure rating is less than 100 psi.

17.2 Permeate

Permeate piping, prior to stabilization, shall be HDPE pipe below grade and 316L stainless steel or FRP above grade. Valves shall be as listed for Finished Water.

17.3 Finished Water

- Finished Water piping may be ductile iron pipe, steel, or HDPE. Ductile iron pipe is generally preferred on the treatment Project Site.
- Ductile Iron Pipe shall be Class 52 on the Project Site.
- Valves less than 12 inch pipe size shall be resilient seated gate valves; valves 12 inches and larger shall be butterfly type.
- Valves shall open LEFT.
- Valves shall be provided with valve box and lid. A concrete collar shall be poured at the top of the valve box. A stainless steel valve identification tag shall be embedded in the concrete collar listing the Valve ID, type of valve, and number of turns.
- CIP Waste piping shall be double wall CPVC for below grade installation.

17.4 Chemicals

Liquid chemicals shall be run underground within flexible HDPE tubing, or other type tubing or hose compatible with the specific chemical. The tubing or hose shall be run within a HDPE carrier pipe providing support and secondary containment. Each HDPE pipe shall have only one length of tubing to allow for ease of replacement. Chemical piping/tubing shall be run together, to the extent possible. The HDPE carrier piping is to be intentionally sloped to pull boxes. Pull boxes, constructed of pre-cast concrete, shall be located no less than 100 ft intervals along the route of the piping. Each pull box shall be equipped with a level sensor to detect chemical leakage. Splices in tubing are to be minimized. Where splices are necessary, they shall be made within a pull box. The top of pull boxes shall be above ground to prevent surface water entry, and shall be equipped with an aluminum cover. Door frame drain shall be piped to a dry well.

18.0 PROCESS PIPING AND VALVES

18.1 Pipe Schedule

The MWH Pipe Schedule will be used during design (as presented in Drawing No. GI-3). The Schedule will list all fluid services used in the project and the corresponding suitable piping materials. The Pipe Schedule will be complemented by piping specification Sections that will provide additional requirements.

Piping material shall be carefully selected to suit each service type and working pressure. High pressure piping shall be constructed of steel. Interior surfaces of ferrous piping shall be lined as applicable for the service. Exposed exterior piping surfaces shall be coated.

All above-ground piping shall be provided with adequate supports.

18.2 Valve Schedule

The MWH Valve Schedule will be used during design. The schedule will include size of valve, type of valve (e.g. butterfly, swing check, ball, gate, plug, etc.), type of actuator (e.g. manual, pneumatic, electric, hydraulic, etc.), pressure rating, type of connections (e.g. flange, wafer, etc.), and applicable specification Section. Valves that are supplied by equipment vendor will not be listed.

1. Valves for saline water (<100 psi) shall be nylon coated steel butterfly.
2. Valves for saline water (>100 psi) shall be super duplex plug.
3. Valves for permeate water shall be nylon coated steel butterfly.
4. Valves for permeate water following stabilization shall be resilient seated gate valves (<12 inch) or butterfly valve (>12 inch).
5. Valves for finished water shall be resilient seated gate valves (<12 inch) or butterfly valve (>12 inch).
6. Shut-off valves for clean water shall be butterfly, gate, or ball valves. Shut-off valves for solid bearing liquid shall be plug valve. Shut-off valves 6-inch and larger with actuators with position indicators. Manual shut-off valves mounted higher than 7 feet above the working level shall be provided with chain actuators.
7. Gate valves 18-inch and larger, or where chain wheel is required, shall be provided with spur gear and hand wheel.
8. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions.

Corrosion resistant valves shall be used for chemical service. Valve bodies and wetted surfaces shall be constructed of PVC, CPVC, stainless steel or other corrosion resistant materials.

18.3 Chemical Piping

Chemical piping shall be corrosion resistant, suitable for the service. Non-metallic materials, such as PVC, CPVC, or HDPE offer superior corrosion resistant and shall be used as applicable. Stainless steel material shall be considered for chemical services where plastic piping are not suitable. Corrosion resistant flexible tubing or hose may be used for chemical lines that are ½” or smaller.

Outside of the chemical containment area, chemical piping shall be provided with double containment piping system with leak detection devices. When located in outdoor areas, secondary containment piping will be HDPE small bore (without joints). When located indoors, secondary containment piping will be HDPE fused. As much as possible, chemical lines shall be routed in a trench, which are not to exceed 100 feet in length. Each trench will be equipped with a level indicator and an alarm. Overhead routing of chemical lines shall be minimized.

In general, CVPC piping shall be installed above ground with true-union ball valves. Butterfly valves shall be close coupled to bulk storage tanks for isolation purposes.

19.0 GENERAL PUMPING EQUIPMENT REQUIREMENTS

19.1 Pump Selection

Pump design shall follow Hydraulic Institute (HI) standards. Quantity and size of pumps for a particular service shall be selected to meet the specified design and maximum flow and head conditions. A system head curve shall be prepared for each pumping stage, and pump performance shall be shown against the system head curve. A standby pump shall be provided as required. Pumps shall be selected to optimize efficiency. For pumps with multiple operating points, the pumps shall be selected such that their best efficiency point (BEP) is at or near the operating point where the pumps operate most of the time. All operating points shall be within the pump manufacturer's allowable operating range (AOR). Variable frequency drives (VFDs) shall be used as applicable. For pumps with a single operating point, pump efficiency shall be optimized at this point. A constant speed drive shall be used for such application. Pump shall be selected such that the maximum nominal synchronous speed does not exceed 1800 rpm. Selection for smaller pumps with low horsepower may be up to 3600 rpm.

Material selection for wetted pump components, such as casing, impeller, shaft, wear rings, shall be carefully selected for suitability with the fluid being pumped or pumpage. Internal coating of the casing shall be suitable for the pumpage. Any materials that come in contact with water shall be listed as NSF 61 compliant and shall prevent dezincification. Bronze materials shall be lead-free.

19.2 Motor Selection

The most common type of motors used for pumping equipment are polyphase, squirrel cage induction motor. The horsepower rating of the motors shall be greater than the maximum horsepower required by the pump. The maximum speed of the motor shall match the maximum speed of the pumps. All outdoor motors shall be provided with totally enclosed fan cooled (TEFC) or weather protected (WP) enclosures. Indoor motors may be provided with open drip proof (ODP) enclosures. Motors that are smaller than 0.5 HP shall be 120V to 240V, single phase. Motors that are 0.5 HP to 500 HP shall be 460V, three phase. Motors that are greater than 500 HP shall be 5,000V, three phase.

19.3 Pump Station Design

Design of pump stations must consider suction and discharge piping configuration, maintenance access around equipment, and clearances required for equipment removal. Pumps may be installed indoor or outdoor. Adequate ventilation equipment and sound attenuation system shall be provided as required. Emergency stop pushbuttons shall be locally provided at each pump.

For the design of the pumps, the maximum allowable suction velocity shall be 5 fps. The maximum allowable discharge velocity shall be 14 fps at the pump discharge nozzle. Typical piping velocities are expected to be no more than 9 fps at ultimate plant capacity.

A separate electrical room to house the electrical equipment shall be provided. The electrical room will be provided with air conditioning system that will provide sufficient cooling to the electrical equipment.

19.4 Piping and Pipe Joints

Pipe materials shall be suitable for the fluid and pressure conditions. Suction piping is critical in pump operation and must be carefully designed. Suction piping shall be sized for 3 to 5 feet per second (fps) velocity in accordance with the Hydraulics Institute (HI) recommendations. The minimum straight length of suction piping shall be 5 times the pipe diameter. An isolation valve shall be provided in the suction piping.

The discharge piping from each pump shall be provided with a check valve and an isolation valve unless Client specifies otherwise. Swing check valve is commonly used for pump discharge application. Pressure and flow instruments shall be provided as necessary.

Dismantling joints with restraint system shall be provided at the suction and discharge piping to facilitate removal of pumps and valves for repair, replacement and future piping modifications. Suction and discharge piping shall be provided with adequate supports and should not impose any load to the suction and discharge flanges of the pump.

19.5 Vibration Control

Pumps should not experience vibration issues if they are operated within the manufacturer's AOR, provided with proper suction piping design, and installed in accordance with the manufacturer's standards. The concrete base for each pump shall be designed for a minimum of 4 times the weight of the rotating element.

20.0 ROTATING EQUIPMENT MONITORING

Temperature and vibration sensors shall be provided in pumps that are 200 HP and larger.

Temperature

- Motor windings, motor bearings and pump bearing temperature sensors shall be provided and continuously monitored through 100 ohm platinum RTD's and input to Schweitzer Engineering Laboratories (SEL) devices provided for power monitoring and motor protection. Values will be available for trending and monitoring through the CAW Business Network.

Vibration

- Vibration data is to be gathered and made available for off-site analysis through the Internet.

- Online vibration data collection system is to be provided based on multichannel continuous processor. Locate processors in a suitably protected area. Provide enclosures suitably rated for the environment in which they are installed.

  - Manufacturer: Ludeca
  - Model: Vibnode
  - Dynamic Range: 96 dB 16 bit A/D converter
  - Frequency Range: 2-1000 Hz
  - Frequency Resolution: 3200 lines
  - RPM Tracking
  - Measurement Functions
    - Fast Fourier Transform (FFT)
    - Time signal
    - High frequency envelope FFT
    - Overall values
    - Narrow and broadband alarms
    - Process parameters
  - Band Analysis: 12 bands per spectrum
  - High Frequency Enveloping: band pass filters for low, medium and high speed machines
  - Digital Ouput: for external trigger
  - Analog Output: 4-20 ma
  - Digital Output: 5-30 volt
  - Ethernet capable
  - Licenses as needed
- 15 minutes UPS on power supply to multichannel processor and monitoring devices
- Protection of multichannel processor and monitoring devices from electric transients including lightning
- Analysis Software
  - OMNITREND software from Ludeca
  - Band analysis capable
  - Narrowband and broadband alarm capable
  - Real time overall values
  - Email alarm capable

    - Built in reporting features
    - Web based for remote access
    - Built in fault frequency markers

- Local personal computers
    - Processor: 4G RAM; 2.5 GHz
    - USB and Ethernet ports
    - 24 inch monitor

- Tachometer
    - Inductive type from Ludeca
    - Suitable for outdoor installation

- Accelerometer
    - Installation will be coordinated with pump vendor, and per CAW's recommendations. Device shall be suitable for outdoor installation.

- Cabling
    - Cables from sensors to multi-channel monitor shall be of the type and length with connectors needed for each application. Cables shall be provided by CTC. Cables shall be installed in conduit where physical protection is needed.

- Device Driver
    - Device driver shall be provided.

- On-site Commissioning
    - A minimum of 2 days of on-site startup service with Ludeca application engineer will be provided.

21.0 CHEMICAL SYSTEMS

The Project includes a variety of chemicals for water treatment purposes. The proposed design follows the outline as presented in Appendix 2 of the RFP. This section presents the basis of design for these chemical systems including storage and feeding. Chemicals for post-stabilization and for cleaning of the RO membranes are addressed above. For all the chemicals discussed herein with the exception of sodium hypochlorite, there will be no change to the bulk storage systems between the 9.6 and 6.4 mgd capacity alternative; however metering pump sizes will be lower for the 6.4 mgd capacity alternative.

The chemicals addressed in this section include:

- Sodium hypochlorite for oxidation and disinfection
- Sodium bisulfite for quenching chlorine residual
- Sulfuric acid for pH depression prior to the cartridge filters
- Threshold inhibitor to inhibit scale formation in the RO membranes
- Non-ionic (or anionic) polymer for enhanced settling of filter washwater
- Sodium hydroxide for pH adjustment
- Zinc orthophosphate or phosphoric acid for corrosion control

All of these chemicals are delivered/stored as liquids except for the polymer which is delivered as a dry or emulsion product. The sodium hypochlorite is generated on-site using salt as the delivered chemical. These chemical systems are all located within the Chemical Storage and Feed Facilities. Lime and carbon dioxide (post-stabilization chemicals) are located outdoors. Selected cleaning chemicals for the RO membranes are located within the RO Building.

All chemical storage and feed systems (including off-loading areas) are contained for spill and leak prevention. All chemical tanks are manufactured of HDXLPE as manufactured by PolyProcessing.

Diaphragm metering pumps are heavy-duty, motor driven with reliable performance and turndown. Insulation and heat tracing are provided where freeze protection is required.

MWH is not including any day tanks for chemicals stored in bulk tanks. Working with numerous clients in California in recent years has convinced us and operators that day tanks are an un-necessary expense.

21.1 Sodium Hypochlorite

The sodium hypochlorite system provides chlorine for addition upstream of pre-treatment to oxidize Fe/Mn and to provide a chlorine residual in the filtered water receiving tanks to minimize bio-growths. A sodium bisulfite feed system is required to remove any remaining chlorine residual before water passes thru cartridge filters upstream of RO. A measurable chlorine residual is also desirable in the spent filter backwash equalization basin(s) to minimize the potential for bio-growths.

Chlorine is also added to the RO effluent after post-stabilization chemicals are added and upstream of finished water storage tanks, in order to carry a free chlorine residual for disinfection and into the finished water conveyance piping. Sodium hypochlorite is also used for membrane cleaning, but the usage is low and therefore not included in these calculations. The design criteria for the Sodium Hypochlorite System are shown in **Table 21-1**.

The sodium hypochlorite system includes the following elements:

- Three (3) 500 ppd on-site sodium hypochlorite generators using electrolytic equipment; a redundant hydrogen air monitoring system shall be provided in the generation and storage areas. For the 6.4 mgd capacity alternative, only two (2) 500 ppd on-site sodium hypochlorite generators will be installed.
- Two (2) salt dissolving/brine tanks capable of storing a minimum of 23 tons of high-quality salt.
- Two (2) dilute sodium hypochlorite solution tanks, each with a minimum capacity of 6,500 gallons; tanks shall be HDXLPE with IMFO-type outlets. For the 6.4 mgd capacity alternative, the size of these tanks may be downsized.
- Six (6) sodium hypochlorite solution dosing pumps, two (2) for raw water dosing (1+1) at 3 mg/L maximum dose, two (2) for backwash doing (1+1) at 1.5 mg/L, and two (2) for post-treatment dosing (1+1) at 2 mg/L maximum dose; pumps will be seal-less magnetic drive gear pumps with variable speed drives.
- Sodium hypochlorite feed control system for 1) local-manual, 2) remote-manual, 3) remote flow-pace and 4) remote compound loop using chlorine residual feedback control.

All equipment for this chemical system shall be located inside the Chemical Storage and Feed Facilities except for the two (2) salt dissolving/brine tanks and connecting piping which shall be located outdoors. The tank area is provided with containment curbing to capture leaks. The indoor tanks are located within a concrete secondary containment area. The generators are located in a separate room away from the storage and solution feeders. Redundant hydrogen in air monitors will be provided in the sodium hypochlorite generation and storage rooms. The Chemical Storage and Feed Facilities are designed to remove/replace tanks via removable wall sections.

The sodium hypochlorite solution tanks are designed to also receive and store deliveries of 12.5% liquid sodium hypochlorite solution in case generator(s) are not working. A manual adjustable dilution panel to continuously dilute to 0.8% solution in the second storage tank is provided.

Low-hardness second pass RO permeate will be used as supply water to the brine tanks and to the generators. Water from the Flush Tank will be transferred by gravity. An on-line conductivity meter (% NaCl) will be used to monitor the brine concentration in the feed to the generators

Table 21-1: Sodium Hypochlorite System Design Criteria

Description	Proposed	Units
Number of On-Site Sodium Hypochlorite Generators	3	each
On-Site Sodium Hypochlorite Generation Rate (each)	500	ppd
Number of Salt Dissolving/Brine Tanks	2	each
Volume of Salt Dissolving/Brine Tanks (each)	23	tons
Number of Brine Transfer Pumps (from Brine Tank to Generator)	2	Each
Number of Dilute Sodium Hypochlorite Solution Tanks	2	each
Volume of Dilute Sodium Hypochlorite Solution Tanks (each)	6,500	gallons
Materials of Construction of Dilute Sodium Hypochlorite Solution Tanks	HDXLPE with IMFO-type outlets	
Source Water	RO Permeate	
Raw Water Sodium Hypochlorite Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	3	mg/L
Type	Seal-less Magnetic Drive Gear	
Flow Control	VFD	
Backwash Sodium Hypochlorite Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	3	mg/L
Type	Seal-less Magnetic Drive Gear	
Flow Control	VFD	
Post-Treatment Sodium Hypochlorite Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	2	mg/L
Type	Seal-less Magnetic Drive Gear	
Flow Control	VFD	

Table 21-2: Estimated Sodium Hypochlorite Usage at 0.8% Solution Strength

Flow Condition	Pre-Filters			Backwash			Post-Treatment		
Scenario	Flow (mgd)	Dose (mg/L)	Chem Usage (lb / day)	Daily Volume (mgd)	Dose (mg/L)	Chem Usage (lb / day)	Flow (mgd)	Dose (mg/L)	Chem Usage (lb / day)
Average Flow / Maximum Dose	21.9	3	548	1.0	1.5	13	9.6	2	160
Maximum Flow / Average Dose	25.5	2	425	1.7	1	21	11.2	1.5	140
Average Flow / Average Dose	21.9	2	365	1.0	1	13	9.6	1.5	120

21.2 Sodium Bisulfite

The sodium bisulfite system provides the ability to de-chlorinate the pre-treated (filtered) water upstream of the RO cartridge filters. Use of 38% liquid sodium bisulfite solution is anticipated via bulk tanker truck deliveries to the Project site. The design criteria for the Sodium Bisulfite System are shown in **Table 21-3**.

The sodium bisulfite system includes the following elements:

- One (1) sodium bisulfite solution tank, with a minimum capacity of 6,300 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Two (2) sodium bisulfite solution dosing pumps for filtered water dosing (1+1) at 4 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point
- ORP sensors downstream of each sodium bisulfite feed point will provide feedback control to maintain proper dose to ensure de-chlorination

The bulk tank will have butterfly valves on all outlets with lever actuators. The sodium bisulfite piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-3: Sodium Bisulfite System Design Criteria

Description	Proposed	Units
Number of Sodium Bisulfite Solution Tanks	1	each
Volume of Sodium Bisulfite Solution Tanks (each)	6,300	gallons
Materials of Construction of Sodium Bisulfite Solution Tanks	HDXLPE with IMFO-type outlets	
Filtered Water Sodium Bisulfite Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	4	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
ORP Sensors	Downstream of Sodium Bisulfite Feed Point	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 21-4: Estimated Sodium Bisulfite Usage at 38% Solution Strength

Flow Condition	Post-Filters			Concentrate Discharge		
Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	21.8	4	795	12.2	4	453
Maximum Flow / Average Dose	25.5	3	617	14.4	3	522
Average Flow / Average Dose	21.8	3	530	12.2	3	453

21.3 Sulfuric Acid

The sulfuric acid system provides the ability to reduce the pH of the pre-treated (filtered) water upstream of the RO cartridge filters for optimum RO performance. Use of 50% liquid sulfuric acid solution is anticipated via bulk tanker truck deliveries to the Project site. The design criteria for the Sulfuric Acid system are shown in **Table 21-5**.

The sulfuric acid system includes the following elements:

- One (1) sulfuric acid solution tank, with a minimum capacity of 6,300 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Two (2) sulfuric acid solution dosing pumps (1+1) at 30 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi
- Continuous dilution water system added downstream of metering pumps, pressurized utility water, at a flow rate of 2 gpm maximum for each feed point
- A pH meter downstream of the cartridge filters will provide feedback control to maintain proper dose to ensure optimum pH is achieved

The bulk tank will have butterfly valves on all outlets with lever actuators. The sulfuric acid piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-5: Sulfuric Acid System Design Criteria

Description	Proposed	Units
Number of Sulfuric Acid Solution Tanks	1	each
Volume of Sulfuric Acid Solution Tanks (each)	6,300	gallons
Materials of Construction of Sulfuric Acid Solution Tanks	HDXLPE with IMFO-type outlets	
Sulfuric Acid Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	30	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
pH Meter	Downstream of Cartridge Filters	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 21-6: Estimated Filtered Water (Pre-Cartridge Filter) Sulfuric Acid Usage at 50% Solution Strength

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	21.9	30	5,479
Maximum Flow / Average Dose	25.5	10	2,127
Average Flow / Average Dose	21.9	10	1,826

21.4 Threshold Inhibitor

The inhibitor system provides the ability of the RO membranes to operate properly by minimizing/controlling scale formation and is added to both passes of the RO system. Use of 100% liquid threshold inhibitor solution is anticipated via bulk tanker truck deliveries to the Project site. The design criteria for the Threshold Inhibitor System are shown in **Table 21-7**.

The inhibitor system includes the following elements:

- One (1) threshold inhibitor solution tank, with a minimum capacity of 6,300 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Four (4) threshold inhibitor solution dosing pumps, two (2) for first pass RO dosing (1+1) at 6 mg/L maximum dose, and two (2) for second pass RO dosing (1+1) at 6 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point

The bulk tank will have butterfly valves on all outlets with lever actuators. The threshold inhibitor piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-7: Threshold Inhibitor System Design Criteria

Description	Proposed	Units
Number of Threshold Inhibitor Solution Tanks	1	each
Volume of Threshold Inhibitor Tanks (each)	6,300	gallons
Materials of Construction of Threshold Inhibitor Tanks	HDXLPE with IMFO-type outlets	
First Pass RO Threshold Inhibitor Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	6	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Second Pass RO Threshold Inhibitor Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	30	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 21-8: Estimated Threshold Inhibitor Usage at 100% Solution Strength

Flow Condition	Pre-Cartridge Filter			Second Pass RO		
Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	21.9	6	1,096	4.6	6	230
Maximum Flow / Average Dose	25.5	3	638	5.4	3	135
Average Flow / Average Dose	21.9	3	548	4.6	3	115

21.5 Non-Ionic Polymer

The polymer system is used to enhance the settleability of the dirty washwater from the pre-treatment filtration process. Polymer solution will be added to the waste washwater pipeline upstream of the equalization basins. It is anticipated that emulsion polymer will be delivered to the Project site in 5-gallon pails or drums and stored within a containment area. The specific type of polymer (non-ionic or anionic) and dosing will be determined during the early phases of plant startup via jar testing and full-scale testing. The design criteria for the Non-Ionic Polymer System are shown in **Table 21-9**.

The polymer system includes the following elements:

- Two (2) dilute polymer solution tanks, one for mixing and one for feeding. Batches of dilute polymer solution shall be made manually by operations staff, and after mixing/aging, the solution will be transferred by gravity to the feed tank.
- Two (2) dilute polymer solution dosing pumps (1+1) at 0.8 mg/L maximum dose based on 0.5% polymer solution strength; pumps will be peristaltic tubing type with discharge pressure < 30 psi
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point

The polymer solution tanks will have PVC or CPVC ball valves with manual actuators. The polymer solution piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-9: Non-Ionic Polymer System Design Criteria

Description	Proposed	Units
Number of Non-Ionic Polymer Solution Tanks	2	each
Volume of Non-Ionic Polymer Solution Tanks (each)	200	gallons
Number of Mixers per Tank	1	each
Materials of Construction of Non-Ionic Polymer Tanks	HDXLPE with IMFO-type outlets	
Non-Ionic Polymer Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	0.8	mg/L
Polymer Solution Strength	0.5	%
Type	Peristaltic Tubing Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 21-10: Estimated Non-Ionic Polymer Usage at 35% Solution Strength

Scenario	Daily Volume (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	1.0	0.8	7
Maximum Flow / Average Dose	1.7	0.2	3
Average Flow / Average Dose	1.0	0.2	2

21.6 Sodium Hydroxide

The sodium hydroxide system provides the ability to adjust the pH of the RO permeate and to adjust pH/alkalinity of the finished water. Use of 50% liquid sodium hydroxide solution is anticipated via bulk tanker truck deliveries to the Project site. Sodium hydroxide is also used for membrane cleaning/neutralization, but the usage is low and therefore not included in these calculations. While the RFP recommends a bulk storage tank material of steel for the sodium hydroxide, MWH has proposed the use of HDXLPE, similar to the other bulk storage tanks on-site. HDXLPE is cheaper than steel, and will also help prevent potential corrosion from the coastal marine environment. The design criteria for the Sodium Hydroxide System are shown in **Table 21-11**.

The sodium hydroxide system includes the following elements:

- One (1) sodium hydroxide solution tank, with a minimum capacity of 6,300 gallons; tank shall be steel with a low-level outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch. The tank will be insulated and heat traced.
- Four (4) sodium hydroxide solution dosing pumps, two (2) for second pass RO dosing (1+1) at 20 mg/L maximum dose, and two (2) for finished water dosing (1+1) at 5 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi.
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point.
- A pH meter upstream of the second pass RO feed and on the finished water discharge will provide feedback control to maintain proper dose to ensure optimum pH is achieved.

The bulk tank will have an insulation jacket and low-power (external) heating system to maintain minimum temperature of the 50% solution of 80 degrees F. Pipe insulation is not provided. The tank will have butterfly valves on all outlets with lever actuators. The sodium hydroxide piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-11: Sodium Hydroxide System Design Criteria

Description	Proposed	Units
Number of Sodium Hydroxide Solution Tanks	1	each
Volume of Sodium Hydroxide Solution Tanks (each)	6,300	gallons
Materials of Construction of Dilute Sodium Hydroxide Solution Tanks	Steel	
Second Pass RO Sodium Hydroxide Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	20	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Post-Treatment Sodium Hydroxide Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	5	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
VFD	No	
pH Meter	Downstream of Cartridge Filters Finished Water	
Dilution Water System		
Type of Water Used	UV-Disinfected RO Permeate	
Flow Rate	2	gpm

Table 21-12: Estimated Sodium Hydroxide Usage at 50% Solution Strength

Flow Condition	Second Pass RO			Post-Treatment		
Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	4.6	20	767	9.6	5	400
Maximum Flow / Average Dose	5.4	10	450	11.2	3	280
Average Flow / Average Dose	4.6	10	384	9.6	3	240

21.7 Zinc Orthophosphate / Phosphoric Acid Corrosion Inhibitor

The phosphate system provides the ability to add corrosion inhibitor to the finished water, if the Owner decides to use this form of corrosion control. The system is designed to store/feed either of two liquid chemicals which will be delivered to the site in bulk tanker trucks 1) 32.5% zinc orthophosphate or 2) 75% phosphoric acid. The design criteria for the Zinc Orthophosphate System are shown in **Table 21-13**.

The phosphate system includes the following elements:

- One (2) solution tank, with a minimum capacity of 6,300 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch.
- Two (2) solution dosing pumps (1+1) at 4 mg/L maximum dose (as PO_4); pumps will be solenoid drive diaphragm-type with discharge pressure < 30 psi.
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point.

The bulk tank will have butterfly valves on all outlets with lever actuators. The solution piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 21-13: Zinc Orthophosphate/Phosphoric Acid System Design Criteria

Description	Proposed	Units
Number of Zinc Orthophosphate/Phosphoric Acid Solution Tanks	1	each
Volume of Zinc Orthophosphate/Phosphoric Acid Solution Tanks (each)	6,300	gallons
Materials of Construction of Zinc Orthophosphate/Phosphoric Acid Solution Tanks	HDXLPE with an IMFO-type Outlet	
Zinc Orthophosphate/Phosphoric Acid Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose (as Zinc Orthophosphate)	4	mg/L
Type	Solenoid Driven Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 21-14: Estimated Zinc Orthophosphate Usage at 38% Solution Strength

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	9.6	4	320
Maximum Flow / Average Dose	11.2	1	93
Average Flow / Average Dose	9.6	1	80

22.0 ARCHITECTURE

This section describes the architectural basis of design for all Design-Build improvements. The design criteria include the design philosophy, standards and principles, and design data to be used to carry out the preliminary and detailed design.

22.1 Code Requirements

- 2013 California Building Code
- 2013 California Fire Code
- American's with Disabilities Act (ADA)
- Occupational Safety and Health Administration (OSHA)
- Local code amendments and ordinances

22.2 Design Philosophy

The architectural design will be developed in character, style, form, color and materials to harmonize effectively with the surrounding environment.

Construction materials and methods will be selected based on their physical appearance and overall visual effect in harmonizing with the surrounding environment, their emergence from the basic structural system, and their appropriateness in accommodating the deployment of mechanical and electrical systems within the facility. Materials used in the construction of the Design-Build Improvements will conform in composition and application to all applicable regulations, including those concerning volatile organic content, lead, mercury, CFCs and asbestos. Materials used for the roofing system and the building perimeter envelope will be established for optimum durability over the full range of climatic variations typical to the region and functions contained within.

The Design-Build Improvements should be kept as low in profile as is functionally possible. Where appropriate, the design will de-emphasize verticality and encourage the grounding of planar elements of the Design-Build Improvements into the natural landscape. Low, horizontal site walls, berming, and the use of sloping wall planes will be considered in achieving balance.

Visible and highly reflective materials and surface finishes will be avoided on the exterior of the Design-Build Improvements.

Exterior walls will use low-maintenance indigenous materials such as masonry and concrete for the Design-Build Improvements. Pre-engineered metal buildings may be used for specific buildings. Surface textures and horizontal banding of harmonious colors are some of the techniques to be used in blending the Design-Build Improvements with its environment. Integral material coloration will be used were possible with limited use of applied coloration such as paint.

The design of roof systems will be carefully developed to harmonize with the visual context of the Design-Build Improvements. Where flat roofs are appropriate, they will be predominately hidden by parapet walls. Where pitched roofs are desired, consideration will be given to selecting, pitch, materials, and coloration to harmonize with surroundings. Highly reflective roof materials will not be visible from adjacent properties. Mansard and jogging roof lines will be employed only when appropriate to the setting. The use of securable skylights will be used for natural interior lighting.

Where windows are appropriate to the design, they will be energy-efficient, low-maintenance durable material, providing acoustical protection, and security. Glazing systems will be designed to be limit reflectivity and glare from sunlight. Glass tinting and window frame colors will be chosen for their consistency with the palette of materials and colors selected for the Design-Build Improvements.

Louvers, insets, grills, trim material, and accents will be employed judiciously and only where functionally necessary or appropriate for compatibility with adjacent structures. Character, style, form, color and materials of louvers, insets, grills, trim, and accents will be of low maintenance durable materials consistent with the color palette chosen for the facility to harmonize effectively with the surrounding environment.

Doors and frames will be low-maintenance durable materials of colors compatible with the wall surface in which they are located.

Exterior lighting will satisfy functional and security needs while not creating light pollution in the form of point sources of direct glare visible from a distance. Lighting will be sensitive to the privacy of adjacent land uses. Fixtures will be carefully selected for efficiency, cutoff, consistent lamp coloration throughout the project, and effectiveness in delivering only the light necessary to the task, while avoiding unnecessary spill lighting beyond site boundaries. Low level light fixtures that light immediate areas are encouraged.

As a proposed alternative, natural lighting of building interiors may be provided by use of skylights and clerestory windows.

All exterior mounted mechanical and electrical equipment will be located and screened from public view.

22.3 Anticipated Structures

The major structures anticipated are listed below.

1. Administration Facilities
2. RO Building
3. Chemical Storage and Feed Facilities
4. UV Disinfection Building
5. Granular Media Filtration Building
6. Electrical Switchgear Building

22.3.1 Administration Facilities

The building for the administration facilities is conceived as a simple, flexible structure that seamlessly engages the desalinization plant's infrastructure and reflects its sustainable mission. Sited off the main entry / access road, the Administration Facilities will serve as the plant's control and lab, as well as the public face of the overall facility. The building is intended to demonstrate, elegantly and subtly, a sustainable and resilient approach to building design, construction and operations as well as a sensitivity to the site and surrounds. The interior planning and materials will reflect the precepts of biomimicry and sustainability.

The plan will incorporate load bearing perimeter CMU walls that support a long span system of open web trusses to allow for a column-free plan and maximum flexibility in interior space planning. The exterior CMU walls will add significant thermal mass to the design and will reduce mechanical heating / cooling needs, provide a durable exterior envelope, and will be locally sourced.

The plan of the building has been shaped and oriented to best take advantage of views, daylighting autonomy, and natural ventilation. The narrow rectilinear shape of the building primarily faces south toward the main entry of the facility and the southern sunlight. The building is placed back, away from the entry drive, providing space for short term and visitor parking, a demonstration garden, and a more generous public entry experience.

The building will reduce its energy demand with its use of good building envelope design and proper window placement, thus minimizing the dependency on artificial lighting and mechanical ventilation and cooling. Daylighting strategies will be maximized including high performance glazing, strategically placed Solartubes, and interior glazing that will optimize daylight transfer and good views for the Administration Facilities occupants. Solartubes, placed in the locker rooms, toilet rooms, and maintenance area, will bring natural light to these interior spaces that do not have direct access to a window. Additionally, roof mounted PV's and solar water heaters will augment the building's electricity costs and reduce mechanical equipment sizes and required spaces. Natural ventilation will be achieved through the use of operable windows and a fan assist system. Potable water use will be reduced by capturing storm water for irrigation. Green (vegetated) roofs will be designed to reduce storm water runoff, increase building thermal capacity, and support diversity and a restorative habitat.

To make evident the story of the client's mission, the building will incorporate environmental graphics and signage that describe the importance of water in this specific region of the State, how the plant serves to conserve potable water, and the specific sustainable features of the building.

22.3.2 RO Building

Materials of construction for the walls and roof will be established for optimum durability based on the exterior and interior environment.

Electrical equipment such as switchgear and large motor starters will be located in a room separate from the RO trains and piping.

RO piping will be run in trenches to provide ready access to the RO systems.

Trenches will be sized to allow access to piping, pipe connections, and pipe supports for inspection, repair, and replacement.

Overhead doors will be provided to allow pumps, RO membranes, and other equipment to be removed/replaced.

Center hallway will be adequately sized for a forklift and scissors lift to allow for maintenance and replacement of RO membranes.

22.3.3 Chemical Storage and Feed Facilities

Liquid chemicals will be stored in a building to provide security and protection of tanks, pumps, piping, and ancillary devices from the elements.

Generally, each chemical will be located in a separate room to provide corrosion protection and avoid the potential of mixing of incompatible chemicals.

Each room will be provided with required lighting and HVAC.

Secondary containment is to be provided for liquid chemical storage. The chemical equipment (tanks, metering pumps, etc.) will be located on the lower level. Stairs will provide access from the access way to the lower level of each room.

Non-hazardous chemicals, such as polymers, may be located in a common area. Secondary containment will be provided with a depressed (two to four inches deep) area covered with FRP grating flush with the surrounding floor.

Fire suppression will be provided per CBC, CFC, NFPA and local requirements.

22.3.4 UV Disinfection Building

Structural elements of the UV Disinfection Building are summarized in **Section 23.0**.

22.3.5 Granular Media Filtration Building

Structural elements of the Granular Media Filtration Building are summarized in **Section 23.0**.

22.3.6 Electrical Switchgear Building

Structural elements of the Electrical Switchgear Building are summarized in **Section 23.0**.

22.4 Building Schedule

The building schedule, which includes building dimensions, building materials, details on doors, windows, floor coverings, skylights, louvers, fire sprinkler requirements and a summary of what each room will contain, is presented in **Appendix F**.

Structural elements of the major buildings are summarized in **Section 23.0**.

23.0 GEOTECHNICAL AND STRUCTURAL DESIGN

The Desalination Infrastructure of the Monterey Peninsula Water Supply Project will include six building structures: Administration Facilities, RO Building, Chemical Storage and Feed Facilities, Granular Medial Filtration Building, UV Disinfection Building, and Electrical Switchgear Building. The primary considerations for the structural design of these buildings are the close proximity to major earthquake faults, and the corrosive environment fostered by the coastal setting and primary use of the facilities. Structural foundations will be also provided for storage tanks, pump stations, cartridge filters and the concentrate equalization pond.

23.1 Design Criteria

The structures will be designed, at a minimum, in accordance with the provisions of the 2013 California Building Code (CBC), as required to obtain a building permit from the County of Monterey Building Services Department. The buildings will be assigned to Occupancy Category III as required by the CBC for "water treatment facilities for potable water…and other public utility facilities". The primary implication of the Occupancy Category III assignment is the required Importance Factors applied to seismic and wind design forces – 1.25 for seismic, 1.15 for wind – which provide for increased structural performance relative to "typical" (Occupancy Category I and II) building structures.

In addition, and in accordance with design requirements specified in the Request for Proposals (RFP), the structures will be designed in consideration of the following:

- ACI 350 "Code Requirements for Environmental Engineering Concrete Structures"
- Building Life Expectancy:
  - Reinforced Concrete Structures – 75 years
  - Administration Facilities – 50 years
  - Electrical Switchgear Building – 30 years
- Seismic Performance (during and after design-level earthquake ground motions):
  - Emergency systems to remain operational
  - Tanks containing chemicals, saline water and Finished Water to remain operational
  - Critical equipment protected from damage

23.2 Administration Facilities

The Administration Facilities will be a single-story structure, approximately rectangular in plan, with plan dimensions of approximately 130 feet by 40 feet. The roof structure will consist of steel decking spanning over steel wide-flange beams (or open-web steel joists), spaced approximately 10 feet on center. The beams/trusses will span across the 40-ft dimension of the building and be supported by perimeter CMU walls. The CMU walls will be supported on conventional shallow strip footings, and the floor construction will be concrete slab-on-grade, approximately 5 inches thick. The lateral (seismic force resisting) system will consist of the metal deck roof diaphragm and the perimeter CMU shear walls.

23.3 RO Building

The RO Building will be a single-story structure, rectangular in plan, with plan dimensions of approximately 295 feet by 88 feet, for the 9.6 design and 218 feet by 88 feet, for the 6.4 design. The building is expected to be a pre-engineered metal building, consisting of pitched portal/moment frames spanning across the 88-ft dimension of the building, and spaced at approximately 25 feet on center. There will be no columns in the building interior. The portal frames will support steel Z-purlin roof framing, which will support the steel roof deck. The steel columns of the steel portal/moment frames will be supported on conventional shallow spread footings. The floor construction will be concrete slab-on-grade, of varying thickness, and with depressions and trenches as required to accommodate the equipment and processes housed within the building. The lateral (seismic force resisting) system will consist of the metal deck roof diaphragm and/or horizontal braced diaphragm via steel tie rods; the portal/moment frames in the transverse building direction; and steel tie rod braced frames at discrete column bays in the longitudinal building direction.

23.4 Other Major Structures

The Chemical Feed and Storage Facilities, Granular Media Filter , UV and Electrical Switchgear Buildings will each be single-story structures, rectangular in plan, with approximate plan dimensions as follows:

- Chemical Feed and Storage Facilities: 166 feet by 50 feet
- Granular Media Filter Building: 120 feet by 42 feet
- UV Disinfection Building: 40 feet by 40 feet
- Electrical Switchgear Building: 75 feet by 60 feet

The structural systems for each building will be similar to those described above for the Administration and/or RO Buildings, i.e. steel-framed roof with CMU walls or pre-engineered metal, with concrete slab-on-grade floors and shallow foundation systems.

23.5 Loading

- Loads/Roof:
  - 20 psf with tributary area reductions allowed
- Platforms & Stairs:
  - 100 psf and 300 lbs concentrated on stair tread
- Others:
  - ASCE 7-10 Table 4-1
  - Occupancy Category III OR IV if water storage facilities and pump structures required to maintain water pressure for fire suppression or if containing hazardous chemicals
- Seismic/Site Class:
  - Presumed Site class D, verify with geotechnical baseline report as may be Site class E due to adjacent River alluvial/beach soils
  - RO Plant Mapped Spectral Response Acceleration at Short Periods (0.2 sec) - 5% Damping (SS):
    - 1.585 g for Occupancy III, 1.585 g for Occupancy IV for 2013 CBC, was 1.323 g for 2010 CBC
  - RO Plant Mapped Spectral Response Acceleration at 1 second period - 5% damping (S1):
    - 0.562 g for Occupancy III, 0.562 g for Occupancy IV for 2013 CBC, was 0.595 g for 2010 CBC
  - Seismic Use Group:

        - Sds = 1.057 g for 2013 CBC, 0.882 g for 2010 CBC
    - Seismic Design Category:
        - D
    - Importance Factor (Ie):
        - 1.50 for Occupancy IV, 1.25 for Occupancy III
    - Seismic Q/A Plan Required?
        - Yes
    - Structural Observations Required?
        - Yes
- Wind:
    - Base Wind Speed - 3 Second Gust (V3S):
        - 115 mph for 2013 CBC, 85 mph for 2010 CBC
    - Fastest Mile Wind Velocity (Vfm) :
        - Not applicable
    - Exposure Category:
        - C
    - Importance Factor (Iw):
        - 1.15

23.6 Geotechnical Information

Geotechnical Baseline Report (GBR) provided within the RFP documents from the URS GBR and will be supplemented where necessary by tender experience specific to the project area.

- Allowable Bearing Pressure
    - All Loads (w/ wind & seismic): Per GBR and presumed minimum of 2600 psf

- Dead plus Live Loads: Per GBR 2000 psf
- Groundwater (GW) Elevations: Per GBR provided by CAW
- Friction Factor: Per GBR and presumed minimum of 0.25 g
- Lateral Soil Pressure (Above GW and Below GW):
    - Restrained (At Rest): Per GBR by CAW
    - Unrestrained (Active): Per GBR by CAW
    - Passive: Per GBR by CAW
    - Seismic: Per GBR by CAW
    - Traffic Surcharge: Per GBR by CAW

- Total Settlement: Per GBR by CAW
- Differential Settlement: Per GBR by CAW

23.7 Structural Materials:

- Concrete:
    - 4,500 psi - STRUCTURAL (all structural applications)
    - 3000 psi - SITEWORK (curb, gutter, and civil applications)
    - 2000 psi - LEAN (unreinforced concrete (thrust blocks and encasements)

- Reinforcing:
    - Grade 60 - all applications

- Steel:
    - Structural Tubing - ASTM A500, Grade B

- Structural Pipe - ASTM A53, Grade B
- Wide Flange Shapes - ASTM A992
- Other Standard Shapes and Plates - ASTM A36

- Stainless Steel:
  - Type 304 - Architectural and common uses, and anaerobic conditions
  - Type 316 - Submerged or corrosive areas

- Aluminum:
  - 6061-T6 - All applications

- Masonry:
  - ASTM C 90, Medium Weight (105 to < 125 pcf), Solid Grouted:
  - Grout: 2000 psi
  - Mortar: Type S - 1800 psi
  - Size: 16" x 8" x 8" high CMU
  - f'm: 1500

- Waterstops: New Construction – TPER and/or PVC 3/8" X 6" flat strip shapes

23.8 Special Inspections and Structural Observations

Per 2013 CBC Requirements

23.9 Design Calculations, Methods and Assumptions:

- Calculations will be done in accordance with CBC. A table of contents shall be included for each set of calculations greater than five sheets long.
- All structures will be designed in accordance with sound engineering principles based on the references listed herein and by the RFP. Hydraulic concrete structures will be designed by ultimate strength and will utilize additional sanitary durability coefficients as stated in ACI 350. Durability factor and cracking need not be considered for seismic loads.
- The governing Building Department will comply by the 2013 CBC as the permit submittals will be after 12-31-2013 and per Monterey County Building Department, phone number 831-755-5208, Francisco Tanguilig, (prior to 12-31-2013 permit submittals will use 2010 CBC,) Building Department stated they will contract the plan check out the third party plan checker WC3.

23.10 Design Requirements by Reference:

- ACI-318/08 Building Code Requirements for Reinforced Concrete
- ACI-350R/06 Environmental Engineering Concrete Structures, Appendix C
- ACI-350.3/06 Seismic Design of Liquid Containing Concrete Structures
- ACI 530 Building Code Requirements for Masonry Structures
- ACI 530.1 Specifications for Masonry Structures
- AISC Manual of Steel Construction
- AISI AISI Specification for the Design of Cold-formed Steel Structural Members
- AA Aluminum Association - Aluminum Design Manual
- 2013 CBC International Code Committee (ICC) - International Building Code 2012 basis
- ASCE-7/10 Minimum Design Loads For Buildings and Other Structures

23.11 Concrete for Tank Foundations, Pump Stations and Inlet Structures

The Recycle and Concentration Equalization Pond Pump Stations will have an exposure very similar to the splash zone as defined in ACI 357-R. Items affected in the splash zone of the Pump Stations are corrosion of the reinforcing steel, chemical deterioration of the concrete, and abrasion of the concrete. To control corrosion, proper cover over reinforcing steel and bar supports is required. ACI 357R Table 2.2 recommends a minimum cover of 2.5" for reinforcing steel in splash zone exposure which will be adhered to. Note that increasing cover beyond this limit can lead to wider cracks, which is detrimental to protecting reinforcing. ACI 357R Table 2.1 recommends a maximum water to cement ratio of 0.40 and a minimum 28 day compressive strength of 5000 psi for concrete in splash zones. ACI 350 defines concrete exposed to seawater as having a "moderate" sulfate exposure and recommends the use of Type V cements (required for severe or very severe exposures.) MWH will use concrete with Type II, V dual certified cement which is common in this locality at typically no additional cost. High-range water reducing admixtures and Xypex Admix C-5000 will also be used to increase the workability and provide uniform cement distribution throughout the mix, as we will be using high cement contents and low water to cement ratios for this concrete.

The information above applies to the following structures:

- Raw water tank foundation,
- Backwash recycle pump station,
- Backwash pond inlet structure, and
- Concentrate equalization pond pump station.

24.0 HVAC SYSTEM

The purpose of this write-up is to establish the appropriate HVAC configurations to meet the following objectives:

1. Provide an operable, maintainable and economical HVAC system design, which meets all code requirements.

24.1 Design Conditions

Outside:

- Winter: 29°F DB (ASHRAE 2%)
- Summer: 77°F DB, 63°F WB (ASHRAE .5%)

Indoor design temperatures:

- Winter: 68°F DB
- Summer: 75°F DB

California Energy Code Compliance Requirements:

- Climate Zone 3

24.1.1 General

- The Project's HVAC systems will be selected to exhibit high reliability and will be of industrial quality.
- HVAC equipment, ductwork and air distribution devices serving corrosive areas will be provided with protective coatings and/or constructed from corrosion resistant materials such as fiberglass reinforced plastic or aluminum.
- Outdoor condensing units and/or air handling units will be located adjacent to the building to be served and supported by a concrete equipment pad.
- All electric motors will be high efficiency type, where available.
- Sub-freezing temperatures at this area seldom occur and only for a few hours at a time. Local experience is that exposed water piping 1" or larger will not freeze.
- Humidity control is not required for human comfort or normal static discharge control. The typical Monterey Bay 55°F fog turns to 50% relative humidity when heated to 70°F.
- Because of the proximity to the Monterey Bay prevailing winds, similar facilities this close to the shore do not require air conditioning. The normal weather is cool and usually, only becomes warm during autumn afternoons when the Santa Anna winds come in from the east.
- Normal warm air temperature of 77°F and a presumed maximum exhaust air temperature rise of 18°F yield a space temperature of 95°F. During the few hours in the year when OSA temperature exceeds 77°F, space temperature can be expected to increase.
- Seismic restraints will be provided where required and rely on ISAT design and products.

24.1.2 MWH Design Recommendations

- Waive freeze protection and reference to humidity control criteria.
- Leave the air conditioning criteria in place.

- Unless it is determined that proposed electrical gear cannot operate at 100°F for a couple hours at a time, size exhaust fans on an 18°F temperature rise.

24.2 Energy Efficiency

All HVAC equipment will be specified to perform at or above code required minimum efficiency levels, and according to the latest rules and regulations of the US Department of Energy.

24.3 Design Codes

The following are the minimum Applicable Codes and Standards for the design of the HVAC systems:

- 2013 California Title 24 Part 4 Mechanical Code
- 2013 California Title 24 Part 5 Plumbing Code
- 2013 California Title 24 Part 6 Energy Code
- 2013 California Title 24 Part 11 Green Building Standards Code and as adapted by Monterey County

24.4 Ventilation Design

Ventilation systems will be wall or roof centrifugal exhaust fans with wall mounted louvers for intake air. In order to conserve power and match ventilation with heat load, 2-speed fans will be used or multi-fans will be used and cycled on and off.

HVAC equipment in classified areas, such as explosive environments will be selected in accordance with NFPA, Building Code, National Electric Code and/or any other local code requirements, to prevent an explosion.

Outdoor heat rejection equipment coils will be dip coated with a corrosion and moisture resistant film to prevent damage by airborne corrosive particles and fumes that may be present in the plant environment.

HVAC equipment, ductwork and air distribution devices located in corrosive areas or serving corrosive areas will be provided with protective coatings and/or constructed from corrosion resistant materials.

24.5 Noise Goals

While some equipment noise is inevitable in process spaces and mechanical rooms, noise levels will nevertheless be considered an important criterion in the design of the HVAC systems.

HVAC systems serving occupied areas will be designed to meet the average noise criteria (ANC) levels recommended by ASHRAE.

Where efficient HVAC equipment selection does not result in acceptable noise levels, sound attenuation devices such as duct silencers will be utilized to reduce noise levels.

Duct velocities will be maintained in accordance with the recommendations in the ASHRAE Applications Handbook.

Noise produced outside of the buildings will be evaluated to comply with local codes and ordinances. The evaluations will also consider the sound emission criteria for all other sources.

24.6 Ductwork Material

Ductwork design and installation shall follow the latest SMACMA standards and be appropriate for the conditions.

PVC ductwork shall be fabricated in accordance with the Sheet Metal and Air Conditioning contractors National Association (SMACNA), a manual on thermoplastic Construction when possible. All ductwork to be fabricated from Type II Grade I, Type I, Grade I and extruded Type I grade I PVC and to conform to ASTM D 1784-81, Class 12454, ASTM E 84 Flame Spread Rate 15.

24.6.1 Insulation

Ductwork conveying mechanically-cooled supply air will generally be insulated in accordance with applicable Energy Efficiency Code requirements.

All outside air intake and supply air ductwork will be insulated to prevent surface condensation from forming when the ducts are carrying cold air thru warm, moist spaces. Supply air ductwork located inside the conditioned space will not be insulated.

Internal duct liner will be used on supply, return, and exhaust ductwork where appropriate for sound attenuation and thermal insulation.

Internal duct liner will not be used on outside air intakes serving normally occupied spaces, due to the potential for growth of microorganisms in accumulated dust on the liner media.

Internal duct liner will also not be used on air conditioning ductwork where the cooling is shutoff at night, to avoid mold growth problems.

Pipes containing fluids at temperatures below ambient will be insulated with a closed cell thermal insulation.

24.7 Administration Building

24.7.1 Thermal Zones:

- Conference Room/Storage Room
- Laboratory
- Control Room
- Visitor (2)
- Private Offices (2)
- General Office (2)
- Maintenance/Toilet/Lockers
- IT Server

24.7.2 HVAC System Selected

Variable Refrigerant Volume (VRV) is a mature HVAC system that has its roots in the Pacific Rim where electricity is very expensive. This 5,000 FT2 building will require multiple heating and cooling zones due to exposures, load patterns and operating schedules. VRV is a sophisticated, split system air source heat pump that provides for multiple, simultaneous heating and cooling zones connected to a single outdoor condenser unit containing multiple compressors. VRV systems have routinely yielded high LEED EAc.1 points for HVAC system performance. VRV systems use R-410a.

Outdoor unit efficiencies are very high and electric strip heaters are not required when outdoor design temperatures are above -4oF. Condenser coils are factory coated for salt and corrosive protection. The outdoor unit creates condensate while in the heating mode and needs to be located where this water is not an issue, usually on a concrete pad in a landscape area.

There are several terminal units (indoor units) available including ceiling mounted cassettes, exposed wall or ceiling, and concealed fan coil units. Each indoor unit is connected by refrigerant piping to a 'branch selector' which in turn is piped to the outdoor unit. Acoustic performance is very attractive for indoor and outdoor units. Since cool air is made at each indoor unit, condensate drain piping is run from each unit to a suitable drain point.

Controls are factory, direct digital based (DDC), interconnect all units and do not require a free-standing Building Management System (BMS) to operate. A central, wall mounted 'control module gives access to all units status, set points and schedule. A BACnet or Lon talk interface can be provided at a later time allowing for BMS monitoring if required in the future. A BMS does not appear to be a project criteria.

CMC required 15 CFM/person ventilation air is provided through a dedicated outside air system (DOAS). The OSA is delivered to the individual indoor units and makes up for normal toilet exhaust.

An IT Server Room is anticipated. This indoor unit can be connected to the VRV system, or provided as a standalone cooling only system. It is anticipated that the Control Room and Lab will be a 24/7 operation, and placing the IT Room on the VRV system could make sense.

There are several manufacturers represented and supported on the Central Coast. Mitsubishi's 'City Multi' line of variable refrigerant flow, Daikin's 'VRVIII-S' and LG's 'MULTI V' are each a viable candidate.

Indoor unit placement depends on the type of unit selected. Cassettes sit in the suspended ceiling grid. Wall mounts are hung on the wall, typically above the door in a Server Room. Fan coil units are mounted above the ceiling with supply and return duct branches going to each room served.

The outdoor unit mounts on a concrete pad outside the building for ease of service. It can be remote should aesthetics require.

100% outside air economizer cycles are not available with VRV, but because the equipment/system is so efficient, the California Energy Code does not require it.

Toilet, Shower, Conference and Break Rooms will have exhaust fans. Fan controls will be with occupancy sensors, humidity sensors and/or lights.

Fire dampers and/or fire smoke dampers will be considered once location of rated walls is verified.

The Administration Building will require California Energy Code compliance documentation for the envelope, mechanical system and electrical system.

24.8 Granular Media Filtration System

This structure is open to the environment. Exhaust and make-up air is not provided at this time.

24.9 RO Building

Addenda 1 indicates that the electrical loads in the building will create over 2,126 MBH in heat and 110,000 CFM of exhaust air. Staying with the suggested design found on TD-5, the 8 intake louvers and 8 exhaust louvers will be approximately 5' square.

Exhaust fans will be controlled by individual thermostats.

Intake louvers will be provided with throw away filters.

There are no other HVAC criteria.

24.10 UV Disinfection Building

Addenda 1 indicates that the electrical loads in the building will create over 360 MBH in heat and 20,000 CFM of exhaust air. Staying with the suggested design found on TD-5, the intake louvers and exhaust louvers will be approximately 3' square.

Exhaust fans will be controlled by individual thermostats.

Intake louvers will be provided with throw away filters.

There are no other HVAC criteria.

24.11 Chemical Storage and Feed Facilities

Addenda 1 indicate that multiple, separate, low and high volume exhaust fans are required. Room air change quantity and location of inlets (high and low) will be considered on an individual basis.

Two speed exhaust fans will be controlled by individual thermostats and occupancy sensors.

Intake louvers will be provided with throw away filters.

There are no other HVAC criteria.

24.12 Electrical Switchgear Building

Addenda 1 indicates that the electrical loads in the building will create over 600 MBH in heat and 33,000 CFM of exhaust air. Staying with the suggested design found on TD-5, the intake louvers and exhaust louvers will be approximately 3' square.

Exhaust fans will be controlled by individual thermostats.

Intake louvers will be provided with throw away filters.

HVAC for the Control Room will be provided by a single thru-the-wall heat pump.

25.0 PLUMBING SYSTEM

Building plumbing and fire protection systems design will conform to the requirements of the following codes and standards and any supplementary requirements of the authorities having jurisdiction:

1. Latest applicable version of Local or International Plumbing Code
2. Latest applicable version of Local or International Fire Code
3. Latest applicable version of (NFPA)

25.1 GENERAL STANDARDS

- Above and below ground piping will be as defined in the RFP.
- Water pressure from potable water system to buildings should be a minimum of 50 psig.
- Separate metered and reduced pressure zone backflow protected water services will be required for potable building water and fire protection.
- Light duty hose valves for building interior and exterior washdown will be 3/4-inch globe valves with hose thread adapters.
- Medium duty hose valves for interior and exterior washdown will be 1-inch globe valves with hose thread adapters.
- Hose valves subject to freezing will be non-freeze type.
- A minimum of 2 hose valves per wall will be provided in process areas.
- Floor drains and hub drains that have infrequent use will have primed P-traps. The water source for trap priming will be protected by a reduced pressure zone backflow preventer.

25.1.1 Building Plumbing Fixtures and Equipment

- Water closets, urinals, lavatories and service sinks will be American Standard or Kohler.
- Water closets will be floor-mounted flush-valve-type, and urinals will be wall-hung flush-valve type.
- Drinking fountains will be double wall-hung units in the Administration Facilities.
- Safety showers / eyewashes will be Speakman, Haws, or equal.
- Water Heater:
  - Tankless, instantaneous type will be Envirotech or equal.
  - Tank-type will be AO Smith, State Industries, Inc., or equal.
- Small-capacity sump pumps will be ABS or equal.
- Piping interior service valves, 2-inch and smaller, will be ball valves; 3-inch and larger will be gate valves.
- Floor drains, roof drains and cleanouts will be JR Smith, Josam, or equal.

25.1.2 Barrier-Free Plumbing Fixtures (ADA)

4. Water closets, urinals, lavatories, and water coolers will be provided for the physically impaired as required by the applicable codes.

25.2 Cross Connection Control

Cross connection control will be provided in accordance with the Plumbing Code.

25.2.1 Backflow Preventers

Backflow preventers will be designed as defined in the RFP. Reduced pressure zone backflow preventers will be installed for the following items, as a minimum:

- Main building potable water service
- Water supply for mechanical equipment and instruments
- As separation between potable water (PW) and non-potable water (UW)
- Backflow preventers that are located outside will be placed within an insulated enclosure

25.3 Emergency Safety Equipment

25.3.1 Safety Showers / Eyewashes

- Combination safety shower / eyewash units will be installed in all chemical areas.
- Recessed combination safety shower / eyewash units will be installed in all laboratory areas.
- Access to these units will be unobstructed.
- The design and installation of the emergency shower / eye wash systems will meet the requirements of ANSI Z358.1-2004
- The emergency shower will deliver 20 gpm of 80-degree F tempered water, for 15 minutes at 30 psig.
- The emergency eye wash will deliver 0.4 gpm of 80-degree F tempered water, for 15 minutes at 30 psig.

25.4 Water Conservation

Low water use plumbing fixtures and trim will be specified and installed in accordance with requirements of the Standard Plumbing Code.

Maximum flow rates will be as follows:

- Water Closet: 1.6 gallons per flushing cycle
- Urinal: 1.0 gallons per flushing cycle
- Private Lavatory: 2.2 gpm
- Public Lavatory: 0.5 gpm
- Shower Head: 2.5 gpm
- Sink Faucet: 2.2 gpm

25.5 Storm Drainage

Rainfall rate: 1.5” per hour (California Plumbing Code Table D-1.1)

Roof drain / Overflow drain type: Not applicable based on roof design. Gutters and downspouts currently called for.

Special treatment: Not applicable

25.6 Sanitary Sewer

A new, on-site septic tank and leach field is to be provided in accordance with County of Monterey requirements.

25.7 Lab Waste

Laboratory fixtures will run through a neutralizing tank prior to discharge using Fuseal Polypro (or equal) piping.

25.8 Compressed Air

A 5 HP air compressor, 80 gallon receiver and refrigerated air dryer will be provided for maintenance and laboratory use.

CA piping will be routed where required and provided with branch drops complete with ball shut off valves and quick-disconnect couplings.

25.9 Deionized Water

A wall mounted, cartridge type filter will be provided in the Laboratory and connected to a single dispenser. Storage tank, recirculation or UV systems are not provided at this time.

25.10 Domestic Water

Pressure regulator: provided if required.

Hose bibbs with vacuum breakers will be provided where required.

Reduced Pressure Zone backflow protection devices to be provided where required.

25.11 Domestic Hot Water

Water heater: Small electric tank type sized for connected load in the Admin Building for showers and emergency equipment; various process buildings for emergency equipment.

25.12 Domestic Hot Water Recirculation

Provided as a means to reduce water consumption and keep tepid water available at emergency equipment. Pumps are controlled by temperature to reduce energy loss.

25.13 Natural Gas

Not required at this time.

25.14 Plumbing Fixtures

Institutional grade fixtures by Kohler, American Standard or Toto.

1.28 GPF, flush valve water closets will be provided if site water pressure is adequate.

Waterless urinals are suggested.

Floor drains with trap primers will be provided at all toilet rooms and emergency equipment.

25.15 Emergency Equipment

Eyewash and showers will be provided in accordance with ANSI Z358 regarding location, distance between/to, temperature of tepid water, flow rate and pipe size.

Emergency equipment drainage should be discussed.

25.16 Design Recommendations

- Design considered under this section is to five feet outside the building perimeter. Coordination with Civil Engineer and Underground Contractor concerning invert elevations, pipe sizing and location is necessary.
- Seismic restraints will be provided where required and rely on ISAT design and products.

26.0 ELECTRICAL SYSTEM

26.1 Electrical Codes, Standards, and Recommended Practices

The Work will be designed and constructed in accordance with applicable sections of the latest provisions of codes, standards, and recommended practices published by the following organizations:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Electrical Testing Laboratories (ETL)
- Illuminating Engineering Society of North America (IESNA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- The Instrumentation, Systems, and Automation Society (ISA)
- International Electrical Testing Association (NETA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories (UL)
- Occupational Safety and Health Administration (OSHA)

The Work will be performed in accordance with applicable portions of the following specific codes, standards and recommended practices, at a minimum and as modified by local and state amendments. Where an edition date is not listed below, per the RFP, the most current editions will be used based upon the date the Project is awarded:

- NFPA 70-2011 - National Electrical Code (NEC)
- International Building Code (IBC), as related to conduits embedded in structural elements
- California Title 24 Building Codes (2013)
- California PUC General Orders 95 (overhead work) and 128 (underground work) in public spaces (however, no overhead utility work is included in this Proposal).
- California Title 24 Building Codes (2013)
- ANSI/NEMA MG 1 – Motors and Generators
- ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures: including Chapter 13, “Seismic Design Requirements for Nonstructural Components,” and Appendix 11A.1.3.10, “Quality Assurance Provisions” – “Special Inspection and Testing” – “Mechanical and Electrical Components”
- IEEE 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Color Book)
- IEEE 399 IEEE Recommended Practice for Industrial and Commercial Power System Analysis
- IEEE 519-1992 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- IEEE 551 IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems (Violet Color Book)
- IEEE 1584 IEEE Guide for Performing Arc-Flash Hazard Calculations
- IES Lighting Handbook (latest edition)
- NETA ATS (ANSI) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

- NFPA 70E Standard for Electrical Safety in the Workplace
- NFPA 101 Life Safety Code
- NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

For the purposes of defining the electrical system, to be provided according to the RFP, it is presumed that no portion of this facility has been identified by local authorities as a "designated critical operations area (DCOA)" per NFPA 1600-2010, Standard on Disaster/Emergency Management and Business Continuity Programs.

26.2 Normal Power Electrical Loads

Estimated loads for the new plant, are based on major process components, and are summarized in the **Appendix G**. These estimated loads are subject to change during the design phase of the project. In addition to these larger process loads, other types of loads, as defined below will be defined during formal design; however, these additional loads have been estimated and included in the preliminary sizing of the electrical distribution system, down to the 480 V level.

26.2.1 Miscellaneous

There will be a number of process loads 5 horsepower (HP) and smaller that will add to the tabulated process loads, and which will include sump pumps, sample pumps, motor-operated valves, chemical pumps, solenoids, panel space heaters, equipment controls, and cooling fans. These loads are expected to be small compared to the process loads included above. Many may be powered from equipment control transformers at 120 V; and, some, such as sump pumps, sample pumps, motor-operated valves, and chemical pumps, may require 480 V from MCCs or power panelboards, or 120/208 V from lighting and appliance panelboards in the area.

26.2.2 HVAC Load Estimate

26.2.2.1 Conditioned Areas

The heating, ventilation, and air conditioning (HVAC) systems will provide mechanical cooling for Electrical Rooms, Administration Facilities, and other identified process buildings/areas. Power for these systems and equipment will be from 480 V panelboards (for packaged units) or MCCs (for starters provided under Division 26) or 120/208 V panelboards (for smaller equipment) nearest the HVAC equipment. These HVAC loads will be added to the above process loads. These loads are expected to be small compared to the process loads included above.

26.2.2.2 Ventilated Areas

The HVAC systems shall provide mechanical ventilation to remove the heat generated by equipment, lighting, and the presence of operators and maintenance personnel. Power for these systems and equipment is from 480V power panelboards (for packaged units) or MCCs (for starters provided under Division 26) or 120/208V panelboards (for smaller equipment) nearest the HVAC equipment. These HVAC loads will be added to the above process loads. These loads are expected to be small compared to the process loads included above.

26.2.2.3 Lighting and Receptacle loads

Circuits for lighting and receptacle loads will be fed from 120/208 V or 277/480 V panelboards located in the areas being served, including outdoor lighting and small loads adjacent to buildings. These loads are expected to be small compared to the process loads included above. For 480 V – 208Y/120 V step-down transformers, ratings will be selected to ensure that secondary-side short-circuit current levels at the transformer terminals will not exceed 10,000 A symmetrical.

26.3 Electrical Service

This Proposal presumes that the treatment plant will be powered from a single existing 21 Y/12.12 kV, 60 Hz utility service in the area, delivered underground to the plant site boundary by the Owner/supplying utility. Under this Project scope, the service will be extended by MWH from the property line, in a concrete-encased ductbank, to a dedicated, fence-enclosed substation, and will terminate in a combination single-service utility meter cubicle and parallel 27 kV metal-enclosed fusible switches. Each fusible switch will supply a 21 Y/12.12 kV – 4160 Y/2400 VAC, 5/5.6/6.25 MVA, 55/65/65 degrees C rated, non-flammable-liquid-cooled (OA/OA/FA) substation transformer.

Each transformer, and its associated secondary feeder, will be sized to have the following approximate capacities:

- At its 55 degrees C (OA) rating, each transformer/feeder, will supply approximately 100-percent of plant capacity at a plant rated capacity of 6.4 mgd.
- At its 65 degrees C (OA) rating, each transformer/feeder will supply approximately 65-percent of plant capacity at a plant rated capacity of 9.6 mgd.
- At its 65 degrees C (FA) rating, each transformer/feeder will supply approximately 50-percent of plant capacity at a plant rated capacity of 12.8 mgd.

From the outdoor electrical service transformers, 4160Y/2400 VAC will extend, via concrete-encased ductbanks into a lineup of 5 kV-rated, metal-clad switchgear (MSD-1) located within a dedicated Electrical Switchgear Building.

26.4 Medium Voltage Switchgear

The 5 kV-rated, metal-clad switchgear will serve as the main switching center to distribute 4160 V, three-phase, three-wire power, via concrete-encased ductbanks, to all medium-voltage motor controllers (for RO First Pass HP Pumps) and outdoor, dry-type, cast-coil 4160 V – 480Y/277 V transformers located outside of the Electrical Switchgear Building. The switchgear will be sized to support a plant rated capacity of 12.8 mgd.

The metal-clad switchgear will be UL-listed, service-entrance rated, and designed with double-ended configuration (Main-Tie-Main). The incoming compartments will contain surge arresters, Owner metering, and protective relays. The switchgear will incorporate automated transfer control of the main-tie-main arrangement, initiated through the SCADA system; however, the gear will be capable of supporting fully automated transfer in the future should dual Utility services eventually be incorporated. The switchgear will also incorporate arc-flash reducing technology.

The circuit breakers in the switchgear lineup will be of the draw-out vacuum-interrupter type with a 1,200 A minimum rating. Sufficient breakers will be incorporated to accommodate current actual and projected future loads, as defined in the RFP. The circuit breaker control voltage will be 125 VDC derived from dedicated control power batteries and charger external to the gear.

1. The switchgear will be standard metal-clad construction, consisting of two-high freestanding structures bolted together to form a single dead-front panel assembly containing circuit breakers, control devices, protective relay and metering units, and all interlocking and miscellaneous control/interface devices. Phase and ground busses will be tin-plated copper, with phase busses having a minimum ampacity of 1,200 amperes and a minimum 250 MVA short-circuit withstand rating.
2. Switchgear (21 kV) and 480V distribution is summarized on the Single Line Diagrams (see Drawing Nos. GE-3 through GE-5 for the 9.6 mgd Base Project and the 6.4 mgd Reduced Capacity Base Project).

26.5 Alternate Electric Service

Provisions (i.e., yard space and adequate depth below grade) will be allotted, from the site perimeter boundary to the Electrical Switchgear Building, to install a ductbank that will support a future alternate 5 kV power supply from an off-site, but adjacent, landfill power system, which is not currently available. The underground duct bank is shown on Drawing No. E-1

Additionally, provisions for adding manual key-interlocking will be included on one main circuit breaker and a spare feeder circuit breaker space on one side of MDS-1, to allow future connection of the alternate 5 kV power supply. If the power supply is implemented, the key interlocks, feeder circuit breaker, ductbank, and cabling will be added to the Project scope by a change order.

26.6 Low-Voltage Distribution

26.6.1 Supply to UV Reactors, Concentrate Equalization Pond, and Flush, Salinas Valley, & Finished Water Pumps

From two (2) of the outdoor 4160 V – 480Y/277 V transformers, feeders in concrete-encased ductbanks will supply a low-voltage (480 VAC), main-tie-main, three-phase, three-wire switchboard assembly (MDS-2), to supply power to the UV Reactors, Flush Pumps, Concentrate Equalization Pond, and Salinas Valley and Finished Water Pumps, and other 480 V loads. This lineup will also provide local building power to the Electrical Switchgear Building as well as redundant feeders to the Administration Facilities.

26.6.2 Supply to Filtered Water, ERD, Second Pass, Recycle, Backwash, & Low-Lift Pumps

From the other two (2) outdoor 4160 V – 480Y/277 V transformers, feeders in concrete-encased ductbanks will supply a second low-voltage (480 VAC), main-tie-main, three-phase, three-wire switchboard assembly (SUS-1), to supply power to Second Pass, ERD Boost, Filtered Water, Backwash, Recycle, and Low Lift Pumps, and other 480 V loads.

These switchboards will incorporate draw-out, power circuit breakers for the main-tie-main and molded-case solid-state trip circuit breakers to supply the sub-distribution to the various loads, power distribution panelboards, and motor controllers in the Electrical Switchgear Building as well as in remote process facilities. The main-tie-main arrangements will incorporate manual transfer control (normal power situations only), initiated through key interlocks on the circuit breakers.

In addition to the key-interlock scheme for MDS-2, its main circuit breakers will be electrically operated as part of the automatic transfer control associated with the 480 VAC standby power system (see Paragraph 26.11 for additional information on the standby power system). Each output circuit breaker from the standby power system will serve separate sides of MDS-2, which will allow for energizing one or both sides of the double-ended switchboard assembly. This will allow limited operational capabilities in the event of a utility power failure, as well as for load-testing of the standby power system. The SCADA system will be used to select which automated transfer interface will be utilized, as well as to perform selective load shedding to not overload and shut down the standby system. Manual selection of the transfer scheme will also be available via a three-position selector switch on the switchboard assembly.

Local building and ancillary system power (480/277 V and 208/120 V) will be developed within the various remote proves buildings and the Administration Facilities. General power and lighting loads will be served separately from instrumentation and sensitive electronic equipment loads by means of providing separate step-down transformers and panelboards. Instrumentation and sensitive electronic equipment loads will be supplied via electrostatically shielded, isolation-type, step-down transformers; and, the secondary panelboards will be provided with surge protective devices.

26.7 Owner Metering and Protective Relays

Power quality meters (Owner-selected type SEL 735), with fiber optic communications to the SCADA system, will be incorporated to for monitor the utility service parameters. Feeder protection relays (Owner-selected type SEL 751A) will be incorporated where indicated and as applicable, and will be programmed to interface with the SCADA system using dual-port, fiber optic communications.

Each RO high-pressure pump motor and associated VFD will include an Owner-selected type SEL 710 relay and ancillary sensors to monitor power consumption data in real time. Power consumption and other electrical parameters will be monitored through SCADA using dual-port, fiber optic communications.

Each pumping stage (Filtered Water Pumping System and Finished Water Pumping System) will be monitored with an appropriate SEL device (located in switchgear, switchboard, or MCC, as applicable) and ancillary sensors (for each pump circuit) to determine the power consumption for the pumping stage (not the individual pump). Power consumption and other electrical parameters will also be monitored through SCADA.

26.8 Electrical Grounding

The electrical system and equipment will be grounded in compliance with NFPA 70 (NEC). A buried copper grounding grid, consisting of No. 3/0 AWG stranded, annealed copper conductors and copper-clad ground rods, will be provided for the new service transformers, outdoor dry-type transformers, the Electrical Switchgear Building, and outdoor generator enclosure. Process buildings and Administration Facilities will also incorporate NEC required grounding electrodes, with No. 3/0 AWG stranded, annealed copper conductors used to bond all indoor transformers, MCCs, and other major electrical equipment to the electrode systems. Electrical equipment, devices, panelboards, and metallic raceways will be connected to the electrode systems via equipment grounding conductors sized per the NEC.

26.9 Electrical Transient Protection

Distribution class surge arresters will be provided at each termination point for exterior cabling, in medium-voltage metal-enclosed switches, transformers, and metal-clad switchgear.

Low-voltage transient-voltage surge protective devices (SPDs), complying with/labeled under UL-1449, Rev 3, will be provided on the main of each 480 V switchgear, switchboard, and power distribution panel supplying circuits that traverse or terminate outdoors. SPDs will also be provided on 120/208V panelboards serving outdoor circuits and “clean-power” systems.

26.10 Uninterruptible Power Supply (UPS) Applications

A dedicated UPS will be provided to supply a minimum of 10 minutes of ride through, at full-load, if a failure occurs in the “normal” power system serving the UV reactors and their associated controls and instrumentation. The UPS will be provided with an integral automatic bypass circuit, as well as a remote manual maintenance by-pass switch that will allow isolation of the unit for servicing and testing. The UPS status will be monitored through SCADA.

Each PLC cabinet will also have its own integral UPS (see also Section 30.2).

27.0 STANDBY POWER

A standby power system ("Optional Standby" as defined in NFPA 70, Article 702), will supply power to 480 V Switchgear MDS-2 in the event that the "normal" utility service, or any plant equipment upstream of MDS-2, fails. The standby power system will consist of a diesel-fueled engine-generator, an integral fuel tank, dual output circuit breakers, and an automatic central control and metering/monitoring system to sequence and properly interlock the generator with the switchgear and loads. The generator will start automatically upon loss of "normal" power, and will automatically activate the transfer scheme.

The generator will be sized to provide standby power to the following loads:

- Any one (1) Finished Water Pump (largest capacity pump)
- Administration Facilities, including its interior lighting and exterior lighting (controlled and fed from the Administration Facilities)
- Sump pumps
- RO flush pumps
- Instrumentation
- Compressed air supply for valve actuators
- Security systems
- Critical valves (with electric actuators)

The standby power system will include the following physical characteristics and capabilities:

- Synchronous, four-pole, brushless generator, with a 105 degrees C temperature rise
- UL 2200 listing
- Factory tested at 0.8 lagging power factor
- UL 142-listed, double-wall, belly-type, fuel storage tank, with leak detection, and sized for 24 hours run time at full load
- SCADA monitoring of generator performance and alarms
- Stairs, handrails, and working surfaces for the enclosure, as required to access controls and equipment

This proposal is based on the presumption that the generator enclosure, as specified in the RFP and repeated herein, will comply with local noise control ordinances and codes. The generator enclosure will be a walk-in, Pritchard Brown Sound Attenuating, Weatherproof Genset Enclosure, as described in Pritchard Brown Specification No. 2130, designed to reduce noise levels to less than 75 dBA @ 23 feet at 100-percent load. A super-critical grade exhaust silencer will be mounted internally in the sound-attenuated enclosure to further reduce the noise signature. The generator and enclosure will, as an integral unit, be IBC rated for local wind and seismic conditions; and, the enclosure will be provided with the manufacturer's standard corrosion-protective finish to mitigate corrosion from salt-laden-air. The Owner will select color of the enclosure when the standby system is submitted for approval.

As part of the start-up and commissioning process, the standby power system will be on-site tested with a load bank at 0.8 lagging power factor. The packaged generator will be installed, and its controls programmed, such that it can be tested under load on a routine basis; however, a permanently installed load bank is not included in this proposal.

Since this standby power source is not an "Emergency" standby source, as defined in NFPA 70, Article 700, all emergency and life safety related equipment will have backup batteries as their primary standby power source.

28.0 CONTROL STRATEGY

General auto operation of the major facility equipment will be generally based on one of two modes as described below.

1. Global Plant Auto Control – Under this scenario, the plant control system will auto start/stop process equipment to meet an operator preset product water production setpoint. As a start permissive, all processes must be detected to be in auto with the minimum number of equipment and trains ready for operation to meet the operator entered production rate. With auto start, sequencing/control of pumping equipment and operational parameters of the Granular Media Filters, First and Second Pass RO trains, and UV reactors will be managed by the control system as per operator preset control setpoints. Operational safety functions will be maintained by the control system. The plant will continue to operate at the preset production rate until:
    a. An operator changes the production rate setpoint (in which case the control system will automatically adjust the number of online equipment accordingly).
        i. Note 1: an inability to achieve the production rate setpoint while the plant is in operation will generate a system alarm but not affect system operation as long as water quality is unaffected and no system faults or overflow conditions are generated.
        ii. Note 2: A request to start the plant or increase production when the control system permissive logic detects insufficient resources available to achieve the production setpoint will result in the plant maintaining current production rates and generation of a permissive fault which lists the process areas of concern.
    b. An operator issues a plant shutdown command (in which case, an operator will need to manually re-initialize plant start)
    c. A system/process fault or overflow is encountered that initiates shutdown (in which case, clearing of the fault will allow the plant to auto re-start to achieve the operator production setpoint)
2. Operator Auto Control – Under this scenario, an authorized operator will manually initiate start/stop control of each process area. The operator will be responsible for start of process trains to support the plant pumping systems once the pumping systems are initiated. With operator initialization, sequencing/control of pumping equipment and operational parameters of the Granular Media Filters, First and Second Pass RO trains, and UV reactors will be managed by the control system as per operator preset control setpoints. Operational safety functions will be maintained by the control system.

28.1 Slant Wells

The Raw Water Slant Well Intake System shall run in Auto, Manual, and Hand Mode. In Auto Mode, the Combination of between 1 and 6 vertical wells and between 1 and 5 slant wells will operate to maintain the plant water demand setpoint (RO permeate output) at the HMI with a setpoint trim based on the level of the Filtered Water Storage Tanks. The operator shall select the lead storage tank at the plant HMI.

At startup, the pump with the least runtime shall start and run at minimum speed and then ramp at 10Hz/min to 60 Hz before second least runtime is called upon. At this time 1st pump shall drop to 45 Hz and ramp up in conjunction when second pump is energized. All energized pumps should receive a common speed signal. This process shall continue with additional pumps, with the pump with longest runtime being left off as a spare. Should the operator selected filtered water tank storage reach the High Level set point, the pumps will ramp down under the same common speed signal until 45 Hz at which time the pump running with the greatest runtime shall be placed in Standby. Should the lead storage tank level transmitter fail, as monitoring by level transmitter failure alarms, the slant well pumps shall maintain a set gpm as measured by the Slant Well Pump Station discharge flowmeter and signal an alarm to plant HMI.

If any pumps are "Not Available", the pump that is not available will not be included in the Auto mode. If a pump fails the next available pump will start and an alarm will signal the operator. Under "Normal Shutdown Procedures" all Slant Well pumps will ramp down as normal until last pump reaches 30 Hz at which time it will shut-down. Under "Emergency Stop for the Slant Well Pumps" a signal will be sent to the Slant Well Pump Station PLC to kill the Start/Stop Relay to provide a "Stop" signal to the VFDs and Pumps will stop immediately. In Manual Mode at the HMI, the Slant Well Pumps will operate at an Operator requested VFD frequency at the HMI, but will not monitor the Filtered Water Storage Tank levels. In Hand Mode locally at the VFD, the Slant Well Pumps will operate at the requested VFD frequency/speed at the VFD, but will not monitor the Filtered Water Storage Tank levels.

28.2 Granular Media Filtration Pretreatment and Filtered Water Storage Tank

Fourteen Granular Media Filters are provided to remove Iron and Manganese from raw water pumped from the Slant Wells. Twelve filters will be operating with one filter in backwash and one filter in standby at any one time. The operator at the plant HMI will allocate which filter will be placed in standby. The raw water from the slant wells passes first through filter influent flowmeter, which are 0-2000 gpm magnetic flowmeters. This reading is used to adjust the flow dosing of the Sodium Hypochlorite Feed Pumps. The Sodium Hypochlorite is dosed prior to each filter's static mixers.

Each granular media flow control valve will have a Hand/Off/Auto switch located at the Granular Media Filter Master Control Panel. In Hand position the valve will open manually, in Auto position the valve will open/close based the filter's operating condition. Any filter with an H/O/A switch in the off position shall be placed "Out of Service" and the motor operated filter isolation valve will close. In normal operation, for a filter that is in service the filter raw water inlet and filtered water outlet valves will be called to open. If any filter's differential pressure setpoint is exceeded for an adjustable time delay and another filter is not currently in backwash mode and sufficient water is available in the filtered water storage tank, that filter will be placed in backwash mode. This will close the raw water inlet valve and the filtered water outlet valves, after confirmation of closure, the backwash supply and backwash waste valves will open and a backwash pump will start and the backwash pump discharge motor operated valve will open. The backwash operation will pump filtered water from the filtered water storage tanks back through the filter to the backwash waste basin for an operator set period of time. The filtered water storage tank level trim will adjust the After a backwash cycle has timed out, the filter will return to service by closing the backwash valves and opening the filter raw water valve and the filter to waste valve for an operator set period of time before resuming normal operation by opening the filtered water outlet valve. A turbidity analyzer and a magnetic flowmeter is provided on the discharge of each filter to monitor turbidity levels and assess if extra time is needed on the filter to waste time.

28.3 Cartridge Filters

Seven (7) 5-micron cartridge filters will remove fine sediment from the feed water and are subject to vendor based controls using operator entered setpoints. Each unit shall be equipped with a local pressure indicating gage and the differential pressure of each cartridge filter, as measured by the common line upstream and downstream pressure transmitters, will be monitored by the plant control system to determine maintenance scheduling. The cartridge filters will be installed downstream of the low pressure booster pumps but upstream of the RO train feed inlets. A high differential pressure alarm shall be set for each filter that will alert the operator that the filter cartridges require replacement. A magmeter will be used to determine instantaneous and total filtered water flow into the RO facility and redundant pressure transmitters shall be used to measure total filtered water head pressure. Both instruments shall report to the control system.

28.4 Reverse Osmosis – Startup, Operation, Shutdown

Under Global Plant Auto Control, the plant control system will auto start/stop process equipment to meet an operator preset product water production setpoint. Operational parameters of the RO System will be managed by the control system as per operator preset control setpoints, as described above. Under Operator Auto Control, an authorized operator will manually initiate start/stop control of each process area.

Four (4) horizontal split-case pumps, two are provided with VFD's and two are provided with soft starters, arranged on a common header are proposed to provide an initial boost to the first pass RO feed water pressure (to accommodate the pressure losses across the inline cartridge filters) and provide a fixed pressure feed to the first pass RO feed pumps and ERD units. The low pressure pumps will pull from the filtered water storage tanks. Redundant discharge pressure transmitters will be installed on the common discharge header, downstream of the cartridge filters. Each pump may be controlled in local manual mode at the associated LCS or VFD. Remote manual and auto control will also be available at the control system HMI. In auto mode, the control system will control the first pass low pressure booster pumps to maintain an operator entered discharge pressure setpoint based on the measured discharge pressure. The operator will select the control pressure signal; however, the control system will be capable of automatically switching to the secondary signal in the event the primary unit fails. The pumps as a group will operate in lead/lag1-thru-lag3/standby fashion and, when called to start, will respond to a common speed reference. Should the control system determine that a pump is "Not Ready" to start or becomes unavailable during operation, the next pump in sequence will be immediately called to start.

High discharge pressure switches, low suction pressure switches and a low-low wetwell level detection (as output by the pump station PLC) will be provided and directly interlocked with each pump's VFD or soft starter. In addition, given the anticipated size of the pump and pump motors, each pump will be equipped with a monitored vibration transmitter and a motor bearing and winding temperature monitoring array. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

The filtered water storage tanks levels will be monitored by a non-contacting level transmitter along with an overflow high-high level detection float. The level transmitters will be used to protect the operation of the RO Low Pressure pumps (as well as the pressure filter backwash pumps if in operation) described above which will singularly work to maintain a set pressure on the First Pass RO feed header and the individual train ERD units. The status of each pump's VFD and soft starter (including current draw) and the status of the level detection instruments will be monitored at the HMI.

As the low pressure booster pump control signals are derived from transmitters downstream of the cartridge filters, the control system will automatically increase the booster pump discharge to compensate for pressure loss across the cartridge filter array. A magmeter, monitored by the plant control system, will be used to determine instantaneous and total First Pass RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the feed water stream prior to introduction to the First Pass RO trains. A motorized variable flow static mixer will be used to accommodate the various plant production rates and ensure proper mixing.

- Sodium Bisulfite – to ensure elimination of any remaining free chlorine ions prior to feed water introduction to the RO membranes.
- Threshold Inhibitor – to prevent membrane scaling.
- Sulfuric Acid – to balance the pH of the water entering the first pass RO units

The following instrumentation will be employed in the analysis of the First Pass RO feed water:

- Redundant Turbidity - to ensure feed water levels are within acceptable range
- pH analyzer – to ensure correct pH of feed water prior to introduction to the membranes
- Conductivity analyzer – to ensure feed water levels are within the membrane manufacture specified range prior to introduction to the membranes.
- Temperature measurement – to aid in the adjustment of optimum first pass recovery
- ORP – elevated levels shall be cause for immediate bypass.
- Total Chlorine Analyzer – to ensure absence of free chlorine ions

The control system will bypass the filtered feed water until the feed water pH, conductivity levels, turbidity levels are within the pre-determined ranges of acceptability. During bypass operation, the bypass valve will be positioned (based on start-up testing) to ensure sufficient back-pressure is retained on the low pressure booster pump discharge line. The bypass valve will also automatically open under high feed pressure conditions.

All analyzers will be equipped with the means to detect sensor failure or transmitter malfunction with the alert routed to the control system via separate discrete output or by means of signal analysis logic. The first pass RO pre-treat analyzers will be assembled on a common panel in the RO Building. A self-healing Ethernet ring network will be used to route the VFD and soft start control and monitoring signals to the First Pass RO Master PLC.

The First Pass RO facility will be equipped with seven dual-stage membrane trains, each equipped with an isobaric energy recovery device (ERD). The trains may be manually initiated by an operator (at the plant control screens, subject to start permissives) or automatically by the First Pass RO Master PLC. Train operation will be under the control of the First Pass RO Master PLC.

<u>Filtered Feed Flow</u>: The rate of feed water flow into the train will be controlled by a variable speed horizontal centrifugal pump. The pump will be equipped with pressure switches and gauges on the discharge and suction lines for mechanical protection. A motorized feed valve will serve to isolate the train from the feed system. The pump may be controlled in local manual mode at the LCS or VFD and the valve may be controlled at the actuator. Remote manual and auto control will also be available for both the valve and the pump. In auto mode, the control system will call the pump to run (at minimum speed for a preset time period) and the feed valve to open simultaneously. Once the preset time period expires, the control system will slowly adjust the pump speed until the train permeate production rate is achieved. Permeate production is represented by the sum flow of the low TDS and high TDS permeate lines. A pressure transmitter will be used by the control system to determine feed water pressure and prevent over-pressurization of the train.

<u>Train Permeate</u>: The First Pass RO trains will be dual stage with a variable split ratio permeate piping arrangement. Under this scenario, permeate will be collected from the front and rear of the pressure vessels. Specifically, low TDS permeate (with direct routing to the UV System) will be collected from the pressure vessels' front membranes while relatively high TDS permeate (with direct routing to the Second Pass RO trains as feed water) will be collected from the rear membranes. The sum total flow of the high and low TDS permeate represents the train total permeate production. In Global Plant Auto mode, all first pass RO trains shall respond to a setpoint that will auto adjust to meet the conductivity setpoint. High TDS conductivity will be monitored by an analyzer with the operator selected signal serving as the control reference point. A magmeter will be installed on both the high and low TDS permeate lines to aid in control as well as confirm total permeate production rate and permeate production ratio. Low and high TDS permeate conductivity levels will also be monitored by dedicated analyzers to ensure expected water quality is being achieved. Flow and conductivity analysis readings will be tracked and recorded at the HMI.

<u>First Stage Concentrate</u>: A magmeter, pressure transmitter and conductivity analyzer will be installed on the first stage concentrate line to track and record conductivity levels and mass balance performance. A differential pressure transmitter will also be used by the control system to monitor the differential pressure across the first stage membranes. The conductivity analyzer will also be used to assist with normalization calculations and determine osmotic pressure.

Isobaric ERD (Rotary Pressure Exchanger Type) with Circulation Boost Pump: Using the first stage high pressure concentrate discharge, an ERD with variable speed, centrifugal circulation pump will be used to effectively reduce the amount of work required by the train feed pump to meet the train permeate production setpoint. Feed water from the low pressure RO booster pumps will be directly fed to the ERD where it is briefly exposed to the high pressure concentrate from the first stage, thereby facilitating energy transfer. The now highly pressurized water is discharged from the ERD to the circulation pump while the low pressure concentrate is discharged to the concentrate control valve. The ERD circulation pump will be equipped with a maintenance switch and motor temperature switch. High discharge pressure, low suction pressure and motor high temperature switches will be directly interlocked with the pump VFD. With confirmation of the train feed valve full open position and the train feed pump at minimum speed, the control system will initiate start of the ERD circulation pump and vary the speed (with respect to the train feed pump) to meet a set train recovery ratio (adjustable over a fixed band as will be necessary as the membranes foul and/or to optimize membrane performance as a result of changes in feed water temperature).

Low Pressure Feed Control Valve and Low Pressure Concentrate: The flow rate, conductivity and pressure of the low pressure concentrate expelled from the ERD will be monitored by a downstream magmeter and pressure transmitter. A modulating butterfly valve also located on the ERD low pressure concentrate line, shall be used to control the flow rate of low pressure feed water to the ERD (as measured by the low pressure feed water magmeter) as well as allow discharge of the low pressure concentrate to the concentrate outfall line at a controlled rate. The valve may be controlled in local manual mode at the actuator or in remote manual mode at the HMI. In auto mode, the control system will automatically modulate the valve to match the train feed pump discharge flow rate (as required to achieve the train permeate production setpoint) plus 1% to allow for over-flushing.

Upon train call to start, the control system will open the low pressure feed valve to a preset position. With confirmation of the train feed valve full open position, the train feed pump at minimum speed and start of the ERD circulation pump, the control system will slowly trim the valve position to achieve the PLC calculated flow rate.

Operator settings: Operator Auto Control/Global Plant Auto Control setting: determines if a train will be run in "Operator Auto" using localized settings or run in "Global Plant Auto" based on plant wide settings. Under an "Operator Auto" operational scenario, the decision to normally start or stop a train is made by the operator at the HMI. The control system will operate the train based on the train's operator pre-set parameters. Under a "Global Plant Auto" operational scenario, the decision to start or stop a train is determined by the plant control system to meet an operator preset plant production rate. Although, the control system will still largely operate each train based on the train's operator pre-set parameters, some global control functions (as identified herein) may be set to override individual train control parameters. A service mode will also be made available at the HMI under which an operator may exercise any piece of equipment connected to the SCADA system via the HMI. A mixed operation of train auto mode / service mode will not be supported. Similarly, a mixed operation of Plant Auto mode / Train Auto mode will not be supported. Although equipment and operational safety functions will be in effect, full operation of a train under service mode will not be encouraged.

Permeate Production and Blend Rates: Each train will have a preset permeate production flow rate setpoint as set by the operator (local train setting), applicable under both "Operator Auto" and "Global Plant Auto" control modes. However, the ratio of permeate production will be established as a common ratio setpoint for all trains under Plant Global Control (fluctuating as necessary to meet the blend water conductivity setpoint). In "Global Plant Auto" mode, a plant production rate (global plant setting) will be maintained by the control system based on an operator preset production rate target. Based on the pre-established plant production setpoint and time delays, the control system will control how many trains will be online. The lead first pass RO train will remain online until a level low-low condition is detected in the filter water storage tanks or the First Pass RO System is called to stop by the operator. The control system will work to operate each train at the maximum production rate without compromising water quality.

Recovery Ratio: Ratio of total permeate flow to total feed water flow. It is anticipated that this value will be a maximum of 50% based on the currently proposed membranes (local train setting).

Train Start Sequence: The sequence for train start will be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the "Global Plant Auto" mode of operation will be based on the required permeate production setpoint.

Permeate Flush Tank: The combined First Pass RO System (high TDS) permeate will be used to feed the Second Pass RO System and serve as source water for the First Pass RO Permeate Flush Tank. The permeate flush tank fill line will be governed by a motorized isolation valve. The tank level will be monitored by redundant non-contacting level transmitters plus two override floats for high-level and low-low level detection. The First Pass RO Master PLC will open and close the fill valve based on the operator preset level setpoints. Trip of the high-high level float will force immediate closure of the fill valve.

Permeate Flush Pumps and Valve: Permeate water flush timer setting. As a function of the shutdown procedure, the concentrate valve will be opened to a preset position, the feed and low TDS valve closed, the feed pump and ERD pump shutdown, the flush valve opened and the lead constant-speed permeate flush pump engaged until the flush timer expires (local train setting). The concentrate valve position setting and the permeate timer setpoint will be operator adjustable at the HMI. The permeate flush system will be equipped with two centrifugal pumps designed to operate in lead/standby mode. The control system will automatically alternate pump starts based on last pump called to start. The permeate flush pumps may be controlled in local manual mode at the associated LCS or starter panel and the permeate valve of each train may be controlled at the actuator. Remote manual control of the valve and the pumps will be available at the HMI.

First Pass RO Cleaning System: RO cleaning solution preparation, valve adjustments, pumping, purging and disposal will be a manual operation with monitoring and control via the first pass RO cleaning system LCP.

Second Pass RO Trains & Blend Water: A magmeter, monitored by the plant control system, will be used to determine instantaneous and total Second Pass RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the feed water prior to introduction to the Second Pass RO trains. A motorized variable flow static mixer will be used to accommodate the various plant production rates and ensure proper mixing.

- Sodium Hydroxide – for pH adjustment
- Threshold Inhibitor – to prevent membrane scaling. (Reference Threshold Inhibitor Section for proposed dosing control.)

The following instrumentation will be employed in the analysis of the First Pass RO filtered feed water.

- pH analyzer – to ensure correct pH of feed water to maximize boron removal
- Turbidity - to ensure feed water levels are within acceptable range
- Temperature measurement – to aid in the optimization of membrane recovery

The Second Pass RO facility will be equipped with three (3) 2-stage membrane trains. The trains may be manually initiated by an operator (at the plant control screens) or automatically by the Second Pass RO Master PLC. Train operation will be under the control of the Second Pass RO Master PLC. Process definitions and control overview presented below.

<u>Feed Flow</u>: The rate of feed water flow into the train will be controlled by a variable speed horizontal centrifugal pump. The pump will be equipped with pressure switches and gauges on the discharge and suction lines for mechanical protection. A motorized feed valve will serve to isolate the train from the feed system. The pump may be controlled in local manual mode at the LCS or VFD and the valve may be controlled at the actuator. Remote manual and auto control will also be available for both the valve and the pump. In auto mode, the control system will call the pump to run (at minimum speed for a preset time period) and the valve to open simultaneously. Once the preset time period expires, the control system will utilize a compound flow control loop to slowly adjust the pump speed until the train permeate production rate is achieved. A pressure transmitter will be used by the control system to determine feed water pressure and prevent over-pressurization of the train.

Pressure switches will be directly interlocked with each pump's VFD. In addition, given the anticipated size of the pump and pump motors, each pump will be equipped with a monitored vibration transmitter and a motor bearing and winding temperature monitoring array. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

<u>Second Stage Feed Water</u>: A pressure transmitter and conductivity analyzer will be installed on the second stage feed line to track and record pressure and conductivity levels. The pressure transmitter will also be used by the control system to prevent over-pressurization of the second stage membranes and to track the differential pressure across the first stage membranes (in conjunction with the first stage feed pressure transmitter). The conductivity analyzer will also be used to assist with normalization calculations and determine osmotic pressure.

<u>Second Stage Permeate</u>: A magmeter and conductivity analyzer will be installed on the second stage permeate line to track and records the second stage permeate production rate and conductivity levels at the HMI.

<u>Second Stage (Final) Concentrate</u>: The rate of concentrate flow (and hence train recovery rate) will be controlled by a modulating ball valve as measured by a downstream magmeter. The valve may be controlled in local manual mode at the actuator or in remote manual mode at the HMI. In auto mode, the control system will open the valve responsible for concentrate flow control to a preset position when the train is called to run. Once the feed pump achieves minimum speed, the control system will slowly adjust the valve position to achieve the PLC calculated concentrate flow rate, as measured by the magmeter, based on the train production rate and train recovery ratio. A pressure transmitter, in conjunction with the second stage feed pressure transmitter, will be used by the control system to track the differential pressure across the second stage membranes. Conductivity and pH analyzer will be

installed on the second stage concentrate line to track and record conductivity levels at the HMI and assist with normalization calculations. Final concentrate will be routed to the filtered water storage tank.

Total Permeate: Conductivity and pH analyzers will be installed on the total permeate line to track and record conductivity levels at the HMI and verify achievement of required water quality. The total permeate production rate will be calculated by the control system based on the sum of the measured first stage permeate flow and the measured second stage permeate flow. This value will also be recorded at the HMI.

Pressure Balance: Prior to startup of the Second Pass RO Trains, at least one first Pass RO Train must be in full production. With no Second Pass RO Trains online, the first pass RO high TDS permeate flow will automatically route to the Second pass First stage line – the control valve of which will be maintained in a full open position with no second pass trains online. With confirmation of flow from the first pass, the lead Second Pass Train will be initiated thereby drawing the First Pass RO System Permeate into the Second Pass RO train. (Note: a vacuum assist system will be considered to mitigate potential cavitation of the second pass feed pumps.) As the lead train establishes a permeate production rate the pressure balance line water column will hydraulically mitigate any dramatic pressure changes during the Second Pass RO startup period.

Under Global Plant Auto operation, the number of second pass RO trains brought online shall equal the number of first pass RO trains.

Permeate Production Rate: Each train will have a preset production permeate flow rate setpoint as set by the operator (local train setting), applicable under both "Operator Auto" and "Global Plant Auto" control modes. In "Global Plant Auto" mode, a plant production rate (global plant setting) will be maintained by the control system based on an operator preset production rate target and as evidenced by the current First Pass RO System permeate flow rate. The lead train will remain online until a stop condition is detected in the lead First Pass RO train feed pressure falls below minimum or the Second Pass RO System is called to stop by the operator. The control system will work to operate each train at the maximum production rate without compromising water quality.

Recovery Ratio: Ratio of total permeates flows to total feed flow. It is anticipated that this value will be a maximum of 90% based on the currently proposed membranes (local train setting)

Train Start Sequence: The sequence for train start will be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the "Global Plant Auto" mode of operation will be based on the current number of online first pass RO trains.

Flush Procedure: As a function of the shutdown procedure, the concentrate valve will be opened to a preset position, the feed valve held open and the feed pump engaged at a preset flush rate speed until the train flush timer expires (local train setting). The concentrate valve position setting, the feed pump speed and the permeate flush timer setpoints will be operator adjustable at the HMI.

Second Pass RO Cleaning System: RO cleaning solution preparation, valve adjustments, pumping, purging and disposal will be a manual operation with monitoring and control via the second pass RO cleaning system LCP as shown on the referenced drawings.

Production Rate: Total permeate flow rate setpoint as set by the operator (local train setting) or as determined by the PLC based on the distribution demand as evidenced by the current Finished Water

Storage Tank level (plant setting). Note: based on pre-established ground storage tank level setpoints and time delays, the PLC shall bring more trains online as the Finished Water Storage Tank level falls and reduce the number of online trains as the level rises. The control system shall work to operate each train at the maximum production rate while simultaneously working to maximize the blend water flow rate (without compromising water quality).

Recovery Ratio: Ratio of total permeate flow to feed flow. It is anticipated that this value will be 80% based on the proposed membranes (local train setting)

Train Start Sequence: The sequence for train start shall be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the plant auto mode of operation shall be based on the current water level in the Finished Water Storage Tank. The number of wells called to run shall be based on the number of wells required to support the trains called to run as measured by the raw water flow meter.

Flush Timer: Feed water flush timer setting. As a function of the shutdown procedure, the concentrate valve shall be opened 100% and the feed pump ramped to 30% of max speed until the flush timer expires (local setting). Concentrate valve position settings and VFD speed settings for the flush operation shall be operator adjustable at the HMI.

28.5 Reverse Osmosis – Clean-in-Place

RO cleaning systems will be manually batched and operated. The membrane cleaning system LCP will provide functions to allow an operator to control and monitor the membrane cleaning process. The feed pumps shall be equipped with pressure switch and gauge assemblies on the discharge and suction lines for mechanical protection at the starter. The cleaning pumps shall be manually operated only at the MCC or LCP.

The cleaning system LCP shall be equipped with a PLC. The plant control system shall monitor the status of the cleaning system equipment and instrumentation via the LCP PLC. No remote controls shall be provided.

28.6 UV Disinfection

Under Global Plant Auto Control, the plant control system will auto start/stop process equipment to meet an operator preset product water production setpoint. Operational parameters of the UV Disinfection system will be managed by the control system as per operator preset control setpoints, as described above. Under Operator Auto Control, an authorized operator will manually initiate start/stop control. The proposed system will implement a calculated dose approach as the dose control strategy. This approach provides significant flexibility to minimize energy consumption by manipulating lamp power to accommodate flow and UVT variance. An empirical UV dose-monitoring equation developed during system validation is incorporated into the operating PLC, which can be set up to automatically adjust lamp power to produce a target UV dose based on the measured flow, UVT and UV intensity values. System control will be set up with an automated startup and shutdown sequence that brings the standby reactor on-line and it warms up to maximum lamp output before switching from operating reactor to duty reactor. The finished water storage tanks downstream of UV reactors operate in series and can be isolated and bypassed in case of receiving any off-spec water during startup and shutdown.

28.7 Post Treatment Stabilization

The product water pump station discharge magmeter, monitored by the plant control system, will be used to calculate and transmit instantaneous and total product water flow as well as control post storage chemical injection. The chemicals listed below will be injected into the product water distribution stream to adjust the alkalinity and hardness of the water and to prevent corrosion in the distribution pipeline.

- Sodium Hypochlorite
- Sodium Hydroxide
- Zinc Orthophosphate
- Carbon Dioxide
- Hydrated Lime

The following instrumentation will be employed in the analysis of the distribution product water for reporting purposes:

- pH analyzer – to ensure RFP distribution product water quality requirements have been met or bettered.
- Conductivity – to ensure RFP distribution product water quality requirements have been met or bettered.
- Turbidity – to ensure RFP product water quality requirements have been met or bettered.
- Free Chlorine Residual – to ensure RFP product water quality requirements have been met or bettered
- Total Chlorine Residual – to ensure RFP product water quality requirements have been met or bettered

28.8 Finished Water Storage and Pumping

The Finished Water Storage Facility will consist of two 750,000 gallon tanks, normally hydraulically equalized. The inlet to each tank will include a manually operated butterfly valve. The discharge from the UV system will gravity flow to the product water tanks which serves the product water pump station wet well. The Finished Water Pump Station will be equipped with four high-service split-case centrifugal product water pumps that feed the Monterey distribution system and two horizontal end suction pumps that feed the Salinas Valley groundwater basin.

The Finished Water Pump Station (FWPS) will consist of two small pumps (25% of the capacity) and will be equipped with a variable frequency drives (VFD's) and two large pumps (50% of the capacity) equipped with soft starters. A pump may be controlled in local manual mode at VFD. Remote manual and auto control will also be available at the control system HMI. In auto mode the product water pump station PLC will initiate start of the pumps based on a pressure setpoint on the discharge of the pump station. A flow transmitter will also be provided on the discharge of the pump station to track the overall flow to the distribution system.

Two, VFD controlled horizontal end suction pumps will pump finished water from the Finished Water Storage Tanks to the Salinas Valley groundwater basin via the Castroville Seawater Improvement Project (CSIP). The pumps rated capacity of 850 gpm (1.2mgd) each will be controlled in a 1 + 1 mode by a pump station discharge flowmeter.

Once initiated, the PLC at the FWPS will control the pumps to maintain an operator established product water pressure setpoint. The pumps will be designed to operate in lead/lag1/lag2/standby fashion and, when called to start, will respond to a common speed reference. The pump station PLC control logic will be run the two large soft start pumps first which will operate in a 1 + 1 operation scheme with a smaller VFD pump to control the pumps to the pressure setpoint. The pump station will be called to stop if a

High discharge and low suction pressure switches detection (as output by the pump station PLC) will be provided and directly interlocked with each pump's VFD and soft starter. In addition, given the anticipated size of the pump and pump motors, each pump will be equipped with a monitored vibration transmitter and a motor bearing and winding temperature monitoring array. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

Surge System: A surge system with redundant compressors and receiving tanks has been allowed for. Final sizing and relevance to system operation will be determined during the detailed design phase.

The product water pump station discharge magmeter, monitored by the plant control system, will be used to calculate and transmit instantaneous and total product water flow as well as control post storage chemical injection. The chemicals listed below will be injected into the product water distribution stream to adjust the alkalinity and hardness of the water and to prevent corrosion in the distribution pipeline.

- Sodium Hypochlorite
- Sodium Hydroxide
- Zinc Orthophosphate
- Carbon Dioxide
- Hydrated Lime

28.9 Chemical Storage and Feed

Under Global Plant Control, the primary plant chemicals will be automatically called to run once the process flow is detected to be greater than a preset "start" minimum for longer than a preset time period. If the process flow is detected to be lower than a preset "stop" minimum for longer than a preset time period, the chemical system will be called to stop. A dedicated "start" and "stop" control threshold will be provided for each chemical system to account for the operational requirements of a given chemical system. As indicated above, the Global Plant Auto Control start permissive will require that all chemical system be in auto with the minimum number of equipment ready for operation.

Under Operator Auto Control, the following chemical system control scenarios may be applied:

- Chemical systems operate as per Global Plant Control i.e. as the operator initiates start of the major process areas, the chemical systems will be automatically called to start. If a chemical system is unavailable, operator start control of a given process will not be affected; however, an alarm will be generated which may result in shutdown of the process as may be required by a given process.
- The operator is responsible for manual start of all chemical systems. Once initiated, sequencing/control of pumping and batching equipment will be managed by the control system as per operator preset control setpoints. Note: although the chemical systems will not automatically start, each system will be called to stop if the associated stop threshold is encountered as described under the Global Plant Control mode.

In general, chemical feed shall be flow-paced by the PLC based on the measured process flow rate and an operator entered chemical injection ratio. LCS panel controls and displays shall be PLC driven. Remote manual controls for the feed pumps shall be provided at the HMI. Pumps shall serve their respective injection points in lead/lag fashion.

28.10 Concentrate Disposal

Concentrate flows from the first pass RO systems will be conveyed to the MRWPCA site via a pipeline and disposed of via the existing MRWPCA outfall. If the MRWPCA outfall does not have sufficient capacity the concentrate will flow into the concentrate equalization basin. An input signal will be provided to the control system from MRWPCA which regulates the maximum flow from the desalination plant. This signal will serve as an input to the concentrate discharge valve. If any back pressure is measured in this line, excess flow will be diverted to the concentrate equalization basin. Once the restriction is reduced, the concentrate equalization discharge pumps will evacuate the pond. While the concentration equalization pond will be constructed, the use of it is anticipated to be minimal. Aeration of the concentrate will be accomplished with the use of an air compressor downstream of the concentrate pump discharge. Concentrate flows from the second pass RO system will be recycled to the Filtered Water Feed Tanks.

29.0 PROCESS CONTROL

The following sample points, analyzers, and points of chemical addition are included in the design. A full field instrument list and I/O list are presented in the drawings.

Table 29-1: Points of Chemical Addition

Chemical	Location	Flow Paced	Trim
Sodium Hypochlorite	Upstream of Pressure Filters	FE-101A	AE-295 (Total Chlorine)
Sulfuric Acid	First Pass RO Feed	FE-170	AE-285 (pH)
Threshold Inhibitor	First Pass RO Feed	FE-170	
Sodium Bisulfite	First Pass RO Feed	FE-170	AE-300 (ORP)
Sodium Hydroxide	Second Pass RO Feed	FE-156	AE-572 (pH)
Threshold Inhibitor	Second Pass RO Feed	FE-156	
Non-Ionic Polymer	Backwash Recycle	FE-865	
Sodium Hydroxide	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-572 (pH)
Carbon Dioxide	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-572 (pH)
Sodium Hypochlorite	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-574 (Total Chlorine)
Zinc Orthophosphate	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	
Hydrated Lime	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-572 (pH)

Table 29-2: Sample Points

Sample Point Location	Analysis	Flow Requirement	Disposal
Pressure Filter Effluent	AE/AIT-104 (Turbidity)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	--	Grab Sample	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-171 (Turbidity)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-172 (Temperature)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-280 (Turbidity)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-285 (pH)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-290 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-295 (Total Chlorine)	Continuous	Recycle to Washwater Equalization Basin
Cartridge Filter Effluent	AE/AIT-300 (ORP)	Continuous	Recycle to Washwater Equalization Basin
First Pass Low TDS RO Permeate	AE/AIT-205 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
First Pass RO Permeate	AE/AIT-207 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
First Pass RO Concentrate	AE/AIT-209 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
First Pass ERD High Pressure Concentrate	AE/AIT-222 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
First Pass ERD Low Pressure Concentrate	AE/AIT-227 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Feed	AE/AIT-305 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Feed	AE/AIT-310 (pH)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Feed (First Stage)	AE/AIT-245 (pH)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Permeate (First Stage)	AE/AIT-248 (pH)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Permeate (First Stage)	AE/AIT-249 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Concentrate (First Stage)	AE/AIT-256 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Permeate (Second Stage)	AE/AIT-258 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Concentrate (Second Stage)	AE/AIT-263 (pH)	Continuous	Recycle to Washwater Equalization Basin
Second Pass RO Concentrate (Second Stage)	AE/AIT-264 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Blended RO Permeate	AE/AIT-251 (pH)	Continuous	Recycle to Washwater Equalization Basin
Blended RO Permeate	AE/AIT-252 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin

Sample Point Location	Analysis	Flow Requirement	Disposal
RO CIP Feed	AE/AIT-370 (pH)	Continuous	Recycle to Washwater Equalization Basin
RO Neutralized CIP	AE/AIT-395 (pH)	Continuous	Recycle to Washwater Equalization Basin
UV Disinfection Feed	AE/AIT-445 (UVT)	Continuous	Recycle to Washwater Equalization Basin
Salinas Valley Discharge	AE/AIT-570 (pH)	Continuous	Recycle to Washwater Equalization Basin
Finished Water Quality	AE/AIT-571 (Turbidity)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-572 (pH)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-573 (Conductivity)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-574 (Total Chlorine)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-575 (Free Chlorine)	Continuous	Purge to Plant Drain System
Backwash Waste	AE/AIT-868 (Turbidity)	Continuous	Recycle to Washwater Equalization Basin
Brine	AE/AIT-891 (Conductivity)	Continuous	Recycle to Washwater Equalization Basin
Brine	AE/AIT-892 (Turbidity)	Continuous	Recycle to Washwater Equalization Basin
Brine	AE/AIT-893 (Dissolved Oxygen)	Continuous	Recycle to Washwater Equalization Basin
Brine	AE/AIT-894 (pH)	Continuous	Recycle to Washwater Equalization Basin

30.0 INSTRUMENTATION AND CONTROL

The Project will include state-of-the-art instrumentation and control devices that will enable the plant to operate with minimal supervision under automatic control, but, If the operator does need to perform any operations manually, provisions will be made to enable that to occur.

30.1 Programmable Logic Controllers

The Programmable Logic Controllers (PLC's) used on the project shall be Allen Bradley's Logix series. This shall apply to the balance of plant and vendor provided equipment. The PLC digital inputs/outputs (I/O) shall be high density 24VDC with isolated dry relay contacts integral to I/O card provided for all discrete outputs. Interposing relays shall be provided if the voltage for the I/O exceeds 24VDC or the contacts do not have adequate electrical ratings. All analog I/O shall be also be high density with up to 32 inputs per card and shall be 4-20mA. A minimum of 20% spares of each type of I/O shall be provided along with spare I/O slots for each type of I/O.

Networking; No fieldbus or proprietary field networking shall be provided for valve actuators or instruments. For modulating valves, 4-20mA analog control with full open and full closed digital feedback to the PLC shall be provided. The PLC's shall all be networked and communicate using Ethernet protocol over CAT6 copper inside buildings or fiber optic cable between buildings and depending upon the network segment distances. All Ethernet communicated signals shall be routed via Ethernet switches located in the PLC enclosure. Manufacturer of the Ethernet switch shall be Hirschman, Allen Bradley, or approved equal. All of the PLC's shall be connected to a self-healing fiber optic ring maintained by the Ethernet switches. Each fiber optic cable connection shall be terminated on a patch panel inside the PLC enclosure. Fiber optic transceivers shall convert the fiber optic Ethernet signal to CAT 6 copper cable inside the PLC enclosure.

PLC Enclosures; each of the PLC's shall be housed in an environmentally suitable PLC enclosure, manufactured by Hoffman, Saginaw and Rittal, or approved equal. All outdoor enclosures shall be NEMA 4X rated, 316 S.S. or fiberglass with appropriate sunshades and heating and cooling devices designed to keep the enclosure within set temperature limits. Indoor enclosures located in controlled environments shall typically be NEMA 12 rated with cooling recirculation fans and heaters, but, in corrosive environments shall either be NEMA 4X 316 S.S. or fiberglass. The enclosure shall also include door activated fluorescent lighting fixture(s). Multilevel termination blocks will be provided that will allow for a minimum of 20% of each I/O type in each cabinet. A common convenience receptacle shall be provided for maintenance use and a Ground Fault Circuit Interrupting (GFCI) shall be provided for the UPS and laptop computer use only. All 120VAC power cables shall be separated inside each enclosure from the 24VDC and 4-20mA analog signals.

30.2 Uninterruptible Power Supplies

All of the PLC enclosures shall be provided with an Uninterruptable Power Supply (UPS) designed to provide uninterrupted power to the enclosure PLC components for up to 15 minutes. A central UPS shall be provided for the control room Human Machine Interfaces (HMI's) and printers and server room networking equipment including; Ethernet switches, routers and firewalls. The UPS shall include a make-before-break static bypass switch along with a separate maintenance bypass switch to fully isolate the unit for maintenance and/or replacement. The bypass feed shall be provided with transient voltage surge suppression and clean power shall be fed from a shielded isolation transformer to this system. Each UPS shall also be supplied with an Ethernet communication card that shall provide overload, equipment over-temperature, low battery, load on bypass and load transferred to the maintenance bypass alarms.

30.3 Operator Interface Hardware and Software

The plant HMI and Local Operator Interface software shall be ICONICS Genesis 32. It shall be deployed in the control room and at operator interfaces throughout the plant including equipment vendor supplied control panels. Each of the local operator interfaces shall be have a minimum diagonal size of 12" and shall utilize touchscreen technology and no keypads. Each of the HMI's and operator interfaces shall be connected via a separate Ethernet connection from the PLC network and shall communicate using 1000-Base T or 1 Gigabit network communication speed.

30.4 Modes of Operation

All plant equipment that is controlled from the plant control system shall be provided with LOCAL/OFF/REMOTE (L/O/R) switches or HAND/OFF/AUTOMATIC (H/O/A) switches either on a local control panel near the equipment or on a local control station located next to the equipment. An auxiliary contact on the switches shall provide confirmation that the switch is in the Remote or Auto position as feedback to the plant or vendor PLC. Only if the switch is placed in Remote or Automatic will the PLC be able to control the operation of the equipment. When a piece of equipment is placed in the LOCAL position, the equipment will be controlled locally by using Start and Stop buttons at the local control panel or station and if the equipment has adjustable speed capability a local speed control adjustment. When equipment provided with an H/O/A switch is placed in the Hand position the equipment will run. When the LOCAL/OFF/REMOTE switch is placed in Remote, the plant operator will control the equipment at the control room HMI or through the local operator interface provided locally at the equipment. Two modes of remote control shall be provided; Remote Manual where the operator controls the piece of equipment by manual controls provided at the HMI or Local Operator Interface and Remote-Automatic where the plant or vendor provided PLC will control the equipment based on setpoints and operating parameters entered by the plant operator. When an H/O/A switch is placed in Automatic the equipment will be controlled by a vendor provided PLC based on parameters entered at the HMI or Local Operator Interface.

30.5 Operator Interface Functions

Graphic Screens; Descriptions shall be provided of each of the HMI and Operator Interface screens to determine level of detail required. The screens shall incorporate the owner standard color conventions for stop, run, open, closed and intermediate conditions.

Alarms; Alarm limits displayed on graphics can be entered by the user at configuration time or from the operator's display during run-time. Alarm limits shall be expressed in engineering units and displayed on an alarm summary page and at the bottom of every graphic screen. An alarm color convention for alarm hierarchy shall be developed in conjunction with the owner.

Reports; Reports shall be provided that will summarize plant operation, electrical consumption, water production, chemical inventory, and regulatory compliance. The HMI software shall be provided with 2 distinct types of report generation: (a) process reporting which generates logs based on processes or equipment scanned or on manually substituted data and (b) management reports which are comprised of lab derived data and process data. The reports shall be provided in forms generated in Microsoft Access. When data that is not generated by the system is required on certain forms, the operator shall be provided with the capability to manually enter this information into the report, or overwrite data that the system has downloaded. Assume that ten (10) reports are required with the ability to update them on a daily, weekly, monthly, quarterly, and annual basis as well as month and year to date basis.

Security; the HMI software shall provide a user-based security system that allows for the creation of users with certain rights and/or privileges. These rights shall include the ability to run any combination or all of the applications in the data acquisition system. The ability to allow or disallow user access to change values, such as setpoints and machine-setups, on an individual tag basis shall be configured in consultation with the owner. Groups of users, such as Operators or Supervisors, shall be created and granted rights. All users assigned to a group obtain the rights of the group, although they are still tracked by the system by their individual ID. Individual members of a group may also be assigned additional rights. The security system will support both centralized and distributed security file management.

30.6 Factory Acceptance Testing

A Factory Acceptance Test (FAT) of the control system equipment shall accomplish two separate goals. The primary goal of a FAT is to ensure that the system has been assembled properly and is in proper working order. The System Integrator shall previously have done their own un-witnessed inspection and testing to ensure the witnessed testing performs without unexpected problems. This will include testing of each individual I/O point and should be witnessed by an Instrumentation & Control staff Engineer and the owner, if requested. The goal shall also allow the Instrumentation &Control staff Engineer and the owner to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the control enclosures, control system network communication systems, special control systems, and other pertinent systems and devices. The second goal is to simulate and test the control logic, and this portion of the FAT should be attended by the design Project manager/Engineer (the “Design Project Manager/Engineer”) or someone familiar with the details of the process design and operation of the facility. All graphics, report generation and alarm functions of the system in accordance with the control narratives.

30.7 On-site Testing

Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance with its Manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Instrumentation & Control staff Engineer.

Loop Validation; Controllers shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the HMI. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as published by manufacturer accuracy specifications. Each analog loop shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For loops which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance with the calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test forms attached at the end of this section which include calculated RMS summation system accuracy tolerance requirements for each output. Loop confirmation sheets for each loop covering each active instrument and control device except simple hand switches and lights shall be provided. Loop confirmation sheets shall form the basis for operational tests.

Operational Ready Test (ORT): Following installation of the process control system components and prior to startup, the entire system shall be certified (inspected, wired, calibrated, tested and documented) that it is installed and ready for the ORT. Each loop shall have been checked and validated for proper installation and calibration using prepared forms. The system integrator shall maintain the loop status reports at the Project Site and make them available to the Owner at any time. Upon successful completion of the ORT, the system integrator shall submit a record copy of the test results to the Owner.

Functional Demonstration Test (FDT); The FDT shall be witnessed by the Owner and shall consist of a loop by loop demonstration of the functionality and operability of the control system. Live field data shall be used to the extent possible. The test shall be scheduled and coordinated with Owner's staff to minimize the impact on plant operations. Upon successful completion of the FDT, the system integrator shall submit a record copy of the test results to the Owner. The report shall include as a minimum:

- Cover sheet for the Instrumentation &Control staff Engineer sign-off/date and space for listing of exceptions
- Confirmation of delivery/acceptance of all submittals (hardware and software)
- Completed and signed loop check sheets
- Completed and signed instrument calibration sheet
- Completed and signed certificates of proper installation of instruments/equipment
- Completed and signed wire continuity test sheets (if recorded separately)
- Completed and signed fiber optic cable attenuation test sheets.
- Completed and signed functional test sheets
- Confirmation of rendered manufacturer services
- Signed confirmation of spare parts delivery
- Confirmation of delivery of draft O&M

Site Acceptance Test (SAT); after completion of the ORT and FDT, the system shall undergo a 30-day SAT under conditions of full plant performance without a single non-field repairable malfunction. Owner shall have full use of the system. Only Owner's staff shall be allowed to operate equipment associated with live plant processes. Plant operations remain the responsibility of the Owner. Any malfunction during the SAT shall be analyzed and corrections made. Any malfunction during the 30 day test which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction. All database, process controller logic, and graphical interface system data points must be fully functioning. All reports must be functioning and providing accurate results. No software or hardware modifications shall be made to the system without prior approval. Following successful completion of the 30 day test, and subsequent review and approval of test documentation, the instrumentation and control system shall be considered substantially complete and the warranty period shall commence.

30.8 Training

MWH shall train the owner's personnel on the maintenance, calibration and repair of all equipment provided as part of this project. The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment. Training shall be for the purpose of familiarizing the owner's technical maintenance staff, with the use, maintenance, calibration, trouble shooting and repair of all components of the PLCS. Training classes shall cover, as a minimum, operational theory, maintenance, trouble-shooting/repair, and calibration of supplied instruments. The training material, including a resume for the proposed instructor(s) (indicating previous instructional experience) and a detailed outline of each lesson shall be submitted to the Instrumentation & Control staff Engineer at least 30 days in advance of when the lesson is to be given. The Instrumentation &Control staff Engineer shall review the submitted data for suitability and shall be able to provide comments that shall be incorporated into the course. Final materials will be provided at least two weeks in advance of the training sessions.

Operator training shall achieve the following minimum goals:

- Use of workstations, touch screens and keyboards
- Retrieve and interpret all standard displays including graphics, overview displays, group displays, trends, point summaries, and alarm summaries,
- Enter data manually
- Change control parameters and setpoint values
- Assume manual control of equipment and control it from the HMI
- Print reports
- Acknowledge alarms
- Respond to hardware and software error
- Historical data collection, retrieval, and archival
- Capability and configurability of reports, alarm reporting, passwords, and system hardware configuration
- Database backup and recovery

Maintenance training shall achieve the following minimum goals:

- Power up and shutdown of all hardware devices
- Perform schedule maintenance functions
- Setup and use off line diagnostics to determine hardware failures
- Use workstations, keypad, or keyboards to retrieve and interpret displays which provide online diagnostic information

- Remove and replace all removable boards/modules
- Maintenance training shall be at least 75% hands-on training.

30.9 Instrument Calibration

All instrumentation field devices shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements. Each instrument shall be calibrated at 0, 25, 50, 75 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to the National Institute of Standards and Testing. Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers. Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

- Project name
- Loop number
- Tag number
- Manufacturer
- Model number
- Serial number
- Calibration range
- Calibration data: Input, output, and error at 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of span
- Switch setting, contact action, and dead-band for discrete elements
- Sensing tube leak detection test result (performed at maximum process pressure).
- Space for comments
- Space for sign-off by and date
- Test equipment used and associated serial numbers

A calibration and testing tag shall be attached to each piece of equipment or system. MWH shall sign the tag when calibration is complete and the calibration and testing has been accepted.

30.10 Protection of Sensitive Equipment

The project shall follow the guidelines for powering and grounding of sensitive electronic equipment listed in IEEE Standard 1100-2005.

- Transient Voltage Surge Suppression (TVSS): TVSS units shall be supplied at the point of use for all instrumentation loads. TVSS units shall be required for all 4 wire instruments (such as chlorine analyzer), and placed on the 120VAC branch circuit and on the 4-20 mA portion of the circuit. The transient voltage surge suppression on the 4-20 mA wiring shall be located on the PLC end. For all two wire 4-20 mA instruments that have signal cable running from outdoor to indoor locations (or signal wire between buildings) transient voltage surge suppression on the field side of the 4-20 ma signal shall be provided. All analog signaling shall be shielded cable.

- Grounding: Each PLC cabinet shall be provided with a direct connection to the ground grid via a driven rod in addition to the equipment safety ground required by the National Electrical Code. Daisy chaining of grounds is not acceptable if it is the only grounding source. A grounding detail showing the interface between the PLC cabinet and the proposed grounding system is required. Instrumentation shields shall be grounded at the PLC end only. The electrical grounding specifications must be cross referenced to the instrumentation and control specifications so that it is understood that the system integrator monitors the quality of system grounding. In order to facilitate an electrically active ground mass, provide connections to structural steel and interface them to the grounding system.

- Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the Manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

- Conduit Spacing: Conduit spacing between power and signal/control cables shall be as listed in IEEE 518-1982.

- Loop Isolators and Converters: Signal isolators shall be provided to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wire-wound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

30.11 Field Devices

All field instruments shall have a 4-20mA analog outputs that shall be trended and logged at the plant HMI with HART protocol overlaid where available and a field mounted indicator displaying the instrument reading in true in engineering units. The field mounted indicator shall be located at a height and location that provides easy access and viewing. Each instrument shall be provided with a means of calibration including electronic calibration device or gases for analyzer equipment. Preferred manufacturers are provided elsewhere. All transmitter analog signals are to be input to SCADA for monitoring, trending, and logging.

Pressure Transmitters: Microprocessor type; accuracy: 0.075% of span and provided with a 3 valve manifold for field calibration. Manufacturers shall be Rosemount, Endress + Hauser, or equal

Differential Pressure Transmitters: Microprocessor type; accuracy: 0.075% of span and provided with a valve manifold for field calibration. Manufacturers shall be Rosemount, Endress + Hauser, or equal

Flow Meters: Process flowmeters shall be magnetic located in at least 2 pipe diameters upstream and a 5 pipe diameters downstream straight run of pipe. Each magnetic flowmeter shall be provided with grounding rings and a ground and electrode and lining materials per manufacturer’s recommendation. The flowmeter shall not be submerged or direct buried. Manufacturers shall be Rosemount, Endress + Hauser, Siemens, Krohne, ABB, or equal

Level Transmitters: Continuous Level measurement shall preferably use ultrasonic or radar type transducers to continuously monitor level. A head pressure transmitter may be used where an ultrasonic or radar transmitter is not practical with a pressure indicator mounted on or adjacent to the transmitter. The sensors shall be corrosion resistant with appropriate rated enclosures and be mounted at least 1ft above maximum liquid surface. A local indicator at ground level shall be provided. Install per manufacturer's recommendations. Manufacturers shall be Endress + Hauser, Ametek Drexelbrook and Siemens, or equal.

Level Switches: Level switches shall be provided independent of continuous level monitors, when overflows could occur. Level switches shall be used to alarm when fluid has entered a sump and is causing a flood condition in a building. RF admittance types, with self-test feature are preferred in most applications. Float sensors shall be provided for flood switches. Point level switch manufacturers shall be Endress + Hauser, ABB and Ametek Drexelbrook or equal and flood switches shall be Siemens Milltronics, or equal.

Weight Transmitters: Certain tanks (day tanks) shall be weighed to determine losing weight over time to calculate/verify chemical feed rate.

Analytical Instruments: Analytical instruments include conductivity, pH, turbidity, ORP, particle count, and residual chlorine. Mount and provide sample supply, and sample conditioning for good operation. Where possible, provide digital output to SCADA for analytical instrument self- diagnostic alarm. Manufacturers shall be Hach, Rosemount and Siemens, but final selection of the analytical instruments shall be made with consultation of the Owner.

30.12 Control Panels

Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated by the CONTRACTOR. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. Enclosures suitable for the environment shall be provided. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed. The control panel controls shall be 120 VAC. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-phase, the control panel shall be provided with a control panel transformer, no 480V starters shall be provided in Instrumentation control panels. Control conductors shall be provided in accordance with the indicated requirements. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel. A control panel main power feeder disconnect shall have a door-mounted handle unless otherwise indicated. Control panels shall be housed in NEMA rated enclosures. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted. Internal control components shall be mounted on an internal back-panel or side-panel as required. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors.

30.13 Preliminary I/O List

A preliminary I/O list for the 9.6 mgd and 6.4 mgd Base Project is presented in **Appendix H**.

30.14 Instrument Schedule

A preliminary instrument schedule for the 9.6 mgd and 6.4 mgd Base Project is presented in **Appendix I**.

31.0 PHYSICAL SECURITY, ELECTRONIC SECURITY AND SPECIAL SYSTEMS

31.1 Physical Security

The MWH Team will utilize its experts and company's extensive experience in implementation of the required physical facility protection features to deter, detect, and delay vandals, criminals, saboteurs, and insider threats, as outlined in the RFP.

1. Our Team will keep close coordination with the Owner to establish Owner's input on security design at appropriate points during the design phase. In addition, our team's experts will coordinate with the Owner preferred cyber protection and implement management practices.
2. Site Fencing: it is intended that the Project Site will be fenced with 6 ft high fence, constructed out of PVC-coated galvanized steel for salt air corrosion protection. Architectural grade fencing will be provided within 50 feet, either side, of the main entrance.
3. Gate: The main entrance will be equipped with closed circuit camera, intercom, lighting, and card access. The gate will be electrically actuated, slide-type with electric actuator.
4. It is intended that all wiring and cabling will be run in conduit and protected from tampering.
5. Site Lighting will be designed for safety and security purposes in accordance with local requirements and Owner's expectations, and to allow proper functioning of security cameras.
6. Security features will be incorporated into hatches, vents, and overflows on all water storage tanks
7. Signs will be placed at 50 ft intervals around the Project Site perimeter; content and format of the signs will be coordinated with the Owner.
8. All chemical fill lines will be designed with lock provisions.
9. Site Areas:
    a. The site will be protected with anti-climb security fencing and provided with intrusion detection.
    b. Primary electrical facilities and standby power facilities will be protected with an additional level of anti-climb security fencing. All other facilities located within the site fence line will not be contained by additional security fencing.
    c. Washwater equalization basin and recycling areas are to be fenced and provided with intrusion detection.
    d. Concentrate equalization basin will be fenced.
10. All vehicle parking is designed to be located away from the building.

32.0 LANDSCAPING AND IRRIGATION

32.1 Landscape Design General

A landscaping and irrigation/xeriscaping plan will be prepared for the site by a State of California licensed Landscape Architect. The Landscape design will be guided by the conceptual site design prepared by students from the College of Architecture and Environmental Design of California Polytechnic State University and progressed to ensure the layout and concept meets CAW and regulatory requirements.

32.2 Landscape Development Regulatory Requirements

The Landscape design for this project is regulated by a number of Monterey County Code Sections. Monterey County Code, Chapter 21.28.070 Site Development Standards and Chapter 18.50 Residential, Commercial and Industrial Water Conservation Measures. Chapter; 21.28.070 Site development standards stipulate All developments shall have landscaping covering a minimum of ten (10) percent of the site area and parking areas must be landscaped subject to a plan approved by the Director of Planning and the landscaping shall be in place prior to the commencement of use. In addition, the exterior landscape development shall be comprised of, low water use or native drought-resistant plant material. Chapter 18.50 identifies an approved low water use drought tolerant plant list and irrigation system requirements for water conserving landscapes.

32.3 Landscape Design Concept

The landscape and site layout will respond to the functional needs of the facility's operators, provide clear and purposeful vehicular and pedestrian routes, respond to the natural environment and be aesthetically pleasing. Strategic placement of landscape planting materials will enhance the aesthetics of the overall site facility design. Limited ornamental plantings may be used provide additional aesthetic enhancement in key locations such as pedestrian areas in and around the Administration Facilities. Landscape screening of facilities such as the Chemical unloading area, Electrical service substation, above-ground Finished Water storage and Washwater treatment facilities will further enhance overall site aesthetics. Incorporation of an integrated water feature as described in the conceptual design prepared by students from the College of Architecture and Environmental Design of California Polytechnic State University can be considered as part of the elective landscape features identified in the RFP.

The proposed site layout and landscape design will be integrated with the site drainage and stormwater design. Low Impact Design (LID) drainage techniques used in combination with a native plant palette offer a highly sustainable landscape design, which will minimize the need for supplemental watering, reduce or eliminate the need for fertilizers, and chemical pest management. Typical techniques of bio-infiltration swales, porous paving, and rain gardens are well suited for this project site. The Landscape design layout will also emphasize practices that minimize resources needed for maintenance and water use.

32.4 Plant Material Selection

The planting design will be dominated by drought tolerant native plant material and include upper and middle story trees and shrubs, and a ground cover layer typical of the local natural vernacular. Native plant materials are best adapted to the local climate and offer a great variety of flower, leaf color, and textures. A low water use plant material palette for the project will be selected from the list provided by Monterey County entitled "A Drought-Tolerant Plant List for the Monterey Peninsula"

Other elements such as topsoil, topdressing mulch, signs, paving, lighting, irrigation and accent features make up other components integral to the landscape planting design are described below.

32.5 Planting Aesthetics

As previously stated, the planting design will be dominated by native plant material (as required by regulations) and include upper and middle story trees and shrubs, and a ground cover layer typical of the natural site characteristics A planting theme comprised of native plant material will provide an aesthetic planting design which appeals to the senses of sight, and smell, and respond to the natural surroundings makes for a pleasant working environment and produce an overall site design that fits the natural surroundings. The planting design should soften building edges, shade buildings from solar effects, frame site views, preserve existing view sheds, and compliment the site layout.

32.6 Topsoil and Compost

Planting areas will use existing amended on site topsoils. Following construction of site facilities, scarification of compacted subgrades and incorporation of organic materials into subgrades optimize the soil profile for vegetation growth and groundwater infiltration. Planting beds should receive a 3-inch to 4-inch top dressing layer of organic compost which will significantly to reduce weeds, related maintenance and increase the water holding capacity of the soil.

32.7 Supplemental Landscape Irrigation Design

As described previously, the Landscape design will be comprised of drought tolerant and low water usage plant materials. However, all newly planted plant material (both natives and ornamental plants) require supplemental irrigation during the first two to three years to become established. An automatic irrigation system utilizing low volume, low pressure drip irrigation technology will be designed to provide an efficient water delivery system for the plant material. Native plant materials have lower water demands to maintain health. Over time as the plant material become established, supplemental watering will no longer be needed and the irrigation system can be reduced or eliminated completely.

The proposed low volume, low pressure drip irrigation system will meet the requirements of Monterey County Code chapter 18.50 for water conservation measures.

33.0 SITE DEVELOPMENT

During the development of the site layout, the Project Team will include the following elements into the consideration cost, hydraulic profile, security, aesthetics, future improvements and expansions, and operations. The project team will design the paved roadways to accommodate large loads of liquid treatment chemical deliveries. The chemical unloading area will incorporate design provisions to allow for drainage to the rear outlet of delivery vehicles.

Taking into the account Owner's recommendations and Team' previous experience, the project team will mitigate the not aesthetically-pleasing facilities and structures (Chemical unloading, Electrical service substation, above ground Finished Water storage, washwater treatment facilities) from visitors' view.

33.1 Site Layout

The site layout should respond to the functional needs of the facility's operators, provide clear and purposeful vehicular and pedestrian routes, respond to the natural environment and be aesthetically pleasing. Buildings and facilities have been sited to minimize the development footprint, protect native vegetation, reduce impervious surfaces, and maximize available open space and minimize site grading, and minimize disruption of natural drainage patterns.

33.1.1 Roadways

Site roadways will be designed to accommodate pickup trucks, automobiles, commercial refuse trucks, and semi truck-trailer combinations (i.e. chemical delivery vehicles where necessary). Allowance for the larger trucks controls design of vehicular access from the street and within the site. During site layout, drive and apron paved areas will be studied to confirm the ability of vehicles to turn around and make deliveries without impacting parked vehicles or driving onto landscaped areas. The need for fire department access will be addressed in the final design related to roadway layout.

Roadway alignments will fit closely with the existing topography to minimize the need for cuts or fills. The alignment of the access roadways will be designed to provide access to all necessary temporary and permanent portal facilities. Vehicle paving will be in accordance with county road and paving design standards, and where appropriate will include continuous curbing to aid in the definition of the road edge. Non-continuous curbing will be used as necessary to facilitate sheet flow for stormwater drainage design.

33.1.2 Parking

Parking will be provided for the maintenance vehicles and equipment required for operation of the permanent facilities. The number of parking spaces provided will be based on the anticipated number of employees and vehicles expected at the site during construction, during future operation anticipating additional future staff and to meet Monterey County code requirements. Consideration will also be made for tour groups which may use buses or multiple cars.

33.1.3 Pedestrian Walkways

Pedestrian paving surfaces should be smooth and durable. Areas close to building entrances should be hard surfaces such as concrete, asphalt or unit pavers. Areas further away from buildings can be gravel or coarse mulch depending on the amount of use. Pedestrian walkways should be wide enough to allow two people to walk side by side (5-feet wide minimum).

33.1.4 Building and Site Signage

Facility signage should promote a unified, high-quality system of design within the facility which provide clear identification, information and communication to staff and visitors. Overall signage should meet Tacoma Water's guidelines. The guidelines provide a framework for the sign system to provide consistency in sign design, size, materials, and illumination throughout the facility.

33.1.4.1 Overall Sign System

A hierarchy of signs should be created for the facility Signs will be designed to create a unique identity for the facility and to provide a graduated system of orientation into and through the site which match existing sign standards

- Project Identification: Signs shall be located at the primary entrances to buildings
- Safety and Warning Signs: Meeting industry and regulatory requirements.
- Site Information Signs: Providing information to visitors about the facility and context.
- Building Identification Signs: To identify individual buildings
- Interior wall mounted Signs: To further identify individual buildings or major facilities within the facility

33.1.5 Site Lighting

Site lighting will be designed to meet minimum requirements of the security of the outside area being illuminated, and utilize control strategies which minimize overall energy usage. Therefore, a variety of different solutions should be coordinated and integrated to the facility design. Specific lighting requirements for each portion of the site, should be identified, and luminaries will be selected that combine appropriate aesthetic design with relevant lighting performance features.

Site lighting typically falls into four basic lighting areas; roadways, open areas, pedestrian areas, and the site perimeter. Each of these areas should be identified and discussed during the design development process to develop an overall site lighting plan.

A lighting plan for a large complex such as this site should designate certain routes as primary pedestrian routes after dark. Primary routes would be the most direct paths between major spaces or parking lots, or the paths that pedestrians would be expected to utilize when moving about the site. Secondary after-hours routes may also have lighting for basic safety.

33.1.6 Site Layout Aesthetics

As previously stated in the Landscaping section, a planting design will be developed to enhance the overall site aesthetics. The planting design will soften building edges, shade buildings from solar effects, frame site views, preserve existing view sheds, and compliment the site layout. In particular the site layout and building design will appropriately emphasize the curb appeal of facilities such as the Administration Facilities and pedestrian areas and mitigate the not aesthetically-pleasing facilities and structures identified by the Owner (Chemical unloading, Electrical service substation, above ground Finished Water storage, wastewater treatment facilities) from visitors view.

33.1.7 Hydraulic Profile

The site layout has been optimized to the plant's hydraulic profile to minimize site excavation and to minimize distance between facilities. In addition, the change in elevation has been used to minimize pumping where possible.

33.2 Site Drainage and Stormwater Management

The proposed drainage design will integrate stormwater runoff management with planting design, commonly known as Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) drainage design. These drainage techniques will allow the site to perform in a more naturalistic manor, and will result in clean and healthy stormwater discharges from the site. Typical techniques of bio-infiltration swales, porous paving, and rain gardens are well suited for this project site.

Specific stormwater management BMPs to be considered include dispersion of rooftop and pavement stormwater runoff into landscape planting areas, bio-infiltration swales, porous paving, and rain gardens.

33.3 Site Grading

The proposed site occupies the terrace above the Salinas river, and rises gradually east to west and to the north from Charles Benson Road. In our site general arrangement, we have in general used the site topography to best drainage advantage to reduce structures and underground collection systems. The stormwater detention pond is located to the northeast, taking advantage of the general site topography, as the lower collection point for the drainage, before controlled discharge. Surface drainage is controlled within the compressed plant footprint, by a series of measures:

1) All buildings are equipped with gutters and downspouts, controlling the major portion of precipitation and directing it to nearby collection inlets
2) All roadways are constructed with mountable curbs, allowing drainage from intermediate/confined areas to surface flow across and collect into the inverted crown pavement section
3) The pavement section is an inverted crown, essentially using the roadway as a collection and transport of stormwater to an inlet
4) Lastly, the inlet and underground stormwater collection system route the collected drainage to the detention pond, where it is collected for controlled discharge.

33.3.1.1 Segregation of Public and Operations Access

While not expected to be a central function of the facility, the general public may visit the site for tours. Also, non-operations staff use and visit the Administration Facilities on a regular basis. These visitors and employees must be provided with safe, secure, and convenient pathways to the areas of the site that they need to access.

Vehicular access to the site should allow convenient access to the public parking areas in front of the Administration Facilities and more restricted access to process and chemical delivery areas.

33.3.1.2 Use of Site Topography

Due to the site topography, there is limited opportunity or necessity to consider ground elevation when locating facilities. There is a slight fall to the site from west to east and south to north, which generally conforms to the hydraulic grade line for the new facility.

33.3.1.3 Conformance with Hydraulic Profile

With the exception of the RO system, the hydraulic profile follows the slope of the site, to the extent feasible. The filtered water tanks are set at an elevation to be able to receive flow from the slant wells with a HGL of 155 feet at the property line. Downstream of the RO system, the flow is by gravity to the finished water tanks. From there, the water will be pumped back to the property line at a HGL of 425 feet.

33.3.1.4 Yard Piping Required

Process facilities should be located close to the existing transmission pipelines to minimize the length of large-diameter connecting pipelines. Facilities should be oriented such that the process basins convey flows from east to west.

33.3.1.5 Future Expansion

To allow for future expansion of plant capacity, allowances will be made to construct additional RO facilities to treat up to 12.8 mgd. The expansion will be to the east and west of the RO building. Additional pretreatment filters and cartridge filters would be constructed adjacent to the filters included in this project.

33.3.1.6 Protection of Cultural Resources

No existing cultural resources have been identified in the project site area and Archaeological investigations are not planned. But, the project team will be mindful of the potential for discovery of protected cultural materials during the design and construction of the CAW facility, and will advise the Owner regarding appropriate actions to be taken.

33.3.2 Yard Piping

The additional yard piping required for the Project will generally conform to the design criteria presented in the pipe schedule and in accordance with Appendix 2. Piping materials will be selected for longevity, durability, and economy. For pressure piping, steel, HDPE and ductile iron piping will meet project requirements for performance and reliability, but CAW prefers ductile iron. Selection between these three materials will be based primarily on cost. In the Monterey, area, MWH has found that ductile iron pipe is generally less expensive (on a total installed cost basis) for pipe diameters of 30 inches and less, and at larger diameters, welded steel pipe is less expensive. HDPE will be evaluated on a case by case basis depending on size, depth and fluid being carried (e.g., RO permeate is aggressive to metal piping).

Appendix A
Process Flow Diagram and Hydraulic Profile

Appendix B
Toray Design Systems – Model Runs

Appendix C
Energy Recovery Inc. (ERI) – Model Runs

Appendix D
Energy Recovery Inc. (ERI) – Reference List

Appendix E
Spare Parts List

Appendix F
Normal Power Electrical Loads

Appendix G
Building Schedule

Appendix H
Preliminary I/O List

Appendix I
Instrument Schedule

Prepared for

CALIFORNIA AMERICAN WATER

Voluntary Alternative Proposal No. 1 Basis of Design Report (BODR)

Voluntary Alternative Proposal No. 1
Basis of Design Report (BODR)

Basis of Design Report – Voluntary Alternative Design

EXECUTIVE SUMMARY

This document comprises the Alternative Basis of Design Report (BoDR) in support of the development of California American Water's (CAW) Monterey Peninsula Water Supply Project (Project), from the perspective of the MWH Constructors, Inc. (MWH) Design-Build Team. This BoDR, along with development drawings and other supporting information, serves as the basis of our proposal and fixed fee pricing.

This BoDR focuses on an alternative to the suggested Baseline Project (9.6 million gallons per day [mgd] firm finished water treatment/production capacity) as presented in the Request for Proposal (RFP) and Appendices (including #2 – Design and Construction Requirements) in order to demonstrate finished water quality compliance and to share our concepts and plan for implementing this challenging project. References are made to voluntary alternatives which have been developed by MWH for consideration by CAW. If CAW requires a reduction in capacity to 6.4 mgd, a similar approach to downsizing the process equipment will be considered during detailed design.

For the Alternative Design, MWH has proposed alternatives that result in a lower capital cost, lower operational cost, easier treatment plant operation, and result in less overall risk to the environment.

The major modifications that have been made from the Base Project are summarized below and **described in detail in Appendix J**:

- **Elimination of Granular Media Filtration System** – while granular media filtration is an effective means of removing particulates upstream of a reverse osmosis (RO) system, the ancillary processes associated with this technology are numerous. The removal of this system not only eliminates the pressure filters, but also eliminates two downstream storage tanks, a backwash waste tank, three (3) sets of pumps (filtered water, backwash supply, and recycle), and three (3) chemical additional points (sodium hypochlorite, sodium bisulfite and non-ionic polymer).

- **Addition of Sand Separators** – based on a review of historical water quality, the probability of iron or manganese being present in the seawater supply is low, therefore MWH has elected to replace the proposed Base Project pressure filtration using multiple granular media filter vessels with sand separators. Sand separators serve two important roles: 1) as a preliminary treatment step before cartridge filters to reduce the solids loading on those pre-treatment steps; and 2) to remove sand particles in order to protect the RO membrane integrity.

- **Modification to RO Train Size** – in order to reduce the number of mechanical equipment associated with the RO system, MWH has elected to increase the capacity of the individual first pass RO trains. This allows for the reduction in the number of high pressure pumps required for operation, and a reduction in the number of energy recovery device (ERD) pumps. The modification to this system also allows for a reduction in RO building size, making the RO Building taller, with a smaller footprint.

- **Elimination of the Ultraviolet (UV) Disinfection System** – based on desktop modeling of the raw water quality data, MWH has calculated that the first pass RO system will be able to remove greater than 99% of the TDS/salt from the feedwater. Disinfection requirements will be met by a combination of RO and chlorine addition.

- **Elimination of the Concentrate Equalization Lagoon** – MWH has elected to remove the concentrate equalization lagoon in the proposed Alternative Design. Based on the information provided regarding the hydraulic capacity of the existing outfall, it is highly unlikely that the MRWPCA outfall will have insufficient capacity for concentrate discharge. In addition, with a proposed capacity of 3,000,000 gallons, and a concentrate flow of approximately 12.3 mgd, the concentrate equalization pond would only provide approximately 6 hours of storage, after which storage in the lagoon would be unavailable. The removal of this system not only eliminates the concentration equalization lagoon, but also eliminates one (1) set of pumps (concentrate discharge), and one (1) proposed chemical additional point (sodium bisulfite).

- **Modifications to Chemical Systems** – MWH has elected to replace the lime slurry system with the delivery of liquid lime to the site; this will eliminate the need for a storage silo, lime feeder, and aging tanks, and replace those with two (2) liquid lime storage tanks and feed pumps. The sodium hypochlorite generation system has been replaced with bulk delivery of liquid sodium hypochlorite. In addition, the number of dosing points for sodium hypochlorite has been reduced, and is only added to carry a free chlorine disinfection residual into the finished water conveyance system. With no chlorine being added upstream of the pre-treatment system, sodium bisulfite is no longer required for chlorine quenching upstream of the RO system. With granular media filtration no longer proposed as a pre-treatment process, the addition of non-ionic polymer for enhancing the settleability of the dirty washwater is no longer required. For sodium hydroxide, MWH proposes to remove the dosing point for post-stabilization. The addition of lime for post-stabilization will increase the pH and decrease the Langelier Saturation Index (LSI) of the finished water, while the addition of sodium hydroxide will only serve to increase the pH, with no effect on the LSI. All of these modifications to the chemical systems also allows for a reduction in the size of the chemical storage and feed facilities.

1.0 INTRODUCTION

This document comprises the Alternative Basis of Design Report (BoDR) in support of the development of California American Water's (CAW) Monterey Peninsula Water Supply Project (Project), from the perspective of the MWH Constructors, Inc. (MWH) Design-Build Team. This BoDR, along with development drawings and other supporting information, serves as the basis of our proposal and fixed fee pricing.

This BoDR focuses on an alternative to the suggested Baseline Project (9.6 million gallons per day [mgd] firm finished water treatment/production capacity) as presented in the Request for Proposal (RFP) and Appendices (including #2 – Design and Construction Requirements) in order to demonstrate finished water quality compliance and to share our concepts and plan for implementing this challenging project. References are made to voluntary alternatives which have been developed by MWH for consideration by CAW. If CAW requires a reduction in capacity to 6.4 mgd, a similar approach to downsizing the process equipment will be considered during detailed design.

This BoDR also provides the information necessary to develop O&M cost estimates and life-cycle cost analyses.

The improvements associated with this Project include:

- Raw water piping (from the property line)
- Sand separators
- Reverse osmosis (RO) system
- Product water stabilization system
- Finished water storage and disinfection
- Finished water pumping system and piping (piping to the property line)
- Salinas Valley desalinated water return pumping system and piping (piping to the property line)
- Concentrate disposal system (piping to the property line)
- Chemical storage and feed facilities
- Electrical facilities including power supply
- Standby power facilities
- Process control and instrumentation system
- Buildings, inclusive of all mechanical, electrical, and special systems:
    - Administration facilities
    - RO building
    - Chemical storage and feed facilities
    - Electrical switchgear building
- Project Site improvements
- All other improvements necessary for a fully functional facility

A process flow diagram and a hydraulic profile for the 9.6 mgd Alternative Design are provided in **Appendix A**.

2.0 GENERAL PROJECT DESIGN CRITERIA

This section presents pertinent design criteria for the Project. These design criteria serve as the guide for facilities and equipment sizing, and to guide the layout of the facility.

2.1 Plant Capacity

The RFP requires a firm finished water treatment/production capacity of 9.6 mgd, as well as consideration of maximum capacity with all treatment trains in service. Although the RFP also requires consideration of a reduction in finished water capacity of 6.4 mgd, depending on the timing and capacity of the Groundwater Replenishment (GWR) Project for the Baseline Project, this reduced capacity is not considered in this BoDR. If CAW requires a reduction in capacity to 6.4 mgd, a similar approach to downsizing the process equipment will be considered during detailed design

The RFP also requests consideration of a potential future maximum capacity of 12.8 mgd to provide a basis for design of fixed capacity components, and to identify space planning requirements for variable capacity components. This wide range in capacities also results in a wide range of plant influent seawater flows to be pre-treated. A summary of important capacity values is presented in **Table 2-1** based on an RO production efficiency of 44%. Firm capacity is with one of the treatment trains or the largest item of equipment out of service. Maximum capacity is with all treatment trains in service.

Table 2-1: Summary of Plant Capacity

Firm Finished Water Capacity (mgd)	Maximum Finished Water Capacity (mgd)[1]	Firm Influent Capacity (mgd)	Maximum Influent Capacity (mgd)
6.4	8.0	14.6	18.2
9.6	11.2	21.8	25.5
12.8	14.4	29.1	32.7

[1] The chemical feed pumps, and finished water pumps must be designed for the maximum finished water capacity.

The plant layout/design for 9.6 mgd will provide spatial allowances to expand various process buildings in the future to achieve a higher capacity up to 12.8 mgd. With all the trains on line after expansion, the maximum finished water capacity will be 14.4 mgd. Therefore, all yard piping has been sized for that production capacity or accommodation has been made for the connection of additional flow. Space will not be allocated inside buildings to accommodate future expansion. Instead, the buildings will need to be enlarged for the additional facilities needed for expansion.

2.2 Future Facilities

MWH has planned for a potential future capacity increase to 12.8 mgd.

2.3 Equipment Life Expectancy

Appendix 2 of the RFP identified the expected life of selected facility assets and MWH has developed a design that meets or exceeds these expectations.

Table 2-2: Equipment Life Expectancy

Equipment	Years
Process Equipment	
RO Equipment	25
Sand Separators	15
Electrical Power Equipment	30
Instrumentation and Control Equipment	20
Tankage	
Chemical Bulk Storage Tanks	25
Finished Water Storage Tanks	50
Buildings/Structures	
Reinforced Concrete Structures	75
Administration Facilities	50
Stand Alone Electrical Switchgear Building	30
Piping and Valves	
Finished Water	
Piping	50
Valves	25
Saline Water	
Piping	25
Valves	15
Chemical Piping and Valves	15

2.4 Staffing

The design proposed by MWH is based on the assumption that the treatment facility will be staffed on a 24/7/365 basis. It is understood that this plant will be operated at or near capacity throughout the year and therefore requires careful attention from operations and maintenance staff. A key goal for this design-build project is to provide for a reliable, efficient and safe facility, including appropriate monitoring and controls, such that partially-attended operation can be considered in the future. MWH has considerable experience in the region having designed Sacramento County Water Agency's Vineyard Surface Water Treatment Plant which is the first large surface water treatment plant to receive approval from CDPH to be operated remotely.

2.5 Sustainable Design, Construction and Operation in Building Technology

We understand that CAW has elected to forego a formal Leadership in Energy & Environmental Design (LEED®) certification process for this facility, but that many of the desired design and construction features that qualify for LEED® certification are desirable. MWH has included numerous sustainable features in our proposed design including efficient use of energy in process equipment as well as for lighting and HVAC of appropriate systems/buildings. Waste minimization and pollution prevention are key themes of our construction methods and operational design practices.

Examples of this technology and how MWH has applied it in other treatment plant designs is presented in the Baseline Project BODR.

2.6 Spill Protection/Secondary Containment for Liquids

Our design complies with CAW's requirements for spill protection and secondary containment. Groundwater is protected from process fluids including all seawater, RO concentrate, RO chemical waste and treatment chemicals. Saline fluid waste is separated from non-saline wastewater to minimize the salinity of sanitary wastes. A curbed pump area is provided for saline fluid waste; this water is collected and pumped to the MRWPCA outfall. Tank overflows from the Flush Tank are directed to the MRWPCA outfall. All tanks are provided with level monitoring plus independent high-level switches and alarms. The Finished Water Storage Tanks are not provided with secondary containment.

All chemical storage tanks and feed systems are located within concrete curbs/walls to provide secondary containment in the event of leaks. All buried chemical piping is provided with secondary containment per Attachment 1 provided with Appendix 2 of the RFP. Liquid spill containment is provided at all liquid chemical off-loading stations.

In comparison to the Base Project, MWH's Alternative Design has eliminated two (2) large basins that would contain seawater or RO concentrate. This change reduces the potential for groundwater contamination via leakage, accidental damage, etc.

2.7 Site Arrangement – Integrated vs. Campus Layout

Our proposed site layout (see Drawing Nos. C-1 through C-5 for the 9.6 mgd Alternative Design) locates the administration facilities, the RO processes and the primary chemical facilities in separate buildings (i.e., campus layout), but in close proximity to each other to enable access by walking between each building. Other treatment/process functions are also within walking distance of the administration facilities, but further away than the RO and chemical facilities. A campus layout provides better flexibility for future expansion and/or process modifications than does an integrated building layout. Although a campus layout requires slightly more walking for the operators, we believe this is a very efficient layout which will provide good service to CAW and the operations/maintenance staff.

2.8 Safety

Our proposed layout and facility design emphasizes safety and exceeds Occupational Safety and Health Administration (OSHA) standards. Use of ladders is minimized except for access to the tops of chemical tanks. We have diligently avoided the use of vaults and other confined spaces. Access to equipment meets all industry norms.

2.9 Redundancy

Our design provides process, equipment and mechanical redundancy such that the plant can operate at design capacity (firm capacity) with any single process unit out of service, including chemical feed systems and chemical feed piping.

2.10 Process Overflows

All processes have overflows which safely direct excess flow away to protect structures, personnel and the environment. All key tanks and process storage elements will have independent high-level switches/alarms, as well as level monitors.

The Flush Tank (combined permeate tank) will overflow to concentrate outfall. The RO CIP Tank will overflow to the CIP sump, which will send waste to the neutralization tanks. Prior to discharge, overflows will be collected in the plant drain lift station and then pumped to the MRWPCA outfall.

2.11 Coastal Marine Environment and Corrosion Control

In a seawater desalination plant, there are many areas within the plant that have the potential for accelerated corrosion. To ensure that functional use of facilities affected by a particular environment is maintained for the design life, materials of construction and protection techniques must be selected suitable to the specific environment. Our design has carefully considered the corrosion potential due to the coastal marine environment, and our use of metallic materials has been avoided as much as possible. Providing CAW with a facility that has a long service life and with long-term aesthetic appeal is paramount to our design philosophy.

For materials that are permanently exposed to seawater or RO concentrate via submergence or splashing, duplex or super duplex stainless steel is recommended for metallic materials (PREN $\geq$ 40 for super duplex and PREN $\geq$ 28 for duplex). MWH will use concrete with Type II, V dual certified cement. High-range water reducing admixtures and Xypex Admix C-5000 will also be used to increase the workability and provide uniform cement distribution throughout the mix.

For the Alternative Design, a number of process equipment has been eliminated from the design (e.g. pressure filters, storage tanks, pumps, etc.). This reduces the potential for corrosion at the site.

2.12 Saline Water and Corrosion Control

Fiberglass reinforced pipe (FRP) or high density polyethylene (HDPE) has been selected for use for the majority of piping through the treatment facility. These pipe materials are suitable for use in saline environments and on saline waters to assist in the prevention of corrosion.

3.0 RAW WATER QUALITY

Raw water quality data were provided in the Request for Proposals, Appendix 2 – Attachment 2 and is summarized in **Table 3-1**. The column "MWH Expectation" defines the actual expected raw water quality, based on previous desalination experience. These values were used to design the alternative project.

Table 3-1: Raw Water Quality, Provided in RFP

Parameter	Units	Design Value (mg/L seawater) **Provided by Cal-Am**		**MWH Expectation** (mg/L seawater)
		Average	Design Maximum	Design Maximum
Applicable for the Pretreatment System				
Color	color units	-	9	-
Turbidity	NTU	-	10	0.2 (if from 180' Aquifer) 1.0 (if from Beach Aquifer)
Total Organic Carbon	mg/L	-	4	-
Iron, total	mg/L	-	2	<0.05 (Dissolved Iron, Fe^{+3})
Manganese, total	mg/L	-	0.2	0.01
Applicable for the Reverse Osmosis System				
Salinity	PSS	33.57	37	33.6 +/- 1.0
Specific Gravity[2]		1.025	1.028	-
Total Dissolved Solids (TDS)[3]	mg/L	34,406	38,019	-
Temperature	°C	12	8 to 20	12 +/- 1
Chloride	mg/L	19,030	21,000	-
Sodium	mg/L	10,604	11,700	-
Sulfate	mg/L	2,667	2,900	-
Magnesium	mg/L	1,262	1,400	-
Calcium	mg/L	405	500	-
Potassium	mg/L	392	570	-
Bicarbonate	mg/L	105	150	-
Carbonate	mg/L	16	-	-
Bromide	mg/L	71	110	-
Silica	mg/L	1.3	30	-
Barium	mg/L	0.013	0.16	-
Strontium	mg/L	7.81	15	-
Fluoride	mg/L	1.28	2	-
Boron	mg/L	4.8	5.4	-
pH	mg/L	8	8.3	-

1. All specific gravity values were calculated by MWH, based on the given salinity.
2. All TDS values were calculated by MWH, based on the given salinity and specific gravity corresponding to that salinity.

4.0 FINISHED WATER QUALITY

Finished water quality requirements for the Project were provided in the RFP and are summarized in **Table 4-1**.

Table 4-1: Finished Water Quality, Provided in RFP

Parameter	Units	Pretreatment Effluent		Combined RO Permeate		Finished Water After Stabilization	
		Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]
General and Inorganic							
Total Dissolved Solids (TDS)	mg/L						300
Turbidity[3]	NTU	0.15	1.0	0.1	0.5	0.5	1.0
Silt Density Index (SDI)[3,4]	min^{-1}	3	4				
Boron	mg/L			0.5	0.7	0.5	0.7
Chloride	mg/L			60	100	60	100
Bromide	mg/L			0.3	0.5	0.3	0.5
Sodium	mg/L			35	60	35	60
Iron, total	mg/L	0.06	0.10				
Manganese, total	mg/L	0.03	0.05				
Product Water Stabilization[5,6]							
Hardness, total	mg/L as $CaCO_3$					40 to 100	–
pH	pH units					7.7 to 8.7	–
Alkalinity, total	mg/L as $CaCO_3$					40 to 100	–
Langelier Saturation Index (LSI)	–					0 to 0.2	–
Calcium Carbonate Precipitation Potential (CCPP)	mg/L					0 to 5	–
Zinc Orthophosphate	mg/L as PO_4					Set by Owner within the range of 1.0 to 3.5 mg/L	3.5
Disinfection and Disinfection Byproducts (DBPs)							
Total Chlorine Residual	mg/L as Cl_2					Set by Owner for a target of 2 mg/L, within the range of 1.5	3.5 mg/L

Parameter	Units	Pretreatment Effluent		Combined RO Permeate		Finished Water After Stabilization	
		Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]	Maximum Average Concen-tration[1]	Not to Exceed Concen-tration[2]
						to 2.5 mg/L	
Trihalomethanes, total (TTHM)[7]	µg/L					40	64
Haloacetic Acids, total of 5 (HAA5)[7]	µg/L					30	48
Total Nitrosamines[7,8]	ng/L					5	8
Bromate	µg/L					5	8

1. The average of the measured concentrations shall be below the Maximum Average Concentration at all times. This footnote does not apply to (a) turbidity or SDI, or (b) finished water total hardness, pH, alkalinity, LSI or CCPP; separate footnotes apply to these parameters. Maximum Average Concentration cannot be exceeded during the applicable period, which shall be (i) daily for continuous samples and samples collected every 15 minutes; and (ii) for the duration of the Acceptance Test, for samples collected daily or weekly.
2. No measurement shall exceed this value, at any time.
3. Measured values must be less than the “maximum average” concentration 95% of the time.
4. The maximum SDI limit applies unless more stringent requirements apply based on the SWRO membrane supplier warranty.
5. The Owner will set the conditions for product water stabilization to minimize corrosion in the existing distribution system. Conditions will likely not be set for all of these parameters concurrently.
6. Finished Water shall be within the “target range” at all times, where the target range is the target concentration set by the Owner, plus or minus the allowed variance shown in Appendix 7.
7. TTHM, HAA5, and total nitrosamine concentrations shall be determined using the Simulated Distribution (SDS) test method in Standard Methods (Method 5710C). Samples of the finished water where it enters the distribution system shall be collected, with no adjustment of chlorine residual or pH, and held at the temperature of the finished water at the time of collection (±2ºC) for a 48-hour holding time.
8. Total Nitrosamines includes the 6 nitrosamine compounds on the EPA’s UCMR2-List 2; NDEA, NDMA, NDBA, NDPA, NMEA and NPYR.

5.0 RAW WATER PUMPING

Others are responsible for the design and construction of the raw water supply and conveyance systems including: 1) slanted beach seawater wells and pumps, 2) raw water pipeline to the Project site boundary, and 3) electrical, controls and communications between the raw water pumps and the Project facilities. MWH will be responsible for design-build of the raw water pipeline (and the fiber optic cable) from the property boundary to the pretreatment facilities as well as integration of the control of the slant well pumps. The raw water pipe size is 48 inches and is based on a proposed future expansion to 12.8 mgd (29.2 mgd feedwater flow) and 14.4 mgd (38.2 mgd feedwater flow) with all trains running. The raw water supply pumps will be able to deliver the proper flow/volume of water using a HGL at the Project site of 155 feet MSL.

6.0 PRE-TREATMENT SYSTEM WITH SAND SEPARATORS

The RFP and Appendix 2 require the use of pre-treatment filtration to remove iron and manganese which may be present in the seawater supply from the slant beach wells. Also, consideration of the potential need to coagulate/filter suspended solids (turbidity) in the influent supply must also be given. Based on a review of historical water quality, the probability of iron or manganese being present in the seawater supply is low. Therefore, MWH has elected to replace the proposed Base Project pressure filtration using multiple granular media filter vessels with sand separators. Sand separators serve two important roles: 1) as a preliminary treatment step before cartridge filters to reduce the solids loading on those pre-treatment steps; and 2) to remove sand particles in order to protect the RO membrane integrity. No chemical addition is required upstream of the sand separators. A bypass of the raw water flow around the sand separators will be provided to enable modification, maintenance and service. Eight (8) sand separators will be installed (with a 7+1 configuration). Additionally, space will be allocated for an additional two (2) future sand separators should they be required for increase flow capacity.

6.1 Design Criteria

The pre-treatment system is size to provide sufficient flow to the RO system in order to meet the 9.6 mgd demand. The design flows for the raw water and pre-treatment systems are summarized in **Table 6-1**.

Table 6-1: Pre-Treatment Design Flows

Description	Proposed	Units
RO System Efficiency	44%	percent
Pre-treatment Capacity (9.6 mgd Design)	21.9	mgd

An influent flowmeter will be installed prior to the sand separators. The flowmeter will be above-ground with appropriate hydraulic conditions to meet accuracy requirements.

Table 6-2: Sand Separators – Design Criteria

Description	Proposed	Units
Number of Sand Separators	8 (7+1)	each
Type	Cyclone	
Materials of Construction	316 Stainless Steel	
Design Flow Rate per unit	2000	gpm
Design Working Pressure per unit	50	psig
Maximum Working Pressure per unit	150	psig
Maximum Clean Pressure Drop per unit at Maximum Design Flow	2	psi
Maximum Dirty Pressure Drop per unit at Maximum Design Flow	15	psi
Inlet/outlet grooved coupling diameter	6	in
Particle Size to be removed at maximum design flow	0.375	in
Removal rate of particle size at maximum design flow	98	%

6.2 Sand Separator Units

The separator shell shall be of unishell construction with a minimum wall thickness of 0.25 inches. The actual shell wall thickness for this project shall be determined by the water pressures, water temperature, shell diameter, and other design variables specific to this installation.

6.3 Flushing

Periodic purging of removed particulates shall be accomplished by an automatic timer-activated motorized ball valve. Valve fabrication shall be straight-through design with 316 stainless steel valve body and ball in a Teflon seat. The timer and programming switch functions shall be performed by the vendor-supplied local control panel.

6.4 Solids Handling

Solids from the sand separator units will be periodically purged and directed to the drain lift station, and ultimately discharged through the ocean outfall.

6.5 Wastewater Sampling

A sampling tap will be provided on the solids purge line from each sand separator unit.

6.6 Instrumentation

There is one (1) influent flow meter located on the raw water header feeding the sand separators. Each sand separator unit will have a loss-of-head differential pressure transmitter and effluent turbidimeter.

6.7 Valves

Each sand separator unit will be equipped with motor-operated isolation and drain valves. Each sand separator unit shall be furnished with pressure gauges installed at the inlet and outlet lines. Shut-off valves (stop valves) on the inlet and outlet of each individual sand separator unit will be provided to allow isolation for maintenance, repair or cleaning. A plug valve on each sand separator unit will be provided for controlling the discharge flow of accumulated solids, and solids purging will be controlled by a vendor-supplied local control panel.

7.0 REVERSE OSMOSIS SYSTEM

RO is a state-of-the-art technology used in large-scale desalination of ocean waters, which typically contain total dissolved solids (TDS) upwards of 35,000-42,000 mg/L. The RO system will be used to remove salts and nutrients from seawater in order to match the water quality goals established in Section 4.0.

After the Cyclone Sand Separates, raw water will pass through 5-micron cartridge filters, which will be located upstream of first pass feed pumps. From the cartridge filters, the water will flow to the RO First Pass High Pressure (HP) pumps, which will pressurize the feedwater to the First Pass seawater RO (SWRO). SWRO feed pressure requirements will depend upon a number of factors including source water temperature, feedwater salinity, recovery, extent of membrane fouling and membrane compaction. In order to minimize the size of the first pass feed pumps, an energy recovery device (ERD) will utilize residual pressure in the first pass concentrate to pressurize a portion of the first pass feed flow. Permeate from the lag (end) elements of the three first pass trains will be collected in a single header and sent to the three second pass RO trains. The second pass is required to meet the finished water quality goals established in **Section 4.0**. The second pass feed pumps will provide pressure to the second pass brackish water RO (BWRO). Permeate from the lead (front) elements of the first pass will go directly to the Finished Water Tanks. Permeate from the second pass will supply the Flush Tank. Most of the BWRO permeate will overflow to the Finished Water Tanks but a portion will be used for RO permeate flushes, RO cleans-in-place (CIP), and as carrier water. Concentrate from the first pass (after passing through the ERD) will be sent to the concentrate outfall line. Concentrate from the second pass will be recycled to a point upstream of the cartridge filters.

All materials in the RO system that are in direct contact with water shall be NSF 61 certified.

7.1 Manufacturers

MWH Treatment (formerly Biwater) will serve as the RO equipment manufacturer (ROEM). MWH Treatment meets all requirements as stated in Proposal Form 1, Attachment 4. All equipment being proposed for the RO system will be provided by manufacturers listed in Appendix 2, Attachment 4.

7.2 RO Model Runs

RO model runs were conducted using the proprietary software, Toray Design Systems 2.0, last updated in February 2013. To determine the requisite number/type of elements and minimum/maximum required feed pressures for each pass, two design conditions were evaluated, as shown in **Table 7-1**. Toray model runs are included **Appendix B**. Results from the Toray models were input into a spreadsheet model provided by Energy Recovery Inc. (ERI), in order to determine the model and number of energy recovery devices required for each RO train. ERI results are included as **Appendix C**.

Table 7-1: RO Model Runs

Case Name	Inputs	Determined…
Design Case - New	Design Average Salinity Design Average Temperature New membranes (0.25 yrs)	The normal operation of the system with new membranes.
Design Case - Old	Design Average Salinity Design Average Temperature Old membranes (Year 5)	The normal operation of the system with old membranes.

7.3 Cartridge Filters

Cartridge filters are commonly utilized as additional protection for the RO membrane elements to capture any final particles of suspended solids that may enter the feed stream. In addition, cartridge filters are required as part of many RO membrane manufacturers' warranties. Horizontal filters will be provided for each RO train. The design meets all access requirements established in the RFP. The design criteria for the cartridge filters are shown in **Table 7-2**.

Table 7-2: Cartridge Filter Design Criteria

Description	Proposed	Units
Maximum Effluent Turbidity	0.5	NTU
Effluent SDI	≤ 2 min^{-1} 95% of the time, < 4 min^{-1} at all times	
Pressure vessel standard	ASME Boiler and Pressure Vessel Code, Section VIII	
Filter Orientation	Horizontal	
Vessel Material	AL-6XN stainless steel (must meet or exceed ASME Section VIII Code for high pressure vessels)	
Vessel Design Pressure	150	psi
Vessel O-rings/gaskets	Buna-N	
Filter Element Rating	5	micron
Filter Efficiency (minimum)	90%	
Filter Type	String-wound depth cartridges	
Filter Materials	Polypropylene (FDA Grade and ANSI/NSF 61 certified	
Filter O-rings	Buna-N	
Filter Outside Diameter	2.44	inch
Filter Inside Diameter	1	inch
Filter Flow Configuration	Outside-In	
Filter Element Length	40	inch
Maximum Design Loading Rate	4	gpm / 10” length
Maximum Pressure Differential of Clean Filter Elements at Design Loading Rate	4	psi
Differential Loading Rate to Trigger Filter Replacement	20	psi
Filter Replacement Interval	Not less than 2 months	
Feed Flow, Total	10	mgd
Number of Filters	7 (6 + 1)	units
Maximum Flow per Unit	3.6	mgd
Elements per Unit	169	elements

7.4 RO System Trains

Each SWRO Train will be an identical, independent train consisting of a cartridge filter, first pass feed pump, first pass skid (single stage), energy recovery device (ERD), and ERD booster pump. Lag permeate from the SWRO trains will be collected in a single header and sent for further treatment by the BWRO Trains. Each BWRO Train will be an identical, independent train consisting of a second pass feed pump, and a second pass skid (two stages). The design criteria for the RO trains are shown in **Table 7-3**.

Table 7-3: RO Train Design Criteria

Description	Proposed	Units
Design Combined Permeate Flow	9.6	mgd
Minimum Combined Permeate Flow (1 SWRO Trains, 1 BWRO Train in Operation)	3.2	mgd
Number of SWRO Trains	4 (3+1)	Trains
Number of BWRO Trains	3 (3+0)	Trains
Materials (bolds, nuts, washers, anchors, support systems)	316 SS	
Chloride Tolerance – Feed	24,000	mg/L Chloride
Chloride Tolerance - Concentrate	43,000	mg/L Chloride
Max Number of Stacked Vessels	10	Vessels
Frames and brackets	Epoxy coated carbon steel	

1. Includes first pass SWRO, feed pump, ERD, ERD booster pump, cartridge filters, and all parts in contact with raw seawater.
2. Includes ERD, first pass concentrate piping, first pass concentrate systems and any and all parts in contact with SWRO concentrate.

7.5 First Pass SWRO

The first pass in each train will utilize seawater RO (SWRO) membranes remove the majority of dissolved constituents found in the raw seawater. The design criteria for the First Pass SWRO are shown in **Table 7-4**.

Table 7-4: First Pass SWRO Design Criteria

Description	Proposed	Units
SWRO Lead Permeate Flow, per train	2.0	mgd
SWRO Lag Permeate Flow, per train	1.3	mgd
Recovery	45%	percent
Average flux rate	8.6	gfd
Maximum feed pressure	760	psi
Vessels per Train	138	Vessels
Allowance for extra vessels	14	Vessels
Elements per pressure vessel	7	elements
Chemical compatibility	Sulfuric acid Threshold Inhibitor	
Concentrate Disposal	Concentrate Outfall	

1. Occurs during the following conditions: Average feed water quality from Table 1 in Appendix 2, Attachment 2 in the RFP, temperature of 12 °C and and Year 5 (average element age of 4 years).
2. Frames will accommodate space and piping for an additional 10% of membranes.

7.6 Second Pass BWRO

Lag permeate from the SWRO trains will be collected and sent to the BWRO trains, in order to meet finished water quality goals. The design criteria for the Second Pass BWRO are shown in **Table 7-5**.

Table 7-5: Second Pass BWRO Design Criteria

Description	Proposed	Units
BWRO Permeate Flow, per train	1.2	mgd
Recovery	90%	percent
Average flux rate	14	gfd
Vessels per Train – 1st Stage BWRO	20	Vessels
Vessels per Train – 2nd Stage BWRO	8	Vessels
Allowance for extra vessels – BWRO	2	Vessels
Elements per pressure vessel	7	elements
Maximum feed pH	10	pH
Chemical compatibility	Sodium Hydroxide Threshold Inhibitor	
Concentrate Disposal	Recycled to SWRO feed (ahead of cartridge filters)	

1. Frames will accommodate space and piping for an additional 10% of membranes.

7.7 RO Membrane Elements

The RO elements in the first pass will be Toray TM820L-400 elements. These are Toray's low energy seawater membranes. The second pass membranes are TM720-440 membranes; Toray's low pressure brackish water RO membranes. Desalcott Plant at Point Lisas Industrial Estates in Trinidad, operated by WASA of Trinidad and Tobago, has successfully used TM820 and TM720 elements since 2002.

Each element shall be factory tested by the manufacturer, under the manufacturer's standard published test conditions, and shall meet the performance stated in the manufacturer's standards. Owner reserves the right to have their representative observe factory testing at any time during regular testing. Each element shall meet or exceed the specified salt rejection defined in the membrane manufacturer's data sheets. Certified test data shall be provided to and accepted by the Owner prior to shipment.

- Certified test data shall include:
    - Element serial number
    - Feed flow
    - Recovery
    - Productivity
    - Rejection

The design criteria for the RO elements are shown in **Table 7-6**.

Table 7-6: Membrane Element Design Criteria

Description	Proposed	Units
First Pass Salt Rejection	99.8%	percent
First Pass Boron Rejection	92% at pH 8	percent
Second Pass Salt Rejection	99.7%	percent
Element size (first and second pass)	8	inch diameter
Element Square Footage (First Pass)	400	square feet/element
Element Square Footage (Second Pass)	440	square feet/ element

7.8 RO Pressure Vessels

The RO pressure vessels shall be pressure rated and stamped in accordance with the ASME Boiler and Pressure Vessel Code – Fiberglass Reinforced Pressure Vessels. Pressure vessels shall be coated with an ultraviolet light resistant coating. Each vessel shall be tested at the manufacturer's facility. A certified copy of the test data shall be submitted and approved by the Owner prior to shipment.

The design criteria for the RO pressure vessels are shown in **Table 7-7**.

Table 7-7: RO Pressure Vessel Design Criteria

Description	Proposed	Units
SWRO Pressure Vessels Rated Working Pressure	1,200	psi
BWRO Pressure Vessels Rated Working Pressure	400	psi
Feed Port Location	Vessel sidewall	
Concentrate Port Location	Vessel sidewall	
First Pass Vessel Port Material	Super Duplex Stainless Steel	
Second Pass Vessel Port Material	High Grade Stainless Steel	

7.9 RO First Pass High Pressure Pumps

The RO First Pass HP pumps will be capable of supplying sufficient pressure to the Pass 1 RO skids under a range of conditions, as discussed in Section 7.2, RO Model Runs. In order to accommodate these varying conditions, the high pressure pumps must utilize variable frequency drives (VFD).

Each RO First Pass HP pump shall be factory testing, at a dedicated test facility, complying with the latest version of the Hydraulic Institute/American National Standard for Rotodynamic Pumps for Hydraulic Performance Tests (HI Standard 14.6). The measurement accuracy shall be Grade 1 as defined by HI Standard 14.6. Pump performance test acceptance grade shall be 1E.

Factory testing shall be performed on actual equipment to be furnished to the job site and shall be performed at a minimum of five flows.

Pump tests shall verify initial performance of new pumps and shall include measurements of:

- Flow
- Head

- Power input to the pump or test motor
- NPSH

Test reports shall include:

- Test data sheets
- Performance test logs
- Equipment performance curves
- Separately indicate equipment guaranteed operating points, including efficiency

Certified factory testing for the RO First Pass HP pump motor shall include:

- Dielectric test on armature
- Insulation resistance
- No load current at rated voltage
- Efficiency and power factor calculated at 100% of full load, at full load speed
- Locked rotor current
- Overspeed test
- Winding resistance
- Balance
- Bearing inspection

The design criteria for the RO First Pass HP pumps are shown in **Table 7-8**.

Table 7-8: RO First Pass HP Pumps Design Criteria

Description	Proposed	Units
Pump Type	Horizontal Multistage Centrifugal	
Efficiency at Design Point	82%	percent
Material of Construction	Super Duplex Stainless Steel	
Variable Frequency Drive (VFD)	Yes	
Installed Units	4 (3+1)	units
Flow per Unit	3.4	mgd

As discussed in Section 7.11, below, the size of the RO First Pass HP pumps is minimized by the utilization of energy recovery devices.

7.10 RO Second Pass Pumps

Permeate from the First Pass will not provide sufficient pressure to operate the Second Pass; therefore the Second Pass skids must be provided with additional pumps. Because the Second Pass has lower feed salinity and uses brackish membranes, the pressure demands on the Second Pass are much lower than the RO First Pass HP pumps. As with the RO First Pass HP pumps, the varying feed conditions (temperature and salinity) will affect the pressure requirements across the Second Pass, requiring the use of a VFD. Testing shall be as listed for the RO First Pass HP pumps.

The design criteria for the RO Second Pass Pumps are shown in **Table 7-9**.

Table 7-9: RO Second Pass Pumps Design Criteria

Description	Proposed	Units
Pump Type	Horizontal Centrifugal	
Efficiency at Design Point	72%	percent
Material of Construction	316 SSL	
Variable Frequency Drive (VFD)	Yes	
Installed Units (6.4 mgd Design)	3 (3+0)	units
Flow per Unit	1.4	mgd
Max Pressure	250	psi

7.11 Energy Recovery Device

Energy recovery devices (ERDs) are used to capture the residual pressure available in the concentrate stream to pressurizing a portion of the feed flow, reducing the flow through the high pressure pumps, and therefore the overall horsepower of the high pressure pumps. See **Figure 7-1** for a schematic.

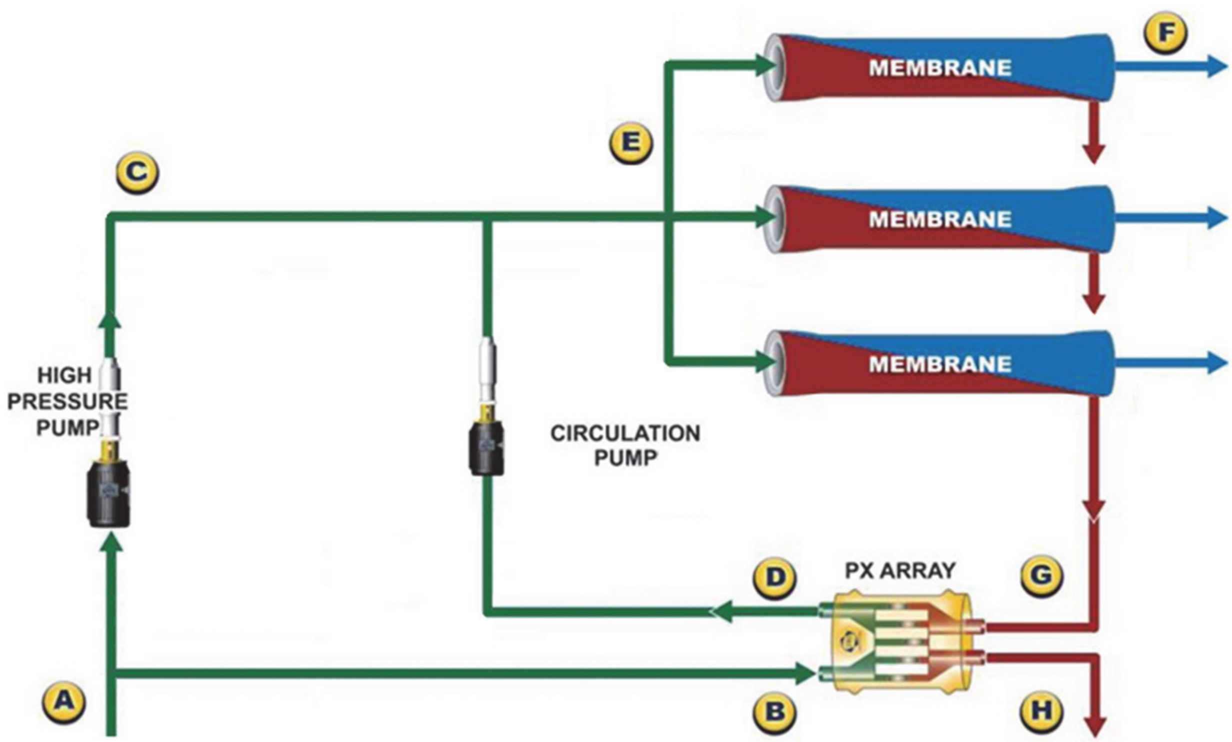


Figure 7-1: Positive Displacement Device (courtesy of Energy Recovery, Inc.)

The feed flow is split into two streams, Stream C is sent through the high pressure feed pumps and Stream B travels to the ERD. Low pressure feed water and high pressure concentrate enter the device and pressure energy is transferred from the concentrate to the feed water. Feed water leaves the device at high pressure and concentrate leaves at low pressure. Because the energy is transferred hydraulically, the efficiency is very high, up to 98%. To make up for friction losses through the RO membrane feed-concentrate channels and through piping, small booster (also called circulation) pumps are installed on Stream D. Some mixing between the First Pass Concentrate and Feed Water will occur, projected to be approximately 2.8%, based on the ERI model. Conductivity meters on the Feed Water entering and leaving the ERD will provide continuous monitoring of mixing.

A reference list for ERI is provided in **Appendix D**.

The design criteria for the ERD are shown in **Table 7-10**.

Table 7-10: ERD Design Criteria

Description	Proposed	Units
Type of ERD	Positive Displacement	
Number of ERD Units per Train	10	units
Expected Lifetime	25	years
Minimum Efficiency	95%	percent
Mixing	2.8%	percent
Feed Flow (Stream B) per Train	3.9	mgd
Pressure Provided (at max pressure conditions)	980	psi

In order to accommodate pressure losses from the RO membranes and pressure lost in the ERD units, small booster pumps are provided for ERD unit. Due to varying pressure requirements in Pass 1 RO, the ERD Booster Pumps will need to utilize a VFD. The design criteria for the ERD Booster Pumps are shown in **Table 7-11**.

Table 7-11: ERD Booster Pumps Design Criteria

Description	Proposed	Units
Material of Construction	Duplex Stainless Steel	
Pump Type	Horizontal Multistage Centrifugal	
Seal type	Mechanical	
Lubrication	Pumped fluid	
Efficiency at Design Point	67%	percent
Variable Frequency Drive (VFD)	Yes	
Installed Units	4 (3+1)	units
Flow per Unit	3.9	mgd
Max Boost Pressure	65	psi

7.12 RO System Piping and Valves

The RO system will generally be comprised of two types of piping, low pressure and high pressure. Information of the locations, designations, type of pipe and type of valves can be found in **Table 7-12**.

Table 7-12: RO System Piping and Valves

Type	Locations	Designation	Pipe	Valves 6" and Smaller
Low Pressure	Ahead of first pass pump, All permeate, First pass concentrate after ERD, CIP lines	18	FRP ASTM D2996, Filament-wound, socket and spigot ends, adhesive bonded	Plastic lined, flanged
High Pressure	After first pass pump, First pass feed after ERD, First pass concentrate ahead of ERD, After second pass pump, Second pass concentrate,	38	Duplex stainless steel	Duplex stainless steel

Interconnecting piping manifolds for the RO trains shall include connections to:

- Feed line
- Permeate line
- Concentrate line
- CIP feed line
- CIP return line
- Flush feed line
- Flush return line
- Waste lines

Backflow prevention will be provided for CIP waste, CIP recirculation and flush waste lines, per CDPH requirements.

Sample ports shall be provided as follows:

- Permeate sample ports on each vessel, such that a probe tube may be passed through for profiling and sampling within the vessel.
- Sample port panel for each train
    - Feed for each train
    - Concentrate for each train
    - Interstage for each train

For ease of maintenance, side ported vessels shall be used. Feed, concentrate and permeate manifolds shall be vertical. Piping shall be run at the ends or alongside the trains in easily accessible pipe trenches. All horizontal runs shall be located beneath trench grating. The system shall be designed such that permeate backpressure cannot exceed the concentrate pressure by more than 5 psi.

7.13 Flush System

Combined permeate (lead permeate from Pass 1 and permeate from Pass 2 will be sent to the Flush Tank. In order to provide proper sanitization of the Flush Tank, a biocide hookup will be provided on the inlet to the Flush Tank.

Two flush pumps will be capable of providing permeate to each First Pass and Second Pass skid and to the Clean-in-Place (CIP) system. The flush system is sized to flush the entire RO system, including the ERDs. The flush system will be plumbed to allow flushing of each train independently, allowing for individual train shutdown and separate flushing for the first and second passes. The first pass can be flushed either through the ERD or through the first pass pumps. Each train shall be provided with flush feed connections, automated flush supply and waste valves. Flush feed connections shall be placed in close proximity to the train itself, without excess piping.

Permeate flushes will occur automatically through the RO PLC whenever the system is shut-down or can be performed manually by the operators. There will be two shutdown flush modes, one when normal power is available, and one when only emergency power is available. During normal shutdown flush, where power is available to the ERD Booster Pump, flush water will be pumped to the low pressure inlet to the ERD. The ERD Booster Pump will continue to operate, pumping flush water from the ERD through the high pressure feed piping, the SWRO membranes, the high pressure concentrate piping, and then out through the spinning ERD units. Seawater will also be displaced from the RO First Pass HP pump during this process as flush water passes through the pump and to drain. The normal flush will provide a very effective flush of the entire RO system with no water hammer or pressure pulsations.

In the case where only emergency power is available, a pressure dump valve on the high pressure concentrate line to the low pressure concentrate discharge line will be opened. The start of the flush pump is delayed until the pressure in the concentrate line drops below the recommended dead head pressure of the flush pumps. At that point, the flush pumps will turn on and permeate will flow through the RO First Pass HP pumps, through the SWRO membranes and out the dump valve. Flush water will also be directed to the low pressure inlet to the ERD, where it will flow through the ERD and to the low pressure concentrate outfall. When pumped at a flowrate near the design concentrate flow rate, this will cause the PX to spin and displace the seawater. This will displace the seawater from the PX units. The HP piping between the SWRO skid and the ERD system, and ERD recirculation pump will not be flushed during the emergency flush.

The design criteria for the Flush Pumps are shown in **Table 7-13** and the design criteria for the Flush tank are shown in **Table 7-14**.

Table 7-13: Flush Pump Design Criteria

Description	Proposed	Units
Pump Type	Horizontal End Suction	
Variable Frequency Drive (VFD)	No	
Installed Units	2 (1+1)	units
Flow per Unit	1,400	gpm
Target Head	115	ft

Table 7-14: Flush Tank Design Criteria

Description	Proposed	Units
Type	Glass Lined	
Number of Tanks	1	each
Volume	120,000	gallons

7.14 Clean-in-Place System

Periodically, the RO membranes will require chemical cleaning to remove fine particulates and other fouling materials that accumulate on the surface of the membranes over time during the routine operation of the RO system. Fouling is evidenced by a decline in mass transfer coefficient (MTC) or an increase in feed-side pressure differential. Membrane elements should be cleaned whenever:

- The normalized permeate flow drops by 10%.
- The normalized salt content of the product water increases by 10%.
- The differential pressure (feed pressure – concentrate pressure) increases by 15% from the reference conditions (initial performance established during the first 24 to 48 hours of operation).
- More than 6 months has passed since a CIP was conducted.

The CIP solutions will be prepared by mixing cleaning chemicals with RO permeate in the RO CIP tank. Chemicals that are anticipated to be used in the typical chemical cleaning process are:

- EDTA
- Sodium hydroxide
- Citric acid
- Sodium bisulfite
- Sulfuric acid

If needed, Sodium Lauryl (Dodecyl) Sulfate is an additional cleaning option.

Chemicals will be added to the CIP recirculation line, which takes water from the CIP tank, passes it through the CIP pumps and returns it to the CIP tank. While the RFP recommends the installation of a submersible mixer in the CIP tank, MWH has elected to remove this mixer from the Alternative Design. Mixing will be provided in-line, and the elimination of this mixer will result in capital and operational cost savings. Once a solution of the desired temperature and chemical make-up is reached, the CIP solution will be sent to the section of RO to be cleaned. The CIP will involve several soak and recirculation steps, and each stage must be cleaned independently to avoid transfer of foulants from one stage to another (e.g. first pass, second pass first stage, and second pass second stage should each be cleaned independently); therefore the piping and valving are designed to allow for cleaning of each pass and each stage individually.

The CIP system shall be manually initiated. The CIP system shall be permanently installed and will include the CIP pumps, the CIP tank, tank heater, and a cartridge filter. While the RFP recommends the use of block and bleed valves shall be used at connections between the CIP system and each RO train in order to provide separation for CDPH compliance, MWH has proposed to use drop out pieces of pipe.

An LCP will be provided for the CIP system, located in the CIP area at four feet above the building floor. The LCP shall display:

- Temperature
- pH
- Pump status
- Flow

- Pressure

The design criteria for the CIP Pumps, Cartridge Filters and Tank are shown in **Table 7-15**, **Table 7-16**, and **Table 7-17**.

Table 7-15: CIP Pump Design Criteria

Description	Proposed	Units
Pump Type	Horizontal End Suction	
Variable Frequency Drive (VFD)	No	
Installed Units	2 (1+1)	units
Flow per Unit	2,650	gpm
Target Head	120	ft

Table 7-16: Cartridge Filter Design Criteria

Description	Proposed	Units
Number of Filters	1	UNITS
Maximum Flow per Unit	2,650	gpm
Cartridge Length	40	Inch
Filter Orientation	Horizontal	
Filter Element Rating	5	micron
Chemical Compatibility	Suitable for pH between 2 to 12	

Table 7-17: CIP Tank Design Criteria

Description	Proposed	Units
Chemical Compatibility	Suitable for storage of pH 2 to 12	
Type	Fiberglass Reinforced Plastic	
Number of Tanks	1	number
Volume	12,000	gallons
Heater Design Criteria	Raise CIP solution to 45 °C in 8 hours or less	
Heater Power	200 kW	
Mixer Type	Provided through pumps	

7.15 Neutralization Tank

Waste from the RO CIPs will be sent to the Neutralization Tank to be neutralized with either sulfuric acid or sodium hydroxide, depending on the CIP solution used. Mixing will be provided by the Neutralization Pumps, which can either recirculate through the tank or discharge to a truck for offsite disposal. Neutralized waste will be sent to the waste water treatment plant. A level monitor and high level switch shall be provided to monitor the neutralization tank level and alarm on high level. The design criteria for the Neutralization Tank are shown in **Table 7-18**.

Table 7-18: Neutralization Tank Design Criteria

Description	Proposed	Units
Type	Fiberglass Reinforced Plastic / HDPE	
Number of Tanks	1	each
Volume	17,000 usable	gallons

7.16 RO Membrane Storage and Preservation

The CIP system will also be used for membrane preservation. In the event that an RO train is not operated for more than 24 hours, the train must be flushed with the RO permeate flush system, and then preserved using the CIP system with a sodium bisulfite to prevent the formation of a biofilm on the membrane surface.

7.17 RO System Control and Instrumentation

The RO system shall be controlled by a programmable logic controller ("PLC") based control system, as follows:

- The PLC shall be Allen Bradley and shall communicate with treatment plant instrumentation and control system over data highway.
- An operator graphical interface will be provided to communicate with the system.
- At a minimum, the following information for the RO system feed (downstream of cartridge filter(s)) shall be provided:
    - Temperature
    - Conductivity
    - pH
    - Turbidity
    - Flowrate
    - Pressure
    - ORP

The RO system shall be designed to operate at a constant permeate flow rate. At a minimum, the following information for each RO train shall be relayed to the main plant control system:

- Train Status
- First Pass Feed:
    - Pressure
    - Flowrate
- Second Pass First Stage Feed:
    - Pressures (before and after feed pump)
    - Flowrate
    - Temperature
    - Conductivity
    - pH
- Second Pass Second Stage Feed
    - Pressure
    - Flowrate

  - Conductivity
  - pH

- First Pass Permeate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- Second Pass First and Second Stage Permeate:
  - Pressure
  - Flowrate
  - conductivity
  - pH
- Second Pass By-pass:
  - Pressure
  - Flowrate
- Combined Permeate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- First pass concentrate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- Second pass second stage concentrate:
  - Pressure
  - Flowrate
  - Conductivity
  - pH
- Combined concentrate:
  - Flowrate
  - Conductivity
  - pH
  - Turbidity
  - Temperature
- Differential Pressure (Train, Passes and Stage)
- Feed, Permeate, and Concentrate Valve Positions
- RO Feed Rate and Calculated Recovery Rate
- Alarm Condition for RO Feed Pumps and Energy Recovery Device
- Energy Recovery Device Flowrates, Pressures, and Conductivities of all streams

RO feed temperature, conductivity, and pH shall be monitored at a common influent location. The capability for real-time online normalization shall be provided, for at least specific flux, differential pressure, and conductivity. Sufficient sample points shall be provided on the process system to allow the operator to determine the performance of the RO system. Each stage of multistage trains shall be instrumented. As discussed in 7.12 RO System Piping and Valves, a common monitoring location for RO feed parameters will be provided.

7.18 Spare Parts

A spare parts list can be found in **Appendix E**.

7.19 Special Tools

Any special tools that are necessary for maintenance of the system or for the removal and replacement of membrane elements shall be provided.

A single element test unit shall be provided at the plant for testing of individual membrane elements. The single element test unit shall meet the following requirements:

- The unit shall include a 5-micron cartridge filter, high pressure feed pump, and one 8-inch single element pressure vessel, and instrumentation.
- The unit shall be capable of operating up to 1200 psi.
- A concentrate recycle line shall be included.
- Instrumentation shall be panel mounted, and include instruments for monitoring:
    - Raw feed pressure
    - Post-cartridge filter pressure
    - Permeate pressure
    - Pressure differential across the single element pressure vessel
    - Feed flow
    - Permeate flow
    - Recycle flow
    - Concentrate flow
    - Feed conductivity
    - Permeate conductivity
    - Concentrate conductivity

Sample ports shall be provided for at least the RO feed water (before and after the concentrate recycle line), permeate, and concentrate flows.

7.20 Factory Testing

Factory tests shall be conducted on all actual equipment to be furnished to the job site. Test reports shall be provided to the Owner documenting the performance of each piece of equipment. Equipment guaranteed operating points shall be indicated.

7.21 RO System 14-Day Run-In Test

The 14-Day Run-In Test (Run-In Test) for the installed membrane system shall be tested for 14 days; MWH shall be fully responsible for every aspect of the performance test. The testing protocol shall include, as a minimum, water quality sampling parameters, sampling locations, projected dates of the performance testing, laboratory for the water sample analysis, and time of sampling relative to time zero. Time zero for the membrane system performance testing is the time of the first sample.

As applicable to the equipment furnished, the ROEM shall state in writing that all necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities are ready for startup and intended operation.

After the Design-Build Improvements are operating, but prior to initiation of the 14-day run-in test, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to plant startup. This shall include verification of proper membrane element installation by conducting a conductivity profile on the pressure vessels of each RO train while the train is operating.

- MWH personnel shall conduct the profiles by sampling permeate from the sample valves on each pressure vessel within a given train.
- Those vessels not meeting pre-established conductivity criteria shall be opened up by MWH and examined for proper installation of end connectors and element interconnectors, damaged o-rings, misaligned concentrate seals, and other like causes.
- Any observed deficiencies shall be corrected by MWH and the vessel retested.

Minimum prerequisites prior to initiation of the 14-Day Run-In Test include the following:

- Successful completion of the performance tests for the reverse osmosis trains.
- Completion of membrane element loading and checkout for the reverse osmosis trains.
- Completion of initial startup operations, including successful completion of performance testing on remaining equipment items as specified herein.

Successful checkout of the RO system and performance testing of related ancillary systems shall constitute grounds for substantial completion of the RO system and allow it to proceed to the Acceptance Test.

The test shall be considered complete when, in the opinion of the Owner, the complete treatment system has operated in the manner intended at plant design capacity for 14 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere.

A significant interruption will require the test then in progress to be stopped and restarted after corrections are made. Significant interruption may include any of the following events:

- Failure of Design-Builder to maintain qualified on-site startup personnel as scheduled.
- Failure of any equipment item or treatment subsystems furnished by MWH to meet specified performance requirements for more than 2 consecutive hours.
- Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
- Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
- As may be determined by the Owner.

The following events will not be considered cause for significant interruption:

- Loss of feedwater delivered to the RO System for reasons beyond the control of MWH.
- Loss of power to the plant for reasons beyond the control of MWH.
- As may be determined by the Owner.

At the end of the 14-day run-in test, MWH's representative shall prepare a test report which shall include daily operating and normalized performance data for each day of the test, for each RO train and the system as a whole.

The membrane trains shall be tested under the following conditions. These conditions must be maintained during the entire performance test.

1. Membrane feed water quality shall be as listed in the Projected and Required Water Characteristics table.
2. Water recovery
    a. 45% in Pass 1
    b. 90% in Pass 2
    c. 44% Overall
3. Permeate Flow
    a. 1388 Pass 1 Lead Permeate
    b. 926 Pass 1 Lag Permeate
    c. 834 Pass 2 Permeate
4. The use of threshold inhibitor in the first stage feed.
5. The use of sodium hydroxide in the second stage feed, if required to meet finished water quality requirements.

The following continuous data shall be collected hourly unless otherwise indicated:

6. Water Quality:
    a. First pass feed temperature
    b. First pass feed turbidity
    c. First pass feed Silt Density Index, once per day
    d. First pass feed conductivity
    e. First pass feed pH
    f. First pass lead permeate conductivity
    g. First pass lag permeate conductivity (feed to second pass)

h. First pass concentrate conductivity

i. First pass concentrate pH

j. Second pass feed pH

k. Second pass, first stage permeate conductivity

l. Second pass, second stage permeate conductivity

m. Interstage conductivity

n. Second pass concentrate conductivity

o. Second pass concentrate pH

7. Mechanical Data

a. First pass feed pressure

b. ERD discharge pressure

c. First pass lead permeate pressure

d. First pass lag permeate pressure

e. First pass concentrate pressure (before ERD)

f. First pass concentrate pressure (after ERD)

g. Second pass feed pressure

h. Second pass interstage pressure

i. Second pass concentrate pressure

j. Second pass permeate pressure

k. First pass feed flow

l. First pass lead permeate flow

m. First pass lag permeate flow

n. First pass concentrate flow

o. Second pass concentrate flow

p. First pass feed flow control valve position

q. Second pass feed flow control valve position

r. First pass concentrate flow control valve position

s. Second pass concentrate flow control valve position

During two of the sampling events, the ROEM shall sample the permeate from each pressure vessel for conductivity. The samples may be analyzed with a properly calibrated field instrument instead of analysis at a laboratory.

The ROEM shall produce and submit a formal bound report for all testing activities. The report shall contain detailed test plans and results for all activities performed during testing. Results from all testing shall be tabulated, trended, and graphed as appropriate. Discussion of testing, along with conclusions and recommendations, shall be presented in the test report. Laboratory analysis data shall be bound into the report as appendices.

7.22 RO System Performance Warranty

MWH shall warrant all components of each RO train supplied against defects in materials and workmanship in accordance with Article 6 of the Design-Build Agreement. This warranty shall state the following provisions with no additional conditions or exceptions:

- Each RO train shall produce the minimum permeate flow rate at the overall recovery and design parameters (44% overall recovery) while treating water at or below the maximum feed water quality parameters provided Section 3.0, and meeting the product water quality parameters specified in Section 4.0.
- The maximum recovery per pass shall be 45 percent for the first pass, and 90 percent for the second pass.

MWH shall furnish a separate warranty for the RO membrane elements. This warranty shall be a pass-through type, directly between the manufacturer and the Owner. This warranty must be signed by an individual authorized to execute contracts on behalf of the membrane manufacturer and shall state the following provisions with no additional conditions or exceptions:

- The membrane elements supplied under these specifications shall be warranted by the manufacturer to be free of liens and encumbrances, and against defects in materials and workmanship for a period of twelve (12) months in accordance with Article 6 of the Design-Build Agreement.
- The manufacturer shall warrant the performance of the membrane elements for a period of three (3) years from completion of the Acceptance Tests described in Appendix 7 (the "Extended Membrane Warranty Period"). The manufacturer shall guarantee the membrane elements during the Extended Membrane Warranty Period in accordance with the performance requirements specified herein and the following prorated replacement conditions if the elements fail to meet the warranted performance:
    - The elements shall at all times during the Extended Membrane Warranty Period have a minimum flow of 90 percent of the minimum product flow specified on the membrane manufacturer's specification sheet for the elements furnished when tested at standard conditions as defined herein.
    - During the Extended Membrane Warranty Period, the element salt passage shall not exceed one hundred and fifty percent (150%) of the maximum salt passage specified on the membrane manufacturer's specification sheet for the elements furnished when tested at standard conditions as defined herein.

- At all times during the Extended Membrane Warranty Period, when the system is operated with feedwater consistent with the conditions applicable for the RO system in Table 1 in Attachment 2 of Appendix 2:
    - Each RO train shall require no more than 1000 psi feed pressure to the first pass to produce design permeate capacity.
    - The RO permeate from each train shall meet both the maximum-average and not-to-exceed concentrations for boron, chloride bromide and sodium listed in **Section 4.0**.

The warranty conditions specified above shall be valid under the following conditions:

- Each RO train has been operated as designed in terms of product water recovery, flux, array configuration, and feedwater pH.
- The feedwater does not contain chemicals that chemically or physically destroy the elements.
- The membrane elements are periodically cleaned with an effective cleaning solution to remove colloidal matter inherent in ocean water.
- The membrane elements are cleaned using standard cleaning solutions prior to performance testing for warranty purposes.
- Biological matter or sparingly soluble substances in the feedwater have not irreversibly fouled the membrane elements.

Should the RO train performance not meet the warranty requirements, the membrane element manufacturer shall provide sufficient replacement elements to achieve the specified train performance. The replacement elements will be provided at the current market price, less a credit of 1/36 of the purchase price for each unused month of the Extended Membrane Warranty Period. The manufacturer shall guarantee that future replacement elements will be sold to the Owner at a price not to exceed $650 per 8-inch 40-inch element at any time within three years from acceptance of each RO train.

7.23 RO Building Size

The only building footprint with a significant change due to the alternative design is the RO building. With fewer trains and taller skids, the length of the building would be reduced by 50 feet. If the building is expanded in the future, additional SWRO Trains would be added to the northwest side of the building and additional BWRO Trains would be added to the southeast side of the building.

Table 7-19: RO Building Size

Production	Length (ft)	Width (ft)	Height (ft)
Baseline 9.6mgd	295	88	18
Alternative 9.6 mgd	245	88	20

8.0 HANDLING OF TREATMENT RESIDUALS

The Project will produce a wide range of types and volumes of liquid and solid residuals which require handling and disposal. This section discusses these residuals and the MWH approach to addressing these within the Project guidelines.

8.1 Plant Drain System

A plant drain system will be provided to collect waste streams from secondary containment systems including sand separator units, cartridge filters, storage tanks, pumping systems, chemical dosing systems, and chemical unloading areas. These waste streams will discharge to a plant drain lift station, from where they will be pumped to the concentrate discharge line (pipeline to MRWPCA).

8.2 Type of Residuals

The types of residuals to be handled and disposed of at the Project Site are summarized in **Table 8-1**.

Table 8-1: Residuals Summary

Residual Stream	Disposal Method	Frequency of Disposal
First Pass RO Concentrate	Pipeline to MRWPCA	Continuous
Second Pass RO Concentrate	Recycled to Upstream of Cartridge Filters	Continuous
Sand Separator Flush Waste	Purge to Plant Drain System; Pipeline to MRWPCA	Continuous (Based on Frequency of Flushing)
CIP Waste, Neutralized	Neutralization Holding Tank; Trucking Offsite (to MRWPCA)	Intermittent
Sample Steams	Purge to Plant Drain System; Pipeline to MRWPCA	
Sanitary Waste	Leachfield	Continuous; Variable
Special Laboratory Waste	Discharge through Neutralization Holding Tank; Trucking Offsite (to MRWPCA)	Intermittent; Not to Exceed More than Twice per Year

8.3 RO Concentrate Disposal

Concentrate flows from the first pass RO systems will be conveyed to the MRWPCA site via a pipeline and disposed of via the existing MRWPCA outfall (pipeline beyond the Project Site boundary by others). MWH has elected to remove the concentrate equalization lagoon in the proposed Alternative Design. Based on the information provided regarding the hydraulic capacity of the existing outfall, it is highly unlikely that the MRWPCA outfall will have insufficient capacity. In addition, with a proposed capacity of 3,000,000 gallons, and a concentrate flow of approximately 12.3 mgd, the concentrate equalization pond would only provide approximately 6 hours of storage, after which storage in the lagoon would be unavailable.

Aeration of the concentrate to achieve outfall oxygen conditions will be accomplished with the use of an air compressor downstream of the concentrate pump discharge.

Concentrate flows from the second pass RO system will be recycled to a point upstream of the cartridge filters.

9.0 PRODUCT WATER STABILIZATION

The RO permeate needs to be chemically treated to achieve desired concentrations of hardness, alkalinity and TDS as well as optimal pH, in order to produce a finished water that is compatible with CAW's other drinking water supplies and that is low in corrosive properties. CAW's existing drinking water also has zinc orthophosphate added to it for corrosion control within the distribution system, and the Project needs to provide the ability to add phosphate as well as other chemicals to adjust hardness, alkalinity and pH. Finished water quality goals are presented in **Table 4-1**.

Chemicals planned to be added to the finished water to achieve stabilization of finished water quality include:

- Lime
- Carbon dioxide

Provisions will be made to add zinc orthophosphate per CAW requirements.

The MWH's design of these chemical systems provides a wide range of dosing and operating capacity to achieve a wide range of finished water quality objectives.

To achieve the finished water stabilization goals for pH, alkalinity, and LSI a system must be designed to meet variable water conditions. Alkalinity requires an increase to between 40 and 100 mg/L as $CaCO_3$, which requires an addition of 30 to 75 mg/L as $Ca(OH)_2$. pH requires an adjustment to between 7.7 and 8.7, which requires an addition of 30 to 90 mg/L of CO_2.

For the tables below, the lowest cost operating strategy is proposed.

The following tables present the lime and carbon dioxide dosage and usage rates based on a minimum alkalinity and LSI conditions per the Finished Water Requirements (Appendix 2 – Attachment 3). Annual cost evaluation will be based on chemical usage (lb/day) for the 9.6 and 6.4 mgd flows. The carbon dioxide system will require a 7,200 lb/day carbon dioxide feeder. A sidestream for carrier water and a pumping system requiring approximately 5 HP at 75 gpm (two [2] pumps operating in a 1+1 configuration). The same size pumps will be used for both the 9.6 and 6.4 mgd capacity alternatives.

Table 9-1: Estimated Post-Treatment Hydrated Lime (as $Ca(OH)_2$) Usage

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Peak Flow @ 9.6 mgd Capacity	11.2	30	2,802
Maximum Flow @ 9.6 mgd Capacity	9.6	30	2,402
Average Flow (Maximum Flow @ 6.4 mgd Capacity or Average Flow at 9.6 mgd Capacity)	6.4	30	1,601

1. Used for calculation of annual cost evaluation

Table 9-2: Estimated Post-Treatment Carbon Dioxide Usage

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Peak Flow @ 9.6 mgd Capacity	11.2	30	2,802
Maximum Flow @ 9.6 mgd Capacity	9.6	30	2,402
Average Flow (Maximum Flow @ 6.4 mgd Capacity or Average Flow at 9.6 mgd Capacity)	6.4	30	1,601

1. Used for calculation of annual cost evaluation

MWH is proposing to dose liquid lime slurry at a concentration of 45%. Four (4) 12,000 gallons tanks will store the liquid lime slurry at a set concentration prior to dosing. The tanks will include a mixing system in order to keep the slurry solids from settling. The design criteria for the Lime Slurry System are shown in **Table 9-3**.

Table 9-3: Lime Slurry System Design Criteria

Description	Proposed	Units
Number of Lime Slurry Storage Tanks	4	each
Volume of Lime Slurry Storage Tanks (each)	12,000	gallons
Materials of Construction of Lime Slurry Storage Tanks	Carbon Steel	
Finished Water Lime Slurry Dosing		
Number of Pumps	2	each
Dose	30	mg/L
Concentration	45	%
Type	Peristaltic Hose Pumps	
Flow Control	VFD	

10.0 DISINFECTION REQUIREMENTS

Disinfection requirements for the Project are well-documented in the RFP and Appendix 2. Although there are two distinct disinfection alternatives for the Project which require different treatment methods, MWH has elected to use chlorine addition to achieve the required disinfection goals.

10.1 Source Water Characterization

Until the proposed new slanted beach wells can be installed, tested and made operational, the evaluation of the source water per LT2ESWTR cannot be completed. If the source water is determined to be under the direct influence of surface water, then the potential for a higher level of disinfection exists. Also, until the selected RO system is installed and the removal of salt/TDS can be demonstrated, the potential for a higher level of disinfection exists.

10.2 Disinfection System Design Criteria

2-log of *Cryptosporidium* removal will be achieved via RO. Disinfection following RO will include:

- Minimum 1.0-log inactivation of *Giardia* using free chlorine
- Minimum 4.0-log inactivation of viruses using free chlorine

The *Giardia* inactivation requirement with free chlorine is usually greater than the virus inactivation requirement, and the finished water storage tanks (referenced below) will provide the required chlorine contact time. The design criteria for the Disinfection System are shown in **Table 10-1**.

Table 10-1: Disinfection System Design Criteria

Description	Proposed	Units
Cryptosporidium Treatment Required	2	log
Meet with RO Membranes	2	log
Giardia Treatment Required	3	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	1	log
Virus Treatment Required	6	log
Meet with RO Membranes	2	log
Meet with Chlorine Disinfection	4	log

11.0 FINISHED WATER STORAGE

The finished water storage element of the Project provides many functions including disinfection and flow balancing prior to finished water pumping and conveyance. The detention time in the tanks may also serve to allow finished water quality/chemistry to stabilize after post-RO chemicals are added. Water flows under pressure from the RO system through the post-RO stabilization system before flowing into the storage tanks.

11.1 Design Criteria

CAW requires two 750,000 gallon tanks to operate in series when both tanks are in service for the 9.6 mgd capacity alternative. During infrequent periods when a tank will be inspected, cleaned and maintained, only one tank will be in service, and the tanks' inlet and outlet piping design accommodates these requirements. With a single tank in service, the plant's operating conditions may need to be adjusted (compared to two tanks in service) to comply with disinfection requirements. The design criteria for the Finished Water Storage Tank are shown in **Table 11-1**.

Table 11-1: Finished Water Storage Design Criteria

Description	Proposed	Units
Number of Tanks	2	each
Volume of Tanks (each)	750,000	gallons
Diameter	76.5	ft
Height (Straight Side)	22	ft
Minimum Water Level	2	ft
Maximum Water Level	21.8	ft
Materials of Construction	Factory Epoxy Coated Bolted Steel	
Level Control	Continuous with Independent High Level Switch	

11.2 CT Compliance

The free chlorine contact time provided in the tanks is adequate to meet the *Giardia* and virus inactivation requirements per the RFP and Appendix 2. MWH has proposed the use of baffles or another alternative method within the Finished Water Storage Tanks to achieve a baffling factor of 0.5; the basis for final design will be selected based on computation fluid dynamics (CFD) modeling. When one of the tanks is out of service for various reasons (infrequent occurrence), plant operations will likely need adjustments compared to a two (2)-tank operational scheme. CT compliance has been calculated based on control, not a fixed volume of water; this will allow CAW flexibility in operation. Operational adjustments may include:

- Maintaining a high water level in the tank with less variation in depth
- Increasing the chlorine residual
- Operating a lower production capacity

11.3 Controls and Appurtenances

Each finished water tank will be provided level monitoring and high-level switches/alarms. Each tank will have an independent drain without creating a cross-connection. Each tank to be provided with two (2) secure points of access (sidewall and top). Each tank to be provided with its own overflow system to handle the maximum influent flow and with features to limit the opportunity for tampering. Each tank to be provided with vent(s) properly sized for inlet and outlet flows, screened, highly corrosion resistant and secured against tampering.

12.0 SALINAS VALLEY DESALINATED WATER RETURN PUMPING AND CONVEYANCE

A portion of the finished water will be pumped from the Finished Water Storage Tanks to the Salinas Valley groundwater basin via the Castroville Seawater Improvement Project (CSIP). The pumped water will be conveyed in a 1.2-mile, 12-inch diameter pipeline from the Project Site to the existing CSIP pond (80 acre-feet storage capacity) at the southern end of the MRWPCA regional WWTP. MWH will design-build the 12-inch pipeline from the finished water pump station to the property boundary.

Two (2) pumps will be installed in a "1+1" installation with a rated capacity of 850 gpm (1.2 mgd) each with a TDH of 30 feet. The pumps will be horizontal, end-suction pumps installed on an outdoor concrete pad adjacent to the four (4) finished water pumps that deliver water to the Monterey distribution system. Both pumps will be equipped with VFDs and all electrical equipment will be located inside the Electrical Switchgear Building. Power metering will be provided for these pumps.

The pump system will be equipped with electrically-actuated butterfly valves at the pump inlet, check valves on the pump outlet and manual isolation valves on the pump outlet. The common pump discharge line will be provided with an above-ground flowmeter. An on-line conductivity analyzer will be installed on the discharge line also. An air gap is provided on the discharge to eliminate backflow concerns. The design criteria for the Salinas Valley Desalinated Water Return Pumping and Conveyance System are shown in **Table 12-1**.

Table 12-1: Salinas Valley Desalinated Water Return Pumping and Conveyance Design Criteria

Description	Proposed	Units
Number of Pumps	2 (1+1)	each
Flow	850	gpm @ 30 ft
Flow Control	VFD	
Pump Horsepower (each)	10	HP
Type	Horizontal, End Suction	
Water Quality Monitoring	Conductivity	

13.0 FINISHED WATER PUMPING AND PRESSURE TRANSIENT CONTROL

The water stored in the two Finished Water Storage Tanks will be pumped to the Monterey distribution system via a 24-inch diameter pipeline with a maximum HGL of 425 feet. These pumps will be co-located outdoors on a concrete pad with the Salinas Valley supply pumps as discussed above. The electrical motor starters are located inside the Electrical Switchgear Building. Power metering will be provided for these pumps. MWH will design-build the 24-inch pipeline from the finished water pump station to the property boundary.

Four (4) pumps total will be installed as described below:

- Two (2) pumps at 50% design capacity, both with constant-speed (with soft-starters) drives (3,350 gpm each with a TDH of 350 feet)
- Two (2) pumps at 25% design capacity, both with VFDs (1,675 gpm with a TDH of 350 feet)

The electrical and controls design allows for three (3) of these pumps to operate simultaneously including the two (2) large pumps plus one (1) small pump. Each small pump discharge line will have its own flowmeter and there will also be a larger flowmeter installed on the common pump discharge line. All flowmeters shall be above-ground. Each pump will be provided with a hydraulically-actuated (water) ball valve (pump control valve) with 2-speed closure time. The valves are designed for a maximum 14 fps velocity through a full-open valve. Opening/closing times will be determined via the transient study discussed below. Each pump will have a manually-actuated butterfly valve downstream of the pump control valve, as well as a manually-actuated valve on the discharge side of the pump. Other pump and piping appurtenances are included in the design such as air release valves, pressure gages and transmitters, motor controls and protective devices.

The finished water pumps will be horizontal, split-case centrifugal pumps installed adjacent to the two (2) Salinas Valley pumps which are discussed above. A mobile A-frame gantry is also being furnished with a manual chain, rated for the largest pump and motor.

A single 25,000-gallon hydropneumatic surge tank will be installed and connected to the discharge of the finished water pumps, to protect against damage to the piping systems in case of un-planned pump shutdowns. The volume of the surge tank will not change for the 6.4 mgd finished water production capacity alternative. MWH will perform a hydraulic transient analysis of the proposed pumping and piping systems (including the downstream transmission and distribution systems) to recommend the appropriate transient control method(s) and system(s). An air compressor will be provided for surge tank operation. An air compressor will be provided for surge tank operation. The design criteria for the Finished Water Pumping System are shown in **Table 13-1**.

Table 13-1: Finished Water Pumping Design Criteria

Description	Proposed	Units
Hydraulic Grade Line		
Maximum	425	feet
50% Design Capacity		
Number of Pumps	1+1	each
Type	Horizontal, Split Case Centrifugal	
Drive	Constant Speed	
Flow (9.6 mgd Finished Water Capacity)	3,350	gpm @ 350 ft
Horsepower (9.6 mgd Finished Water Capacity)	400	HP
VFD	No	
25% Design Capacity		
Number of Pumps	2	Each
Type	Horizontal, Split Case Centrifugal	
Drive	Variable Speed	
Flow (9.6 mgd Finished Water Capacity)	1,675	gpm @ 350 ft
Horsepower (9.6 mgd Finished Water Capacity)	200	HP
VFD	Yes	
Flow Meters	One (1) on each small pump; One (1) common	
Surge Tank		
Number of Tanks	1	each
Volume	25,000	gallons
Type	Hydropneumatic	

14.0 YARD PIPING AND VALVES

MWH will comply with the requirements for yard piping outlined in the RFP and Appendices. The Design-Build Team will perform the analyses to specify required parameters for yard piping, such as routing, verification of materials of construction, pressure rating etc., necessary for successful completion of the project. The project team will verify minimum separation between the yard piping and any electrical services equipment, such as transformers and switchgear. Currently, this minimum separation is 25 feet. In addition, the project team will identify such parameters as minimum cover; minimum horizontal and vertical separation between the piping with different services; identification of permit requirements, if necessary; and others. A piping schedule has been developed as is presented in Drawing No. GI-3.

14.1 Raw/Saline Water

Raw water piping shall be HDPE. For below ground installation, pressure rating is less than 100 psi.

14.2 Permeate

Permeate piping, prior to stabilization, shall be HDPE pipe below grade and 316L stainless steel or FRP above grade. Valves shall be as listed for Finished Water.

14.3 Finished Water

- Finished Water piping may be ductile iron pipe, steel, or HDPE. Ductile iron pipe is generally preferred on the treatment Project Site.
- Ductile Iron Pipe shall be Class 52 on the Project Site.
- Valves less than 12 inch pipe size shall be resilient seated gate valves; valves 12 inches and larger shall be butterfly type.
- Valves shall open LEFT.
- Valves shall be provided with valve box and lid. A concrete collar shall be poured at the top of the valve box. A stainless steel valve identification tag shall be embedded in the concrete collar listing the Valve ID, type of valve, and number of turns.
- CIP Waste piping shall be double wall CPVC for below grade installation.

14.4 Chemicals

Liquid chemicals shall be run underground within flexible HDPE tubing, or other type tubing or hose compatible with the specific chemical. The tubing or hose shall be run within a HDPE carrier pipe providing support and secondary containment. Each HDPE pipe shall have only one length of tubing to allow for ease of replacement. Chemical piping/tubing shall be run together, to the extent possible. The HDPE carrier piping is to be intentionally sloped to pull boxes. Pull boxes, constructed of pre-cast concrete, shall be located no less than 100 ft intervals along the route of the piping. Each pull box shall be equipped with a level sensor to detect chemical leakage. Splices in tubing are to be minimized. Where splices are necessary, they shall be made within a pull box. The top of pull boxes shall be above ground to prevent surface water entry, and shall be equipped with an aluminum cover. Door frame drain shall be piped to a dry well.

15.0 PROCESS PIPING AND VALVES

15.1 Pipe Schedule

The MWH Pipe Schedule will be used during design (as presented in Drawing No. GI-3). The Schedule will list all fluid services used in the project and the corresponding suitable piping materials. The Pipe Schedule will be complemented by piping specification Sections that will provide additional requirements.

Piping material shall be carefully selected to suit each service type and working pressure. High pressure piping shall be constructed of steel. Interior surfaces of ferrous piping shall be lined as applicable for the service. Exposed exterior piping surfaces shall be coated.

All above-ground piping shall be provided with adequate supports.

15.2 Valve Schedule

The MWH Valve Schedule will be used during design. The schedule will include size of valve, type of valve (e.g. butterfly, swing check, ball, gate, plug, etc.), type of actuator (e.g. manual, pneumatic, electric, hydraulic, etc.), pressure rating, type of connections (e.g. flange, wafer, etc.), and applicable specification Section. Valves that are supplied by equipment vendor will not be listed.

1. Valves for saline water (<100 psi) shall be nylon coated steel butterfly.
2. Valves for saline water (>100 psi) shall be superduplex plug.
3. Valves for permeate water shall be nylon coated steel butterfly.
4. Valves for permeate water following stabilization shall be resilient seated gate valves (<12 inch) or butterfly valve (>12 inch).
5. Valves for finished water shall be resilient seated gate valves (<12 inch) or butterfly valve (>12 inch).
6. Shut-off valves for clean water shall be butterfly, gate, or ball valves. Shut-off valves for solid bearing liquid shall be plug valve. Shut-off valves 6-inch and larger with actuators with position indicators. Manual shut-off valves mounted higher than 7 feet above the working level shall be provided with chain actuators.
7. Gate valves 18-inch and larger, or where chain wheel is required, shall be provided with spur gear and hand wheel.
8. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions.

Corrosion resistant valves shall be used for chemical service. Valve bodies and wetted surfaces shall be constructed of PVC, CPVC, stainless steel or other corrosion resistant materials.

15.3 Chemical Piping

Chemical piping shall be corrosion resistant, suitable for the service. Non-metallic materials, such as PVC, CPVC, or HDPE offer superior corrosion resistant and shall be used as applicable. Stainless steel material shall be considered for chemical services where plastic piping are not suitable. Corrosion resistant flexible tubing or hose may be used for chemical lines that are ½" or smaller.

Outside of the chemical containment area, chemical piping shall be provided with double containment piping system with leak detection devices. When located in outdoor areas, secondary containment piping will be HDPE small bore (without joints). When located indoors, secondary containment piping will be HDPE fused. As much as possible, chemical lines shall be routed in a trench, which are not to exceed 100 feet in length. Each trench will be equipped with a level indicator and an alarm. Overhead routing of chemical lines shall be minimized.

In general, CVPC piping shall be installed above ground with true-union ball valves. Butterfly valves shall be close coupled to bulk storage tanks for isolation purposes.

16.0 GENERAL PUMPING EQUIPMENT REQUIREMENTS

16.1 Pump Selection

Pump design shall follow Hydraulic Institute (HI) standards. Quantity and size of pumps for a particular service shall be selected to meet the specified design and maximum flow and head conditions. A system head curve shall be prepared for each pumping stage, and pump performance shall be shown against the system head curve. A standby pump shall be provided as required. Pumps shall be selected to optimize efficiency. For pumps with multiple operating points, the pumps shall be selected such that their best efficiency point (BEP) is at or near the operating point where the pumps operate most of the time. All operating points shall be within the pump manufacturer's allowable operating range (AOR). Variable frequency drives (VFDs) shall be used as applicable. For pumps with a single operating point, pump efficiency shall be optimized at this point. A constant speed drive shall be used for such application. Pump shall be selected such that the maximum nominal synchronous speed does not exceed 1800 rpm. Selection for smaller pumps with low horsepower may be up to 3600 rpm.

Material selection for wetted pump components, such as casing, impeller, shaft, wear rings, shall be carefully selected for suitability with the fluid being pumped or pumpage. Internal coating of the casing shall be suitable for the pumpage. Any materials that come in contact with water shall be listed as NSF 61 compliant and shall prevent dezincification. Bronze materials shall be lead-free.

16.2 Motor Selection

The most common type of motors used for pumping equipment are polyphase, squirrel cage induction motor. The horsepower rating of the motors shall be greater than the maximum horsepower required by the pump. The maximum speed of the motor shall match the maximum speed of the pumps. All outdoor motors shall be provided with totally enclosed fan cooled (TEFC) or weather protected (WP) enclosures. Indoor motors may be provided with open drip proof (ODP) enclosures. Motors that are smaller than 0.5 HP shall be 120V to 240V, single phase. Motors that are 0.5 HP to 500 HP shall be 460V, three phase. Motors that are greater than 500 HP shall be 5,000V, three phase.

16.3 Pump Station Design

Design of pump stations must consider suction and discharge piping configuration, maintenance access around equipment, and clearances required for equipment removal. Pumps may be installed indoor or outdoor. Adequate ventilation equipment and sound attenuation system shall be provided as required. Emergency stop pushbuttons shall be locally provided at each pump.

For the design of the pumps, the maximum allowable suction velocity shall be 5 fps. The maximum allowable discharge velocity shall be 14 fps at the pump discharge nozzle. Typical piping velocities are expected to be no more than 9 fps at ultimate plant capacity.

A separate electrical room to house the electrical equipment shall be provided. The electrical room shall be provided with air conditioning system that will provide sufficient cooling to the electrical equipment.

16.4 Piping and Pipe Joints

Pipe materials shall be suitable for the fluid and pressure conditions. Suction piping is critical in pump operation and must be carefully designed. Suction piping shall be sized for 3 to 5 feet per second (fps) velocity in accordance with the Hydraulics Institute (HI) recommendations. The minimum straight length of suction piping shall be 5 times the pipe diameter. An isolation valve shall be provided in the suction piping.

The discharge piping from each pump shall be provided with a check valve and an isolation valve unless Client specifies otherwise. Swing check valve is commonly used for pump discharge application. Pressure and flow instruments shall be provided as necessary.

Dismantling joints with restraint system shall be provided at the suction and discharge piping to facilitate removal of pumps and valves for repair, replacement and future piping modifications. Suction and discharge piping shall be provided with adequate supports and should not impose any load to the suction and discharge flanges of the pump.

16.5 Vibration Control

Pumps should not experience vibration issues if they are operated within the manufacturer's AOR, provided with proper suction piping design, and installed in accordance with the manufacturer's standards. The concrete base for each pump shall be designed for a minimum of 4 times the weight of the rotating element.

17.0 ROTATING EQUIPMENT MONITORING

Temperature and vibration sensors shall be provided in pumps that are 200 HP and larger.

Temperature

- Motor windings, motor bearings and pump bearing temperature sensors shall be provided and continuously monitored through 100 ohm platinum RTD's and input to Schweitzer Engineering Laboratories (SEL) devices provided for power monitoring and motor protection. Values will be available for trending and monitoring through the CAW Business Network.

Vibration

- Vibration data is to be gathered and made available for off-site analysis through the Internet.
- Online vibration data collection system is to be provided based on multichannel continuous processor. Locate processors in a suitably protected area. Provide enclosures suitably rated for the environment in which they are installed.
  - Manufacturer: Ludeca
  - Model: Vibnode
  - Dynamic Range: 96 dB 16 bit A/D converter
  - Frequency Range: 2-1000 Hz
  - Frequency Resolution: 3200 lines
  - RPM Tracking
  - Measurement Functions
    - Fast Fourier Transform (FFT)
    - Time signal
    - High frequency envelope FFT
    - Overall values
    - Narrow and broadband alarms
    - Process parameters
  - Band Analysis: 12 bands per spectrum
  - High Frequency Enveloping: band pass filters for low, medium and high speed machines

    - Digital Ouput: for external trigger
    - Analog Output: 4-20 ma
    - Digital Output: 5-30 volt
    - Ethernet capable
    - Licenses as needed

- 15 minutes UPS on power supply to multichannel processor and monitoring devices
- Protection of multichannel processor and monitoring devices from electric transients including lightning
- Analysis Software
    - OMNITREND software from Ludeca
    - Band analysis capable
    - Narrowband and broadband alarm capable
    - Real time overall values
    - Email alarm capable
    - Built in reporting features
    - Web based for remote access
    - Built in fault frequency markers
- Local personal computers
    - Processor: 4G RAM; 2.5 GHz
    - USB and Ethernet ports
    - 24 inch monitor
- Tachometer
    - Inductive type from Ludeca
    - Suitable for outdoor installation

- Accelerometer
  - Installation will be coordinated with pump vendor, and per CAW's recommendations. Device shall be suitable for outdoor installation.
- Cabling
  - Cables from sensors to multi-channel monitor shall be of the type and length with connectors needed for each application. Cables shall be provided by CTC. Cables shall be installed in conduit where physical protection is needed.
- Device Driver
  - Device driver shall be provided.
- On-site Commissioning
  - A minimum of 2 days of on-site startup service with Ludeca application engineer will be provided.

18.0 CHEMICAL SYSTEMS

The Project includes a variety of chemicals for water treatment purposes. The proposed design follows the outline as presented in Appendix 2 of the RFP. This section presents the basis of design for these chemical systems including storage and feeding. Chemicals for post-stabilization and for cleaning of the RO membranes are addressed above. In comparison to the Base Project design, the Chemical Storage and Feed Facilities will decrease in size due to the removal of sodium bisulfite and non-ionic polymer from the treatment train, and due to the proposed delivery of sodium hypochlorite in liquid form rather than on-site generation.

The chemicals addressed in this section include:

- Sodium hypochlorite for oxidation and disinfection
- Sulfuric acid for pH depression prior to the cartridge filters
- Threshold inhibitor to inhibit scale formation in the RO membranes
- Sodium hydroxide for pH adjustment
- Zinc orthophosphate or phosphoric acid for corrosion control

All of these chemicals are delivered/stored as liquids and all chemical systems are located within the Chemical Storage and Feed Facilities. Selected cleaning chemicals for the RO membranes are located within the RO Building.

All chemical storage and feed systems (including off-loading areas) are contained for spill and leak prevention. All chemical tanks are manufactured of HDXLPE as manufactured by PolyProcessing.

Diaphragm metering pumps are heavy-duty, motor driven with reliable performance and turndown. Insulation and heat tracing are provided where freeze protection is required.

MWH is not including any day tanks for chemicals stored in bulk tanks. Working with numerous clients in California in recent years has convinced us and operators that day tanks are an un-necessary expense.

18.1 Sodium Hypochlorite

Sodium hypochlorite is added to the RO effluent after post-stabilization chemicals are added and upstream of finished water storage tanks, in order to carry a free chlorine residual for disinfection and into the finished water conveyance piping. Sodium hypochlorite is also used for membrane cleaning/neutralization, but the usage is low and therefore not included in these calculations. Use of 12.5% liquid sodium hypochlorite is anticipated via bulk tanker truck deliveries to the Project site. This solution can be diluted to 6% if desired by CAW, but this will require the storage tanks to be upsized. The design criteria for the Sodium Hypochlorite System are shown in **Table 18-1**.

The sodium hypochlorite system includes the following elements:

- One (1) sodium hypochlorite solution tanks, each with a minimum capacity of 12,000 gallons; tanks shall be HDXLPE with IMFO-type outlets.
- Two (2) sodium hypochlorite solution dosing pumps for post-treatment dosing (1+1) at 2 mg/L maximum dose; pumps will be seal-less magnetic drive gear pumps with variable speed drives.

- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point
- Sodium hypochlorite feed control system for 1) local-manual, 2) remote-manual, 3) remote flow-pace and 4) remote compound loop using chlorine residual feedback control.

Table 18-1: Sodium Hypochlorite System Design Criteria

Description	Proposed	Units
Number of Sodium Hypochlorite Solution Tanks	1	each
Volume of Sodium Hypochlorite Solution Tanks (each)	12,000	gallons
Materials of Construction of Sodium Hypochlorite Solution Tanks	HDXLPE with IMFO-type outlets	
Post-Treatment Sodium Hypochlorite Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	2	mg/L
Type	Seal-less Magnetic Drive Gear	
Flow Control	VFD	

Table 18-2: Estimated Sodium Hypochlorite Usage at 12.5% Solution Strength

Flow Condition	Post-Treatment		
Scenario	**Flow (mgd)**	**Dose (mg/L)**	**Chem Usage (lb/day)**
Average Flow / Maximum Dose	9.6	2	160
Maximum Flow / Average Dose	11.2	1.5	140
Average Flow / Average Dose	9.6	1.5	120

18.2 Sulfuric Acid

The sulfuric acid system provides the ability to reduce the pH of the pre-treated water upstream of the RO cartridge filters for optimum RO performance. Use of 50% liquid sulfuric acid solution is anticipated via bulk tanker truck deliveries to the Project site. The design criteria for the Sulfuric Acid System are shown in **Table 18-3**.

The sulfuric acid system includes the following elements:

- One (1) sulfuric acid solution tank, with a minimum capacity of 6,000 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Two (2) sulfuric acid solution dosing pumps (1+1) at 30 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi
- Continuous dilution water system added downstream of metering pumps, pressurized utility water, at a flow rate of 2 gpm maximum for each feed point
- A pH meter downstream of the cartridge filters will provide feedback control to maintain proper dose to ensure optimum pH is achieved

The bulk tank will have butterfly valves on all outlets with lever actuators. The sulfuric acid piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 18-3: Sulfuric Acid System Design Criteria

Description	Proposed	Units
Number of Sulfuric Acid Solution Tanks	1	each
Volume of Sulfuric Acid Solution Tanks (each)	6,000	gallons
Materials of Construction of Sulfuric Acid Solution Tanks	HDXLPE with IMFO-type outlets	
Sulfuric Acid Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	30	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
pH Meter	Downstream of Cartridge Filters	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 18-4: Estimated First and Second Pass RO (Pre-Cartridge Filter) Sulfuric Acid Usage at 50% Solution Strength

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	21.9	30	5,479
Maximum Flow / Average Dose	25.5	10	2,127
Average Flow / Average Dose	21.9	10	1,826

18.3 Threshold Inhibitor

The inhibitor system provides the ability of the RO membranes to operate properly by minimizing/controlling scale formation and is added to both passes of the RO system. Use of 100% liquid threshold inhibitor solution is anticipated via bulk tanker truck deliveries to the Project site. The design criteria for the Threshold Inhibitor System are shown in **Table 18-5**.

The inhibitor system includes the following elements:

- One (1) threshold inhibitor solution tank, with a minimum capacity of 6,000 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Four (4) threshold inhibitor solution dosing pumps, two (2) for first pass RO dosing (1+1) at 6 mg/L maximum dose, and two (2) for second pass RO dosing (1+1) at 6 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi

- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point

The bulk tank will have butterfly valves on all outlets with lever actuators. The threshold inhibitor piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 18-5: Threshold Inhibitor System Design Criteria

Description	Proposed	Units
Number of Threshold Inhibitor Solution Tanks	1	each
Volume of Threshold Inhibitor Tanks (each)	6,000	gallons
Materials of Construction of Threshold Inhibitor Tanks	HDXLPE with IMFO-type outlets	
First Pass RO Threshold Inhibitor Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	6	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Second Pass RO Threshold Inhibitor Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	30	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 18-6: Estimated Threshold Inhibitor Usage at 100% Solution Strength

Flow Condition	Pre-Cartridge Filter			Second Pass RO		
Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	21.9	6	1,096	4.6	6	230
Maximum Flow / Average Dose	25.5	3	638	5.4	3	135
Average Flow / Average Dose	21.9	3	548	4.6	3	115

18.4 Sodium Hydroxide

The sodium hydroxide system provides the ability to adjust the pH of the second pass RO permeate feed. Use of 50% liquid sodium hydroxide solution is anticipated via bulk tanker truck deliveries to the Project site. Sodium hydroxide is also used for membrane cleaning/neutralization, but the usage is low and therefore not included in these calculations. The design criteria for the Sodium Hydroxide System are shown in **Table 18-7**.

The sodium hydroxide system includes the following elements:

- One (1) sodium hydroxide solution tank, with a minimum capacity of 6,000 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch
- Two (2) sodium hydroxide solution dosing pumps for second pass RO dosing (1+1) at 20 mg/L maximum dose; pumps will be diaphragm-type with discharge pressure < 30 psi.
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point.
- A pH meter upstream of the second pass RO feed and on the finished water discharge will provide feedback control to maintain proper dose to ensure optimum pH is achieved.

Table 18-7: Sodium Hydroxide System Design Criteria

Description	Proposed	Units
Number of Sodium Hydroxide Solution Tanks	1	each
Volume of Sodium Hydroxide Solution Tanks (each)	6,000	gallons
Materials of Construction of Dilute Sodium Hydroxide Solution Tanks	HDXLPE with IMFO-type outlets	
Second Pass RO Sodium Hydroxide Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose	20	mg/L
Type	Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
pH Meter	Downstream of Cartridge Filters	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 18-8: Estimated Sodium Hydroxide Usage at 50% Solution Strength

Flow Condition	Second Pass RO		
Scenario	**Flow (mgd)**	**Dose (mg/L)**	**Chemical Usage (lb/day)**
Average Flow / Maximum Dose	4.6	20	767
Maximum Flow / Average Dose	5.4	10	450
Average Flow / Average Dose	4.6	10	384

18.5 Zinc Orthophosphate / Phosphoric Acid Corrosion Inhibitor

The phosphate system provides the ability to add corrosion inhibitor to the finished water, if the Owner decides to use this form of corrosion control. The system is designed to store/feed either of two liquid chemicals which will be delivered to the site in bulk tanker trucks 1) 32.5% zinc orthophosphate or 2) 75% phosphoric acid. The design criteria for the Zinc Orthophosphate System are shown in **Table 18-9**.

The phosphate system includes the following elements:

- One (2) solution tank, with a minimum capacity of 6,000 gallons; tank shall be HDXLPE with an IMFO-type outlet, along with fill, overflow and vent nozzles and nozzle for an ultrasonic level sensor and high-level switch.
- Two (2) solution dosing pumps (1+1) at 4 mg/L maximum dose (as PO4); pumps will be solenoid drive diaphragm-type with discharge pressure < 30 psi.
- Continuous dilution water system added downstream of metering pumps, using pressurized utility water, at a flow rate of 2 gpm maximum for each feed point.

The bulk tank will have butterfly valves on all outlets with lever actuators. The solution piping shall be CPVC in above-ground applications and flexible PVC tubing (inside secondary containment HDPE pipe) in buried applications.

Table 18-9: Zinc Orthophosphate/Phosphoric Acid System Design Criteria

Description	Proposed	Units
Number of Zinc Orthophosphate/Phosphoric Acid Solution Tanks	1	each
Volume of Zinc Orthophosphate/Phosphoric Acid Solution Tanks (each)	6,000	gallons
Materials of Construction of Zinc Orthophosphate/Phosphoric Acid Solution Tanks	HDXLPE with an IMFO-type Outlet	
Zinc Orthophosphate/Phosphoric Acid Solution Dosing		
Number of Pumps	2 (1+1)	each
Dose (as Zinc Orthophosphate)	4	mg/L
Type	Solenoid Driven Diaphragm-Type with Discharge Pressure <30 psi	
Flow Control	VFD	
Dilution Water System		
Type of Water Used	Pressurized Utility Water	
Flow Rate	2	gpm

Table 18-10: Estimated Zinc Orthophosphate Usage at 38% Solution Strength

Scenario	Flow (mgd)	Dose (mg/L)	Chemical Usage (lb/day)
Average Flow / Maximum Dose	9.6	4	320
Maximum Flow / Average Dose	11.2	1	93
Average Flow / Average Dose	9.6	1	80

19.0 ARCHITECTURE

This section describes the architectural basis of design for all Design-Build improvements. The design criteria include the design philosophy, standards and principles, and design data to be used to carry out the preliminary and detailed design.

19.1 Code Requirements

- 2013 California Building Code
- 2013 California Fire Code
- American's with Disabilities Act (ADA)
- Occupational Safety and Health Administration (OSHA)
- Local code amendments and ordinances

19.2 Design Philosophy

The architectural design will be developed in character, style, form, color and materials to harmonize effectively with the surrounding environment.

Construction materials and methods will be selected based on their physical appearance and overall visual effect in harmonizing with the surrounding environment, their emergence from the basic structural system, and their appropriateness in accommodating the deployment of mechanical and electrical systems within the facility. Materials used in the construction of the Design-Build Improvements will conform in composition and application to all applicable regulations, including those concerning volatile organic content, lead, mercury, CFCs and asbestos. Materials used for the roofing system and the building perimeter envelope will be established for optimum durability over the full range of climatic variations typical to the region and functions contained within.

The Design-Build Improvements should be kept as low in profile as is functionally possible. Where appropriate, the design will de-emphasize verticality and encourage the grounding of planar elements of the Design-Build Improvements into the natural landscape. Low, horizontal site walls, berming, and the use of sloping wall planes will be considered in achieving balance.

Visible and highly reflective materials and surface finishes will be avoided on the exterior of the Design-Build Improvements.

Exterior walls will use low-maintenance indigenous materials such as masonry and concrete for the Design-Build Improvements. Pre-engineered metal buildings may be used for specific buildings. Surface textures and horizontal banding of harmonious colors are some of the techniques to be used in blending the Design-Build Improvements with its environment. Integral material coloration will be used were possible with limited use of applied coloration such as paint.

The design of roof systems will be carefully developed to harmonize with the visual context of the Design-Build Improvements. Where flat roofs are appropriate, they will be predominately hidden by parapet walls. Where pitched roofs are desired, consideration will be given to selecting, pitch, materials, and coloration to harmonize with surroundings. Highly reflective roof materials will not be visible from adjacent properties. Mansard and jogging roof lines will be employed only when appropriate to the setting. The use of securable skylights will be used for natural interior lighting.

Where windows are appropriate to the design, they will be energy-efficient, low-maintenance durable material, providing acoustical protection, and security. Glazing systems will be designed to be limit reflectivity and glare from sunlight. Glass tinting and window frame colors will be chosen for their consistency with the palette of materials and colors selected for the Design-Build Improvements.

Louvers, insets, grills, trim material, and accents will be employed judiciously and only where functionally necessary or appropriate for compatibility with adjacent structures. Character, style, form, color and materials of louvers, insets, grills, trim, and accents will be of low maintenance durable materials consistent with the color palette chosen for the facility to harmonize effectively with the surrounding environment.

Doors and frames will be low-maintenance durable materials of colors compatible with the wall surface in which they are located.

Exterior lighting will satisfy functional and security needs while not creating light pollution in the form of point sources of direct glare visible from a distance. Lighting will be sensitive to the privacy of adjacent land uses. Fixtures will be carefully selected for efficiency, cutoff, consistent lamp coloration throughout the project, and effectiveness in delivering only the light necessary to the task, while avoiding unnecessary spill lighting beyond site boundaries. Low level light fixtures that light immediate areas are encouraged.

As a proposed alternative, natural lighting of building interiors may be provided by use of skylights and clerestory windows.

All exterior mounted mechanical and electrical equipment will be located and screened from public view.

19.3 Anticipated Structures

The major structures anticipated are listed below.

1. Administration Facilities
2. RO Building
3. Chemical Storage and Feed Facilities
4. Electrical Switchgear Building

19.3.1 Administration Facilities

The building for the administration facilities is conceived as a simple, flexible structure that seamlessly engages the desalinization plant's infrastructure and reflects its sustainable mission. Sited off the main entry / access road, the Administration Facilities will serve as the plant's control and lab, as well as the public face of the overall facility. The building is intended to demonstrate, elegantly and subtly, a sustainable and resilient approach to building design, construction and operations as well as a sensitivity to the site and surrounds. The interior planning and materials will reflect the precepts of biomimicry and sustainability.

The plan will incorporate load bearing perimeter CMU walls that support a long span system of open web trusses to allow for a column-free plan and maximum flexibility in interior space planning. The exterior CMU walls will add significant thermal mass to the design and will reduce mechanical heating / cooling needs, provide a durable exterior envelope, and will be locally sourced.

The plan of the building has been shaped and oriented to best take advantage of views, daylighting autonomy, and natural ventilation. The narrow rectilinear shape of the building primarily faces south toward the main entry of the facility and the southern sunlight. The building is placed back, away from the entry drive, providing space for short term and visitor parking, a demonstration garden, and a more generous public entry experience.

The building will reduce its energy demand with its use of good building envelope design and proper window placement, thus minimizing the dependency on artificial lighting and mechanical ventilation and cooling. Daylighting strategies will be maximized including high performance glazing, strategically placed Solartubes, and interior glazing that will optimize daylight transfer and good views for the Administration Facilities occupants. Solartubes, placed in the locker rooms, toilet rooms, and maintenance area, will bring natural light to these interior spaces that do not have direct access to a window. Additionally, roof mounted PV's and solar water heaters will augment the building's electricity costs and reduce mechanical equipment sizes and required spaces. Natural ventilation will be achieved through the use of operable windows and a fan assist system. Potable water use will be reduced by capturing storm water for irrigation. Green (vegetated) roofs will be designed to reduce storm water runoff, increase building thermal capacity, and support diversity and a restorative habitat.

To make evident the story of the client's mission, the building will incorporate environmental graphics and signage that describe the importance of water in this specific region of the State, how the plant serves to conserve potable water, and the specific sustainable features of the building.

19.3.2 RO Building

Materials of construction for the walls and roof will be established for optimum durability based on the exterior and interior environment.

Electrical equipment such as switchgear and large motor starters will be located in a room separate from the RO trains and piping.

RO piping will be run in trenches to provide ready access to the RO systems.

Trenches will be sized to allow access to piping, pipe connections, and pipe supports for inspection, repair, and replacement.

Overhead doors will be provided to allow pumps, RO membranes, and other equipment to be removed/replaced.

Center hallway will be adequately sized for a forklift and scissors lift to allow for maintenance and replacement of RO membranes.

19.3.3 Chemical Storage and Feed Facilities

Liquid chemicals will be stored in a building to provide security and protection of tanks, pumps, piping, and ancillary devices from the elements.

Generally, each chemical will be located in a separate room to provide corrosion protection and avoid the potential of mixing of incompatible chemicals.

Each room will be provided with required lighting and HVAC.

Secondary containment is to be provided for liquid chemical storage. The chemical equipment (tanks, metering pumps, etc.) will be located on the lower level. Stairs will provide access from the access way to the lower level of each room.

Non-hazardous chemicals, such as polymers, may be located in a common area. Secondary containment will be provided with a depressed (two to four inches deep) area covered with FRP grating flush with the surrounding floor.

Fire suppression will be provided per CBC, CFC, NFPA and local requirements.

19.3.4 Electrical Switchgear Building

Structural elements of the Electrical Switchgear Building are summarized in **Section 20.0.**

19.4 Building Schedule

The building schedule, which includes building dimensions, building materials, details on doors, windows, floor coverings, skylights, louvers, fire sprinkler requirements and a summary of what each room will contain, is presented in **Appendix F**.

Structural elements of the major buildings are summarized in **Section 20.0**.

20.0 GEOTECHNICAL AND STRUCTURAL DESIGN

The Desalination Infrastructure of the Monterey Peninsula Water Supply Project will include four building structures: Administration Facilities, RO Building, Chemical Storage and Feed Facilities, and Electrical Switchgear Building. The primary considerations for the structural design of these buildings are the close proximity to major earthquake faults, and the corrosive environment fostered by the coastal setting and primary use of the facilities. Structural foundations will be also provided for storage tanks, pump stations, cartridge filters and the concentrate equalization pond.

20.1 Design Criteria

The structures will be designed, at a minimum, in accordance with the provisions of the 2013 California Building Code (CBC), as required to obtain a building permit from the County of Monterey Building Services Department. The buildings will be assigned to Occupancy Category III as required by the CBC for "water treatment facilities for potable water…and other public utility facilities". The primary implication of the Occupancy Category III assignment is the required Importance Factors applied to seismic and wind design forces – 1.25 for seismic, 1.15 for wind – which provide for increased structural performance relative to "typical" (Occupancy Category I and II) building structures.

In addition, and in accordance with design requirements specified in the RFP, the structures will be designed in consideration of the following:

- ACI 350 "Code Requirements for Environmental Engineering Concrete Structures"
- Building Life Expectancy:
  - Reinforced Concrete Structures – 75 years
  - Administration Facilities – 50 years
  - Electrical Switchgear Building – 30 years
- Seismic Performance (during and after design-level earthquake ground motions):
  - Emergency systems to remain operational
  - Tanks containing chemicals, saline water and Finished Water to remain operational
  - Critical equipment protected from damage

20.2 Administration Facilities

The Administration Facilities will be a single-story structure, approximately rectangular in plan, with plan dimensions of approximately 130 feet by 40 feet. The roof structure will consist of steel decking spanning over steel wide-flange beams (or open-web steel joists), spaced approximately 10 feet on center. The beams/trusses will span across the 40-ft dimension of the building and be supported by perimeter CMU walls. The CMU walls will be supported on conventional shallow strip footings, and the floor construction will be concrete slab-on-grade, approximately 5 inches thick. The lateral (seismic force resisting) system will consist of the metal deck roof diaphragm and the perimeter CMU shear walls.

20.3 RO Building

The RO Building will be a single-story structure, rectangular in plan, with plan dimensions of approximately 245 feet by 88 feet. The building is expected to be a pre-engineered metal building, consisting of pitched portal/moment frames spanning across the 88-ft dimension of the building, and spaced at approximately 25 feet on center. There will be no columns in the building interior. The portal frames will support steel Z-purlin roof framing, which will support the steel roof deck. The steel columns of the steel portal/moment frames will be supported on conventional shallow spread footings. The floor construction will be concrete slab-on-grade, of varying thickness, and with depressions and trenches as required to accommodate the equipment and processes housed within the building. The lateral (seismic force resisting) system will consist of the metal deck roof diaphragm and/or horizontal braced diaphragm via steel tie rods; the portal/moment frames in the transverse building direction; and steel tie rod braced frames at discrete column bays in the longitudinal building direction.

20.4 Other Major Structures

The Chemical Feed and Storage Facilities and Electrical Switchgear Building will each be single-story structures, rectangular in plan, with approximate plan dimensions as follows:

- Chemical Feed and Storage Facilities: 100 feet by 50 feet
- Electrical Switchgear Building: 75 feet by 60 feet

The structural systems for each building will be similar to those described above for the Administration Facilities and/or RO Buildings, i.e. steel-framed roof with CMU walls or pre-engineered metal, with concrete slab-on-grade floors and shallow foundation systems.

20.5 Loading

- Loads/Roof:
    - 20 psf with tributary area reductions allowed
- Platforms & Stairs:
    - 100 psf and 300 lbs concentrated on stair tread
- Others:
    - ASCE 7-10 Table 4-1
    - Occupancy Category III OR IV if water storage facilities and pump structures required to maintain water pressure for fire suppression or if containing hazardous chemicals
- Seismic/Site Class:
    - Presumed Site class D, verify with geotechnical baseline report as may be Site class E due to adjacent River alluvial/beach soils
    - RO Plant Mapped Spectral Response Acceleration at Short Periods (0.2 sec) - 5% Damping (SS):
        - 1.585 g for Occupancy III, 1.585 g for Occupancy IV for 2013 CBC, was 1.323 g for 2010 CBC
    - RO Plant Mapped Spectral Response Acceleration at 1 second period - 5% damping (S1):
        - 0.562 g for Occupancy III, 0.562 g for Occupancy IV for 2013 CBC, was 0.595 g for 2010 CBC
    - Seismic Use Group:
        - Sds = 1.057 g for 2013 CBC, 0.882 g for 2010 CBC
    - Seismic Design Category:
        - D
    - Importance Factor (Ie):

- 1.50 for Occupancy IV, 1.25 for Occupancy III
  - Seismic Q/A Plan Required?
    - Yes
  - Structural Observations Required?
    - Yes
- Wind:
  - Base Wind Speed - 3 Second Gust (V3S):
    - 115 mph for 2013 CBC, 85 mph for 2010 CBC
  - Fastest Mile Wind Velocity (Vfm) :
    - Not applicable
  - Exposure Category:
    - C
  - Importance Factor (Iw):
    - 1.15

20.6 Geotechnical Information

Geotechnical Baseline Report (GBR) provided within the RFP documents from the URS GBR and will be supplemented where necessary by tender experience specific to the project area.

- Allowable Bearing Pressure
  - All Loads (w/ wind & seismic): Per GBR and presumed minimum of 2600 psf

- Dead plus Live Loads: Per GBR 2000 psf
- Groundwater (GW) Elevations: Per GBR provided by CAW
- Friction Factor: Per GBR and presumed minimum of 0.25 g

- Lateral Soil Pressure (Above GW and Below GW):
  - Restrained (At Rest): Per GBR by CAW
  - Unrestrained (Active): Per GBR by CAW
  - Passive: Per GBR by CAW
  - Seismic: Per GBR by CAW
  - Traffic Surcharge: Per GBR by CAW

- Total Settlement: Per GBR by CAW
- Differential Settlement: Per GBR by CAW

20.7 Structural Materials:

- Concrete:
  - 4,500 psi - STRUCTURAL (all structural applications)
  - 3000 psi - SITEWORK (curb, gutter, and civil applications)
  - 2000 psi - LEAN (unreinforced concrete (thrust blocks and encasements)

- Reinforcing:
  - Grade 60 - all applications

- Steel:
  - Structural Tubing - ASTM A500, Grade B
  - Structural Pipe - ASTM A53, Grade B
  - Wide Flange Shapes - ASTM A992

- Other Standard Shapes and Plates - ASTM A36

- Stainless Steel:
  - Type 304 - Architectural and common uses, and anaerobic conditions
  - Type 316 - Submerged or corrosive areas

- Aluminum:
  - 6061-T6 - All applications
- Masonry:
  - ASTM C 90, Medium Weight (105 to < 125 pcf), Solid Grouted:
  - Grout: 2000 psi
  - Mortar: Type S - 1800 psi
  - Size: 16" x 8" x 8" high CMU
  - f'm: 1500

- Waterstops: New Construction – TPER and/or PVC 3/8" X 6" flat strip shapes

20.8 Special Inspections and Structural Observations

Per 2013 CBC Requirements

20.9 Design Calculations, Methods and Assumptions:

- Calculations will be done in accordance with CBC. A table of contents shall be included for each set of calculations greater than five sheets long.

- All structures will be designed in accordance with sound engineering principles based on the references listed herein and by the RFP. Hydraulic concrete structures will be designed by ultimate strength and will utilize additional sanitary durability coefficients as stated in ACI 350. Durability factor and cracking need not be considered for seismic loads.

- The governing Building Department will comply by the 2013 CBC as the permit submittals will be after 12-31-2013 and per Monterey County Building Department, phone number 831-755-5208, Francisco Tanguilig, (prior to 12-31-2013 permit submittals will use 2010 CBC,) Building Department stated they will contract the plan check out the third party plan checker WC3.

20.10 Design Requirements by Reference:

- ACI-318/08 Building Code Requirements for Reinforced Concrete
- ACI-350R/06 Environmental Engineering Concrete Structures, Appendix C
- ACI-350.3/06 Seismic Design of Liquid Containing Concrete Structures
- ACI 530 Building Code Requirements for Masonry Structures
- ACI 530.1 Specifications for Masonry Structures
- AISC Manual of Steel Construction
- AISI AISI Specification for the Design of Cold-formed Steel Structural Members
- AA Aluminum Association - Aluminum Design Manual
- 2013 CBC International Code Committee (ICC) - International Building Code 2012 basis
- ASCE-7/10 Minimum Design Loads For Buildings and Other Structures

21.0 HVAC SYSTEM

The purpose of this write-up is to establish the appropriate HVAC configurations to meet the following objectives:

1. Provide an operable, maintainable and economical HVAC system design, which meets all code requirements.

21.1 Design Conditions

Outside:

- Winter: 29°F DB (ASHRAE 2%)
- Summer: 77°F DB, 63°F WB (ASHRAE .5%)

Indoor design temperatures:

- Winter: 68°F DB
- Summer: 75°F DB

California Energy Code Compliance Requirements:

- Climate Zone 3

21.1.1 General

- The Project's HVAC systems will be selected to exhibit high reliability and will be of industrial quality.
- HVAC equipment, ductwork and air distribution devices serving corrosive areas will be provided with protective coatings and/or constructed from corrosion resistant materials such as fiberglass reinforced plastic or aluminum.
- Outdoor condensing units and/or air handling units will be located adjacent to the building to be served and supported by a concrete equipment pad.
- All electric motors will be high efficiency type, where available.
- Sub-freezing temperatures at this area seldom occur and only for a few hours at a time. Local experience is that exposed water piping 1" or larger will not freeze.
- Humidity control is not required for human comfort or normal static discharge control. The typical Monterey Bay 55°F fog turns to 50% relative humidity when heated to 70°F.
- Because of the proximity to the Monterey Bay prevailing winds, similar facilities this close to the shore do not require air conditioning. The normal weather is cool and usually, only becomes warm during autumn afternoons when the Santa Anna winds come in from the east.
- Normal warm air temperature of 77°F and a presumed maximum exhaust air temperature rise of 18°F yield a space temperature of 95°F. During the few hours in the year when OSA temperature exceeds 77°F, space temperature can be expected to increase.
- Seismic restraints will be provided where required and rely on ISAT design and products.

21.1.2 MWH Design Recommendations

- Waive freeze protection and reference to humidity control criteria.
- Leave the air conditioning criteria in place.
- Unless it is determined that proposed electrical gear cannot operate at 100°F for a couple hours at a time, size exhaust fans on an 18°F temperature rise.

21.2 Energy Efficiency

All HVAC equipment will be specified to perform at or above code required minimum efficiency levels, and according to the latest rules and regulations of the US Department of Energy.

21.3 Design Codes

The following are the minimum Applicable Codes and Standards for the design of the HVAC systems:

- 2013 California Title 24 Part 4 Mechanical Code
- 2013 California Title 24 Part 5 Plumbing Code
- 2013 California Title 24 Part 6 Energy Code
- 2013 California Title 24 Part 11 Green Building Standards Code and as adapted by Monterey County

21.4 Ventilation Design

Ventilation systems will be wall or roof centrifugal exhaust fans with wall mounted louvers for intake air. In order to conserve power and match ventilation with heat load, 2-speed fans will be used or multi-fans will be used and cycled on and off.

HVAC equipment in classified areas, such as explosive environments will be selected in accordance with NFPA, Building Code, National Electric Code and/or any other local code requirements, to prevent an explosion.

Outdoor heat rejection equipment coils will be dip coated with a corrosion and moisture resistant film to prevent damage by airborne corrosive particles and fumes that may be present in the plant environment.

HVAC equipment, ductwork and air distribution devices located in corrosive areas or serving corrosive areas will be provided with protective coatings and/or constructed from corrosion resistant materials.

21.5 Noise Goals

While some equipment noise is inevitable in process spaces and mechanical rooms, noise levels will nevertheless be considered an important criterion in the design of the HVAC systems.

HVAC systems serving occupied areas will be designed to meet the average noise criteria (ANC) levels recommended by ASHRAE.

Where efficient HVAC equipment selection does not result in acceptable noise levels, sound attenuation devices such as duct silencers will be utilized to reduce noise levels.

Duct velocities will be maintained in accordance with the recommendations in the ASHRAE Applications Handbook.

Noise produced outside of the buildings will be evaluated to comply with local codes and ordinances. The evaluations will also consider the sound emission criteria for all other sources.

21.6 Ductwork Material

Ductwork design and installation shall follow the latest SMACMA standards and be appropriate for the conditions.

PVC ductwork shall be fabricated in accordance with the Sheet Metal and Air Conditioning contractors National Association (SMACNA), a manual on thermoplastic Construction when possible. All ductwork to be fabricated from Type II Grade I, Type I, Grade I and extruded Type I grade I PVC and to conform to ASTM D 1784-81, Class 12454, ASTM E 84 Flame Spread Rate 15.

21.6.1 Insulation

Ductwork conveying mechanically-cooled supply air will generally be insulated in accordance with applicable Energy Efficiency Code requirements.

All outside air intake and supply air ductwork will be insulated to prevent surface condensation from forming when the ducts are carrying cold air thru warm, moist spaces. Supply air ductwork located inside the conditioned space will not be insulated.

Internal duct liner will be used on supply, return, and exhaust ductwork where appropriate for sound attenuation and thermal insulation.

Internal duct liner will not be used on outside air intakes serving normally occupied spaces, due to the potential for growth of microorganisms in accumulated dust on the liner media.

Internal duct liner will also not be used on air conditioning ductwork where the cooling is shutoff at night, to avoid mold growth problems.

Pipes containing fluids at temperatures below ambient will be insulated with a closed cell thermal insulation.

21.7 Administration Facilities

21.7.1 Thermal Zones:

- Conference Room/Storage Room
- Laboratory
- Control Room
- Visitor (2)
- Private Offices (2)
- General Office (2)
- Maintenance/Toilet/Lockers
- IT Server

21.7.2 HVAC System Selected

Variable Refrigerant Volume (VRV) is a mature HVAC system that has its roots in the Pacific Rim where electricity is very expensive. This 5,000 FT2 building will require multiple heating and cooling zones due to exposures, load patterns and operating schedules. VRV is a sophisticated, split system air source heat pump that provides for multiple, simultaneous heating and cooling zones connected to a single outdoor condenser unit containing multiple compressors. VRV systems have routinely yielded high LEED EAc.1 points for HVAC system performance. VRV systems use R-410a.

Outdoor unit efficiencies are very high and electric strip heaters are not required when outdoor design temperatures are above -4oF. Condenser coils are factory coated for salt and corrosive protection. The outdoor unit creates condensate while in the heating mode and needs to be located where this water is not an issue, usually on a concrete pad in a landscape area.

There are several terminal units (indoor units) available including ceiling mounted cassettes, exposed wall or ceiling, and concealed fan coil units. Each indoor unit is connected by refrigerant piping to a 'branch selector' which in turn is piped to the outdoor unit. Acoustic performance is very attractive for indoor and outdoor units. Since cool air is made at each indoor unit, condensate drain piping is run from each unit to a suitable drain point.

Controls are factory, direct digital based (DDC), interconnect all units and do not require a free-standing Building Management System (BMS) to operate. A central, wall mounted 'control module gives access to all units status, set points and schedule. A BACnet or Lon talk interface can be provided at a later time allowing for BMS monitoring if required in the future. A BMS does not appear to be a project criteria.

CMC required 15 CFM/person ventilation air is provided through a dedicated outside air system (DOAS). The OSA is delivered to the individual indoor units and makes up for normal toilet exhaust.

An IT Server Room is anticipated. This indoor unit can be connected to the VRV system, or provided as a standalone cooling only system. It is anticipated that the Control Room and Lab will be a 24/7 operation, and placing the IT Room on the VRV system could make sense.

There are several manufacturers represented and supported on the Central Coast. Mitsubishi's 'City Multi' line of variable refrigerant flow, Daikin's 'VRVIII-S' and LG's 'MULTI V' are each a viable candidate.

Indoor unit placement depends on the type of unit selected. Cassettes sit in the suspended ceiling grid. Wall mounts are hung on the wall, typically above the door in a Server Room. Fan coil units are mounted above the ceiling with supply and return duct branches going to each room served.

The outdoor unit mounts on a concrete pad outside the building for ease of service. It can be remote should aesthetics require.

100% outside air economizer cycles are not available with VRV, but because the equipment/system is so efficient, the California Energy Code does not require it.

Toilet, Shower, Conference and Break Rooms will have exhaust fans. Fan controls will be with occupancy sensors, humidity sensors and/or lights.

Fire dampers and/or fire smoke dampers will be considered once location of rated walls is verified.

The Administration Facilities will require California Energy Code compliance documentation for the envelope, mechanical system and electrical system.

21.8 RO Building

Addenda 1 indicates that the electrical loads in the building will create over 2,126 MBH in heat and 110,000 CFM of exhaust air. Staying with the suggested design found on TD-5, the 8 intake louvers and 8 exhaust louvers will be approximately 5' square.

Exhaust fans will be controlled by individual thermostats.

Intake louvers will be provided with throw away filters.

There are no other HVAC criteria.

21.9 Chemical Storage and Feed Facilities

Addenda 1 indicate that multiple, separate, low and high volume exhaust fans are required. Room air change quantity and location of inlets (high and low) will be considered on an individual basis.

Two speed exhaust fans will be controlled by individual thermostats and occupancy sensors.

Intake louvers will be provided with throw away filters.

There are no other HVAC criteria.

21.10 Electrical Switchgear Building

Addenda 1 indicates that the electrical loads in the building will create over 600 MBH in heat and 33,000 CFM of exhaust air. Staying with the suggested design found on TD-5, the intake louvers and exhaust louvers will be approximately 3' square.

Exhaust fans will be controlled by individual thermostats.

Intake louvers will be provided with throw away filters.

HVAC for the Control Room will be provided by a single thru-the-wall heat pump.

22.0 PLUMBING SYSTEM

Building plumbing and fire protection systems design will conform to the requirements of the following codes and standards and any supplementary requirements of the authorities having jurisdiction:

1. Latest applicable version of Local or International Plumbing Code

2. Latest applicable version of Local or International Fire Code

3. Latest applicable version of (NFPA)

22.1 GENERAL STANDARDS

- Above and below ground piping will be as defined in the RFP.
- Water pressure from potable water system to buildings should be a minimum of 50 psig.
- Separate metered and reduced pressure zone backflow protected water services will be required for potable building water and fire protection.
- Light duty hose valves for building interior and exterior washdown will be 3/4-inch globe valves with hose thread adapters.
- Medium duty hose valves for interior and exterior washdown will be 1-inch globe valves with hose thread adapters.
- Hose valves subject to freezing will be non-freeze type.
- A minimum of 2 hose valves per wall will be provided in process areas.
- Floor drains and hub drains that have infrequent use will have primed P-traps. The water source for trap priming will be protected by a reduced pressure zone backflow preventer.

22.1.1 Building Plumbing Fixtures and Equipment

- Water closets, urinals, lavatories and service sinks will be American Standard or Kohler.
- Water closets will be floor-mounted flush-valve-type, and urinals will be wall-hung flush-valve type.
- Drinking fountains will be double wall-hung units in the Administration Facilities.
- Safety showers / eyewashes will be Speakman, Haws, or equal.
- Water Heater:
  - Tankless, instantaneous type will be Envirotech or equal.
  - Tank-type will be AO Smith, State Industries, Inc., or equal.
- Small-capacity sump pumps will be ABS or equal.
- Piping interior service valves, 2-inch and smaller, will be ball valves; 3-inch and larger will be gate valves.
- Floor drains, roof drains and cleanouts will be JR Smith, Josam, or equal.

22.1.2 Barrier-Free Plumbing Fixtures (ADA)

Water closets, urinals, lavatories, and water coolers will be provided for the physically impaired as required by the applicable codes.

22.2 Cross Connection Control

Cross connection control will be provided in accordance with the Plumbing Code.

22.2.1 Backflow Preventers

Backflow preventers will be designed as defined in the RFP. Reduced pressure zone backflow preventers will be installed for the following items, as a minimum:

- Main building potable water service
- Water supply for mechanical equipment and instruments
- As separation between potable water (PW) and non-potable water (UW)
- Backflow preventers that are located outside will be placed within an insulated enclosure

22.3 Emergency Safety Equipment

22.3.1 Safety Showers / Eyewashes

- Combination safety shower / eyewash units will be installed in all chemical areas.
- Recessed combination safety shower / eyewash units will be installed in all laboratory areas.
- Access to these units will be unobstructed.
- The design and installation of the emergency shower / eye wash systems will meet the requirements of ANSI Z358.1-2004
- The emergency shower will deliver 20 gpm of 80-degree F tempered water, for 15 minutes at 30 psig.
- The emergency eye wash will deliver 0.4 gpm of 80-degree F tempered water, for 15 minutes at 30 psig.

22.4 Water Conservation

Low water use plumbing fixtures and trim will be specified and installed in accordance with requirements of the Standard Plumbing Code.

Maximum flow rates will be as follows:

- Water Closet: 1.6 gallons per flushing cycle
- Urinal: 1.0 gallons per flushing cycle
- Private Lavatory: 2.2 gpm
- Public Lavatory: 0.5 gpm
- Shower Head: 2.5 gpm
- Sink Faucet: 2.2 gpm

22.5 Storm Drainage

Rainfall rate: 1.5” per hour (California Plumbing Code Table D-1.1)

Roof drain / Overflow drain type: Not applicable based on roof design. Gutters and downspouts currently called for.

Special treatment: Not applicable

22.6 Sanitary Sewer

A new, on-site septic tank and leach field is to be provided in accordance with County of Monterey requirements.

22.7 Lab Waste

Laboratory fixtures will run through a neutralizing tank prior to discharge using Fuseal Polypro (or equal) piping.

22.8 Compressed Air

A 5 HP air compressor, 80 gallon receiver and refrigerated air dryer will be provided for maintenance and laboratory use.

CA piping will be routed where required and provided with branch drops complete with ball shut off valves and quick-disconnect couplings.

22.9 Deionized Water

A wall mounted, cartridge type filter will be provided in the Laboratory and connected to a single dispenser. Storage tank, recirculation or UV systems are not provided at this time.

22.10 Domestic Water

Pressure regulator: provided if required.

Hose bibbs with vacuum breakers will be provided where required.

Reduced Pressure Zone backflow protection devices to be provided where required.

22.11 Domestic Hot Water

Water heater: Small electric tank type sized for connected load in the Administration Facilities for showers and emergency equipment; various process buildings for emergency equipment.

22.12 Domestic Hot Water Recirculation

Provided as a means to reduce water consumption and keep tepid water available at emergency equipment. Pumps are controlled by temperature to reduce energy loss.

22.13 Natural Gas

Not required at this time.

22.14 Plumbing Fixtures

Institutional grade fixtures by Kohler, American Standard or Toto.

1.28 GPF, flush valve water closets will be provided if site water pressure is adequate.

Waterless urinals are suggested.

Floor drains with trap primers will be provided at all toilet rooms and emergency equipment.

22.15 Emergency Equipment

Eyewash and showers will be provided in accordance with ANSI Z358 regarding location, distance between/to, temperature of tepid water, flow rate and pipe size.

Emergency equipment drainage should be discussed.

22.16 Design Recommendations

- Design considered under this section is to five feet outside the building perimeter. Coordination with Civil Engineer and Underground Contractor concerning invert elevations, pipe sizing and location is necessary.
- Seismic restraints will be provided where required and rely on ISAT design and products.

23.0 ELECTRICAL SYSTEM

23.1 Electrical Codes, Standards, and Recommended Practices

The Work will be designed and constructed in accordance with applicable sections of the latest provisions of codes, standards, and recommended practices published by the following organizations:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Electrical Testing Laboratories (ETL)
- Illuminating Engineering Society of North America (IESNA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- The Instrumentation, Systems, and Automation Society (ISA)
- International Electrical Testing Association (NETA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories (UL)
- Occupational Safety and Health Administration (OSHA)

The Work will be performed in accordance with applicable portions of the following specific codes, standards and recommended practices, at a minimum and as modified by local and state amendments. Where an edition date is not listed below, per the RFP, the most current editions will be used based upon the date the Project is awarded:

- NFPA 70-2011 - National Electrical Code (NEC)
- International Building Code (IBC), as related to conduits embedded in structural elements
- California Title 24 Building Codes (2013)
- California PUC General Orders 95 (overhead work) and 128 (underground work) in public spaces (however, no overhead utility work is included in this Proposal).
- California Title 24 Building Codes (2013)
- ANSI/NEMA MG 1 – Motors and Generators
- ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures: including Chapter 13, "Seismic Design Requirements for Nonstructural Components," and Appendix 11A.1.3.10, "Quality Assurance Provisions" – "Special Inspection and Testing" – "Mechanical and Electrical Components"
- IEEE 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Color Book)
- IEEE 399 IEEE Recommended Practice for Industrial and Commercial Power System Analysis
- IEEE 519-1992 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- IEEE 551 IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems (Violet Color Book)
- IEEE 1584 IEEE Guide for Performing Arc-Flash Hazard Calculations
- IES Lighting Handbook (latest edition)
- NETA ATS (ANSI) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

- NFPA 70E Standard for Electrical Safety in the Workplace
- NFPA 101 Life Safety Code
- NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

For the purposes of defining the electrical system, to be provided according to the RFP, it is presumed that no portion of this facility has been identified by local authorities as a “designated critical operations area (DCOA)” per NFPA 1600-2010, Standard on Disaster/Emergency Management and Business Continuity Programs.

23.2 Normal Power Electrical Loads

Estimated loads for the new plant, are based on major process components, and are summarized in the **Appendix G**. These estimated loads are subject to change during the design phase of the project. In addition to these larger process loads, other types of loads, as defined below will be defined during formal design; however, these additional loads have been estimated and included in the preliminary sizing of the electrical distribution system, down to the 480 V level.

23.2.1 Miscellaneous

There will be a number of process loads 5 horsepower (HP) and smaller that will add to the tabulated process loads, and which will include sump pumps, sample pumps, motor-operated valves, chemical pumps, solenoids, panel space heaters, equipment controls, and cooling fans. These loads are expected to be small compared to the process loads included above. Many may be powered from equipment control transformers at 120 V; and, some, such as sump pumps, sample pumps, motor-operated valves, and chemical pumps, may require 480 V from MCCs or power panelboards, or 120/208 V from lighting and appliance panelboards in the area.

23.2.2 HVAC Load Estimate

23.2.2.1 Conditioned Areas

The heating, ventilation, and air conditioning (HVAC) systems will provide mechanical cooling for Electrical Rooms, Administration Facilities, and other identified process buildings/areas. Power for these systems and equipment will be from 480 V panelboards (for packaged units) or MCCs (for starters provided under Division 26) or 120/208 V panelboards (for smaller equipment) nearest the HVAC equipment. These HVAC loads will be added to the above process loads. These loads are expected to be small compared to the process loads included above.

23.2.2.2 Ventilated Areas

The HVAC systems shall provide mechanical ventilation to remove the heat generated by equipment, lighting, and the presence of operators and maintenance personnel. Power for these systems and equipment is from 480V power panelboards (for packaged units) or MCCs (for starters provided under Division 26) or 120/208V panelboards (for smaller equipment) nearest the HVAC equipment. These HVAC loads will be added to the above process loads. These loads are expected to be small compared to the process loads included above.

23.2.2.3 Lighting and Receptacle loads

Circuits for lighting and receptacle loads will be fed from 120/208 V or 277/480 V panelboards located in the areas being served, including outdoor lighting and small loads adjacent to buildings. These loads are expected to be small compared to the process loads included above. For 480 V – 208Y/120 V step-down transformers, ratings will be selected to ensure that secondary-side short-circuit current levels at the transformer terminals will not exceed 10,000 A symmetrical.

23.3 Electrical Service

This Proposal presumes that the treatment plant will be powered from a single existing 21 Y/12.12 kV, 60 Hz utility service in the area, delivered underground to the plant site boundary by the Owner/supplying utility. Under this Project scope, the service will be extended by MWH from the property line, in a concrete-encased ductbank, to a dedicated, fence-enclosed substation, and will terminate in a combination single-service utility meter cubicle and parallel 27 kV metal-enclosed fusible switches. Each fusible switch will supply a 21 Y/12.12 kV – 4160 Y/2400 VAC, 5/5.6/6.25 MVA, 55/65/65 degrees C rated, non-flammable-liquid-cooled (OA/OA/FA) substation transformer.

Each transformer, and its associated secondary feeder, will be sized to have the following approximate capacities:

- At its 55 degrees C (OA) rating, each transformer/feeder, will supply approximately 100-percent of plant capacity at a plant rated capacity of 6.4 mgd.
- At its 65 degrees C (OA) rating, each transformer/feeder will supply approximately 65-percent of plant capacity at a plant rated capacity of 9.6 mgd.
- At its 65 degrees C (FA) rating, each transformer/feeder will supply approximately 50-percent of plant capacity at a plant rated capacity of 12.8 mgd.

From the outdoor electrical service transformers, 4160Y/2400 VAC will extend, via concrete-encased ductbanks into a lineup of 5 kV-rated, metal-clad switchgear (MSD-1) located within a dedicated Electrical Switchgear Building.

23.4 Medium Voltage Switchgear

The 5 kV-rated, metal-clad switchgear will serve as the main switching center to distribute 4160 V, three-phase, three-wire power, via concrete-encased ductbanks, to all medium-voltage motor controllers (for RO First Pass HP Pumps) and outdoor, dry-type, cast-coil 4160 V – 480Y/277 V transformers located outside of the Electrical Switchgear Building. The switchgear will be sized to support a plant rated capacity of 12.8 mgd.

The metal-clad switchgear will be UL-listed, service-entrance rated, and designed with double-ended configuration (Main-Tie-Main). The incoming compartments will contain surge arresters, Owner metering, and protective relays. The switchgear will incorporate automated transfer control of the main-tie-main arrangement, initiated through the SCADA system; however, the gear will be capable of supporting fully automated transfer in the future should dual Utility services eventually be incorporated. The switchgear will also incorporate arc-flash reducing technology.

The circuit breakers in the switchgear lineup will be of the draw-out vacuum-interrupter type with a 1,200 A minimum rating. Sufficient breakers will be incorporated to accommodate current actual and projected future loads, as defined in the RFP. The circuit breaker control voltage will be 125 VDC derived from dedicated control power batteries and charger external to the gear.

1. The switchgear will be standard metal-clad construction, consisting of two-high freestanding structures bolted together to form a single dead-front panel assembly containing circuit breakers, control devices, protective relay and metering units, and all interlocking and miscellaneous control/interface devices. Phase and ground busses will be tin-plated copper, with phase busses having a minimum ampacity of 1,200 amperes and a minimum 250 MVA short-circuit withstand rating.

2. Switchgear (21 kV) and 480V distribution is summarized on the Single Line Diagrams (see Drawing Nos. GE-3 through GE-5 for the 9.6 mgd Alternative Design).

23.5 Alternative Electric Service

Provisions (i.e., yard space and adequate depth below grade) will be allotted, from the site perimeter boundary to the Electrical Switchgear Building, to install a ductbank that will support a future alternative 5 kV power supply from an off-site, but adjacent, landfill power system, which is not currently available. The underground duct bank is shown on Drawing No. E-1.

Additionally, provisions for adding manual key-interlocking will be included on one main circuit breaker and a spare feeder circuit breaker space on one side of MDS-1, to allow future connection of the alternative 5 kV power supply. If the power supply is implemented, the key interlocks, feeder circuit breaker, ductbank, and cabling will be added to the Project scope by a change order.

23.6 Low-Voltage Distribution

23.6.1 Supply to Flush, Salinas Valley, & Finished Water Pumps

From two (2) of the outdoor 4160 V – 480Y/277 V transformers, feeders in concrete-encased ductbanks will supply a low-voltage (480 VAC), main-tie-main, three-phase, three-wire switchboard assembly (MDS-2), to supply power to the Flush Pumps, Salinas Valley Pumps, Finished Water Pumps, and other 480 V loads. This lineup will also provide local building power to the Electrical Switchgear Building as well as redundant feeders to the Administration Facilities.

23.6.2 Supply to ERD, Second Pass, & Low-Lift Pumps

From the other two (2) outdoor 4160 V – 480Y/277 V transformers, feeders in concrete-encased ductbanks will supply a second low-voltage (480 VAC), main-tie-main, three-phase, three-wire switchboard assembly (SUS-1), to supply power to Second Pass, ERD Boost, and Low Lift Pumps, and other 480 V loads.

These switchboards will incorporate draw-out, power circuit breakers for the main-tie-main and molded-case solid-state trip circuit breakers to supply the sub-distribution to the various loads, power distribution panelboards, and motor controllers in the Electrical Switchgear Building as well as in remote process facilities. The main-tie-main arrangements will incorporate manual transfer control (normal power situations only), initiated through key interlocks on the circuit breakers.

In addition to the key-interlock scheme for MDS-2, its main circuit breakers will be electrically operated as part of the automatic transfer control associated with the 480 VAC standby power system (see Paragraph 26.11 for additional information on the standby power system). Each output circuit breaker from the standby power system will serve separate sides of MDS-2, which will allow for energizing one or both sides of the double-ended switchboard assembly. This will allow limited operational capabilities in the event of a utility power failure, as well as for load-testing of the standby power system. The SCADA system will be used to select which automated transfer interface will be utilized, as well as to perform selective load shedding to not overload and shut down the standby system. Manual selection of the transfer scheme will also be available via a three-position selector switch on the switchboard assembly.

Local building and ancillary system power (480/277 V and 208/120 V) will be developed within the various remote proves buildings and the Administration Facilities. General power and lighting loads will be served separately from instrumentation and sensitive electronic equipment loads by means of providing separate step-down transformers and panelboards. Instrumentation and sensitive electronic equipment loads will be supplied via electrostatically shielded, isolation-type, step-down transformers; and, the secondary panelboards will be provided with surge protective devices.

23.7 Owner Metering and Protective Relays

Power quality meters (Owner-selected type SEL 735), with fiber optic communications to the SCADA system, will be incorporated to for monitor the utility service parameters. Feeder protection relays (Owner-selected type SEL 751A) will be incorporated where indicated and as applicable, and will be programmed to interface with the SCADA system using dual-port, fiber optic communications.

Each RO high-pressure pump motor and associated VFD will include an Owner-selected type SEL 710 relay and ancillary sensors to monitor power consumption data in real time. Power consumption and other electrical parameters will be monitored through SCADA using dual-port, fiber optic communications.

Each pumping stage (Finished Water Pumping System) will be monitored with an appropriate SEL device (located in switchgear, switchboard, or MCC, as applicable) and ancillary sensors (for each pump circuit) to determine the power consumption for the pumping stage (not the individual pump). Power consumption and other electrical parameters will also be monitored through SCADA.

23.8 Electrical Grounding

The electrical system and equipment will be grounded in compliance with NFPA 70 (NEC). A buried copper grounding grid, consisting of No. 3/0 AWG stranded, annealed copper conductors and copper-clad ground rods, will be provided for the new service transformers, outdoor dry-type transformers, the Electrical Switchgear Building, and outdoor generator enclosure. Process buildings and Administration Facilities will also incorporate NEC required grounding electrodes, with No. 3/0 AWG stranded, annealed copper conductors used to bond all indoor transformers, MCCs, and other major electrical equipment to the electrode systems. Electrical equipment, devices, panelboards, and metallic raceways will be connected to the electrode systems via equipment grounding conductors sized per the NEC.

23.9 Electrical Transient Protection

Distribution class surge arresters will be provided at each termination point for exterior cabling, in medium-voltage metal-enclosed switches, transformers, and metal-clad switchgear.

Low-voltage transient-voltage surge protective devices (SPDs), complying with/labeled under UL-1449, Rev 3, will be provided on the main of each 480 V switchgear, switchboard, and power distribution panel supplying circuits that traverse or terminate outdoors. SPDs will also be provided on 120/208V panelboards serving outdoor circuits and "clean-power" systems.

23.10 Uninterruptible Power Supply (UPS) Applications

A dedicated UPS will be provided to supply a minimum of 10 minutes of ride through, at full-load, if a failure occurs in the "normal" power systems. The UPS will be provided with an integral automatic bypass circuit, as well as a remote manual maintenance by-pass switch that will allow isolation of the unit for servicing and testing. The UPS status will be monitored through SCADA.

Each PLC cabinet will also have its own integral UPS (see also Section 27.2).

24.0 STANDBY POWER

A standby power system ("Optional Standby" as defined in NFPA 70, Article 702), will supply power to 480 V Switchgear MDS-2 in the event that the "normal" utility service, or any plant equipment upstream of MDS-2, fails. The standby power system will consist of a diesel-fueled engine-generator, an integral fuel tank, dual output circuit breakers, and an automatic central control and metering/monitoring system to sequence and properly interlock the generator with the switchgear and loads. The generator will start automatically upon loss of "normal" power, and will automatically activate the transfer scheme.

The generator will be sized to provide standby power to the following loads:

- Any one (1) Finished Water Pump (largest capacity pump)
- Administration Facilities, including its interior lighting and exterior lighting (controlled and fed from the Administration Facilities)
- Sump pumps
- RO flush pumps,
- Instrumentation,
- Compressed air supply for valve actuators,
- Security systems
- Critical valves with electric actuators

The standby power system will include the following physical characteristics and capabilities:

- Synchronous, four-pole, brushless generator, with a 105 degrees C temperature rise
- UL 2200 listing
- Factory tested at 0.8 lagging power factor
- UL 142-listed, double-wall, belly-type, fuel storage tank, with leak detection, and sized for 24 hours run time at full load
- SCADA monitoring of generator performance and alarms
- Stairs, handrails, and working surfaces for the enclosure, as required to access controls and equipment

This proposal is based on the presumption that the generator enclosure, as specified in the RFP and repeated herein, will comply with local noise control ordinances and codes. The generator enclosure will be a walk-in, Pritchard Brown Sound Attenuating, Weatherproof Genset Enclosure, as described in Pritchard Brown Specification No. 2130, designed to reduce noise levels to less than 75 dBA @ 23 feet at 100-percent load. A super-critical grade exhaust silencer will be mounted internally in the sound-attenuated enclosure to further reduce the noise signature. The generator and enclosure will, as an integral unit, be IBC rated for local wind and seismic conditions; and, the enclosure will be provided with the manufacturer's standard corrosion-protective finish to mitigate corrosion from salt-laden-air. The Owner will select color of the enclosure when the standby system is submitted for approval.

As part of the start-up and commissioning process, the standby power system will be on-site tested with a load bank at 0.8 lagging power factor. The packaged generator will be installed, and its controls programmed, such that it can be tested under load on a routine basis; however, a permanently installed load bank is not included in this proposal.

Since this standby power source is not an "Emergency" standby source, as defined in NFPA 70, Article 700, all emergency and life safety related equipment will have backup batteries as their primary standby power source.

25.0 CONTROL STRATEGY

General auto operation of the major facility equipment will be generally based on one of two modes as described below.

1. Global Plant Auto Control – Under this scenario, the plant control system will auto start/stop process equipment to meet an operator preset product water production setpoint. As a start permissive, all processes must be detected to be in auto with the minimum number of equipment and trains ready for operation to meet the operator entered production rate. With auto start, sequencing/control of pumping equipment and operational parameters of the Sand Separators and First and Second Pass RO trains will be managed by the control system as per operator preset control setpoints. Operational safety functions will be maintained by the control system. The plant will continue to operate at the preset production rate until:
    a. An operator changes the production rate setpoint (in which case the control system will automatically adjust the number of online equipment accordingly).
        i. Note 1: an inability to achieve the production rate setpoint while the plant is in operation will generate a system alarm but not affect system operation as long as water quality is unaffected and no system faults or overflow conditions are generated.
        ii. Note 2: A request to start the plant or increase production when the control system permissive logic detects insufficient resources available to achieve the production setpoint will result in the plant maintaining current production rates and generation of a permissive fault which lists the process areas of concern.
    b. An operator issues a plant shutdown command (in which case, an operator will need to manually re-initialize plant start)
    c. A system/process fault or overflow is encountered that initiates shutdown (in which case, clearing of the fault will allow the plant to auto re-start to achieve the operator production setpoint)
2. Operator Auto Control – Under this scenario, an authorized operator will manually initiate start/stop control of each process area. The operator will be responsible for start of process trains to support the plant pumping systems once the pumping systems are initiated. With operator initialization, sequencing/control of pumping equipment and operational parameters of the Sand Separators and First and Second Pass RO trains will be managed by the control system as per operator preset control setpoints. Operational safety functions will be maintained by the control system.

25.1 Slant Wells

The Raw Water Slant Well Intake System shall run in Auto, Manual, and Hand Mode. In Auto Mode, the Combination of between one (1) and six (6) vertical wells and between one (1) and five (5) slant wells will operate to maintain the plant water demand setpoint (RO permeate output) at the HMI with a setpoint trim based on the discharge pressure from the cartridge filters. The operator shall select the lead pressure transmitter at the plant HMI.

At startup, the pump with the least runtime shall start and run at minimum speed and then ramp at 10Hz/min to 60 Hz before second least runtime is called upon. At this time 1st pump shall drop to 45 Hz and ramp up in conjunction when second pump is energized. All energized pumps should receive a common speed signal. This process shall continue with additional pumps, with the pump with longest runtime being left off as a spare. Should the operator selected pressure transmitter reach the High Pressure set point, the pumps will ramp down under the same common speed signal until 45 Hz at which time the pump running with the greatest runtime shall be placed in Standby. Should the lead pressure transmitter fail the slant well pumps shall maintain a set gpm as measured by the Slant Well Pump Station discharge flowmeter and signal an alarm to plant HMI.

If any pumps are "Not Available", the pump that is not available will not be included in the Auto mode. If a pump fails the next available pump will start and an alarm will signal the operator. Under "Normal Shutdown Procedures" all Slant Well pumps will ramp down as normal until last pump reaches 30 Hz at which time it will shut-down. Under "Emergency Stop for the Slant Well Pumps" a signal will be sent to the Slant Well Pump Station PLC to kill the Start/Stop Relay to provide a "Stop" signal to the VFDs and Pumps will stop immediately. In Manual Mode at the HMI, the Slant Well Pumps will operate at an Operator requested VFD frequency at the HMI, but will not monitor the pressure. In Hand Mode locally at the VFD, the Beach Well Pumps will operate at the requested VFD frequency/speed at the VFD, but will not monitor the pressure.

25.2 Sand Separator Pre-Treatment

Eight (8) cyclone-type sand separators are provided to remove solids from raw water pumped from the Slant Wells. Seven (7) sand separators will be operating with one sand separator in standby at any one time. The operator at the plant HMI will allocate which sand separator will be placed in standby. The raw water from the slant wells passes first through the sand separator influent flowmeter, which are 0-2500 gpm magnetic flowmeters.

Each sand separator flow control valve will have a Hand/Off/Auto switch located at the Sand Separator Master Control Panel. In Hand position the valve will open manually, in Auto position the valve will open/close based the sand separator's operating condition. Any sand separator with an H/O/A switch in the off position shall be placed "Out of Service" and the motor operated isolation valve will close. In normal operation, for a sand separator that is in service the sand separator raw water inlet and pre-treated water outlet valves will be called to open. If any sand separator's differential pressure setpoint is exceeded for an adjustable time delay and another sand separator is not currently in flush mode, that sand separator will be placed in flush mode. This will close the raw water inlet valve and the pre-treated water outlet valves. After a flush cycle has timed out, the sand separator will return to service by closing the flush valve before resuming normal operation by opening the pre-treated water outlet valve. A turbidity analyzer and a magnetic flowmeter is provided on the discharge of each sand separator to monitor turbidity levels and assess if extra time is needed on the flush time.

25.3 Cartridge Filters

Seven (7) 5-micron cartridge filters will remove fine sediment from the feed water and are subject to vendor based controls using operator entered setpoints. Each unit shall be equipped with a local pressure indicating gage and the differential pressure of each cartridge filter, as measured by the common line upstream and downstream pressure transmitters, will be monitored by the plant control system to determine maintenance scheduling. The cartridge filters will be installed downstream of the sand separators but upstream of the RO train feed inlets. A high differential pressure alarm shall be set for each filter that will alert the operator that the filter cartridges require replacement. A magmeter will be used to determine instantaneous and total feed water flow into the RO facility and redundant pressure transmitters shall be used to measure total feed water head pressure. Both instruments shall report to the control system.

25.4 Reverse Osmosis – Startup, Operation, Shutdown

Under Global Plant Auto Control, the plant control system will auto start/stop process equipment to meet an operator preset product water production setpoint. Operational parameters of the RO System will be managed by the control system as per operator preset control setpoints, as described above. Under Operator Auto Control, an authorized operator will manually initiate start/stop control of each process area.

The Slant Well pumps will provide a fixed pressure feed to the first pass RO units based on a pressure setpoint downstream of the cartridge filters. The control system will automatically increase the Slant Well pump discharge to compensate for pressure loss across the cartridge filter array. A magmeter, monitored by the plant control system, will be used to determine instantaneous and total First Pass RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the feed water stream prior to introduction to the First Pass RO trains. A motorized variable flow static mixer will be used to accommodate the various plant production rates and ensure proper mixing.

- Sodium Bisulfite – to ensure elimination of any remaining free chlorine ions prior to feed water introduction to the RO membranes.
- Threshold Inhibitor – to prevent membrane scaling.
- Sulfuric Acid – to balance the pH of the water entering the first pass RO units

The following instrumentation will be employed in the analysis of the First Pass RO feed water:

- Redundant Turbidity - to ensure feed water levels are within acceptable range
- pH analyzer – to ensure correct pH of feed water prior to introduction to the membranes
- Conductivity analyzer – to ensure feed water levels are within the membrane manufacture specified range prior to introduction to the membranes.
- Temperature measurement – to aid in the adjustment of optimum first pass recovery
- ORP – elevated levels shall be cause for immediate bypass.
- Total Chlorine Analyzer – to ensure absence of free chlorine ions

The control system will bypass the feed water until the feed water pH, conductivity levels, turbidity levels are within the pre-determined ranges of acceptability. During bypass operation, the bypass valve will be positioned (based on start-up testing) to ensure sufficient back-pressure is retained on the low pressure booster pump discharge line. The bypass valve will also automatically open under high feed pressure conditions.

All analyzers will be equipped with the means to detect sensor failure or transmitter malfunction with the alert routed to the control system via separate discrete output or by means of signal analysis logic. The first pass RO pre-treat analyzers will be assembled on a common panel in the RO Building. A self-healing Ethernet ring network will be used to route the VFD and soft start control and monitoring signals to the First Pass RO Master PLC.

The First Pass RO facility will be equipped with seven dual-stage membrane trains, each equipped with an isobaric energy recovery device (ERD). The trains may be manually initiated by an operator (at the plant control screens, subject to start permissives) or automatically by the First Pass RO Master PLC. Train operation will be under the control of the First Pass RO Master PLC.

<u>Feed Flow</u>: The rate of feed water flow into the train will be controlled by variable speed pumps at the Slant Well Pump Station. A motorized feed valve will serve to isolate the train from the feed system. The pump may be controlled in local manual mode at a VFD at the Slant Well Pump Station and the valve may be controlled at the actuator. Remote manual and auto control will also be available for both the valve and the pump. In auto mode, the control system will call the pump to run (at minimum speed for a preset time period) and the feed valve to open. Once the preset time period expires, the control system will slowly adjust the pump speed until the train permeate production rate is achieved. Permeate production is represented by the sum flow of the low TDS and high TDS permeate lines. A pressure transmitter will be used by the control system to determine feed water pressure and prevent over-pressurization of the train.

<u>Train Permeate</u>: The First Pass RO trains will be dual stage with a variable split ratio permeate piping arrangement. Under this scenario, permeate will be collected from the front and rear of the pressure vessels. Specifically, low TDS permeate will be collected from the pressure vessels' front membranes while relatively high TDS permeate (with direct routing to the Second Pass RO trains as feed water) will be collected from the rear membranes. The sum total flow of the high and low TDS permeate represents the train total permeate production. In Global Plant Auto mode, all first pass RO trains shall respond to a setpoint that will auto adjust to meet the conductivity setpoint. High TDS conductivity will be monitored by an analyzer with the operator selected signal serving as the control reference point. A magmeter will be installed on both the high and low TDS permeate lines to aid in control as well as confirm total permeate production rate and permeate production ratio. Low and high TDS permeate conductivity levels will also be monitored by dedicated analyzers to ensure expected water quality is being achieved. Flow and conductivity analysis readings will be tracked and recorded at the HMI.

<u>First Stage Concentrate</u>: A magmeter, pressure transmitter and conductivity analyzer will be installed on the first stage concentrate line to track and record conductivity levels and mass balance performance. A differential pressure transmitter will also be used by the control system to monitor the differential pressure across the first stage membranes. The conductivity analyzer will also be used to assist with normalization calculations and determine osmotic pressure.

<u>Isobaric ERD (Rotary Pressure Exchanger Type) with Circulation Boost Pump</u>: Using the first stage high pressure concentrate discharge, an ERD with variable speed, centrifugal circulation pump will be used to effectively reduce the amount of work required by the train feed pump to meet the train permeate production setpoint. Feed water from the cartridge filter discharge will be directly fed to the ERD where it is briefly exposed to the high pressure concentrate from the first stage, thereby facilitating energy transfer. The now highly pressurized water is discharged from the ERD to the circulation pump while the low pressure concentrate is discharged to the concentrate control valve. The ERD circulation pump will be equipped with a maintenance switch and motor temperature switch. High discharge

pressure, low suction pressure and motor high temperature switches will be directly interlocked with the pump VFD. With confirmation of the train feed valve full open position and the train feed pump at minimum speed, the control system will initiate start of the ERD circulation pump and vary the speed (with respect to the train feed pump) to meet a set train recovery ratio (adjustable over a fixed band as will be necessary as the membranes foul and/or to optimize membrane performance as a result of changes in feed water temperature).

Low Pressure Feed Control Valve and Low Pressure Concentrate: The flow rate, conductivity and pressure of the low pressure concentrate expelled from the ERD will be monitored by a downstream magmeter and pressure transmitter. A modulating butterfly valve also located on the ERD low pressure concentrate line, shall be used to control the flow rate of low pressure feed water to the ERD (as measured by the low pressure feed water magmeter) as well as allow discharge of the low pressure concentrate to the concentrate disposal pipeline at a controlled rate. The valve may be controlled in local manual mode at the actuator or in remote manual mode at the HMI. In auto mode, the control system will automatically modulate the valve to match the train feed pump discharge flow rate (as required to achieve the train permeate production setpoint) plus 1% to allow for over-flushing.

Upon train call to start, the control system will open the low pressure feed valve to a preset position. With confirmation of the train feed valve full open position, the train feed pump at minimum speed and start of the ERD circulation pump, the control system will slowly trim the valve position to achieve the PLC calculated flow rate.

Operator Settings: Operator Auto Control / Global Plant Auto Control setting: determines if a train will be run in “Operator Auto” using localized settings or run in “Global Plant Auto” based on plant wide settings. Under an “Operator Auto” operational scenario, the decision to normally start or stop a train is made by the operator at the HMI. The control system will operate the train based on the train’s operator pre-set parameters. Under a “Global Plant Auto” operational scenario, the decision to start or stop a train is determined by the plant control system to meet an operator preset plant production rate. Although, the control system will still largely operate each train based on the train’s operator pre-set parameters, some global control functions (as identified herein) may be set to override individual train control parameters. A service mode will also be made available at the HMI under which an operator may exercise any piece of equipment connected to the SCADA system via the HMI. A mixed operation of train auto mode / service mode will not be supported. Similarly, a mixed operation of Plant Auto mode / Train Auto mode will not be supported. Although equipment and operational safety functions will be in effect, full operation of a train under service mode will not be encouraged.

Permeate Production and Blend Rates: Each train will have a preset permeate production flow rate setpoint as set by the operator (local train setting), applicable under both “Operator Auto” and “Global Plant Auto” control modes. However, the ratio of permeate production will be established as a common ratio setpoint for all trains under Plant Global Control (fluctuating as necessary to meet the blend water conductivity setpoint). In “Global Plant Auto” mode, a plant production rate (global plant setting) will be maintained by the control system based on an operator preset production rate target. Based on the pre-established plant production setpoint and time delays, the control system will control how many trains will be online. The lead first pass RO train will remain online until a level low-low condition is detected in the filter water storage tanks or the First Pass RO System is called to stop by the operator.

The control system will work to operate each train at the maximum production rate without compromising water quality.

Recovery Ratio: Ratio of total permeate flow to total feed water flow. It is anticipated that this value will be a maximum of 50% based on the currently proposed membranes (local train setting).

Train Start Sequence: The sequence for train start will be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the "Global Plant Auto" mode of operation will be based on the required permeate production setpoint.

Permeate Flush Tank: The combined First Pass RO System (high TDS) permeate will be used to feed the Second Pass RO System and serve as source water for the First Pass RO Permeate Flush Tank. The permeate flush tank fill line will be governed by a motorized isolation valve. The tank level will be monitored by redundant non-contacting level transmitters plus two override floats for high-level and low-low level detection. The First Pass RO Master PLC will open and close the fill valve based on the operator preset level setpoints. Trip of the high-high level float will force immediate closure of the fill valve.

Permeate Flush Pumps and Valve: Permeate water flush timer setting. As a function of the shutdown procedure, the concentrate valve will be opened to a preset position, the feed and low TDS valve closed, the feed pump and ERD pump shutdown, the flush valve opened and the lead constant-speed permeate flush pump engaged until the flush timer expires (local train setting). The concentrate valve position setting and the permeate timer setpoint will be operator adjustable at the HMI. The permeate flush system will be equipped with two centrifugal pumps designed to operate in lead/standby mode. The control system will automatically alternative pump starts based on last pump called to start. The permeate flush pumps may be controlled in local manual mode at the associated LCS or starter panel and the permeate valve of each train may be controlled at the actuator. Remote manual control of the valve and the pumps will be available at the HMI.

First Pass RO Cleaning System: RO cleaning solution preparation, valve adjustments, pumping, purging and disposal will be a manual operation with monitoring and control via the first pass RO cleaning system LCP.

Second Pass RO Trains & Blend Water: A magmeter, monitored by the plant control system, will be used to determine instantaneous and total Second Pass RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the feed water prior to introduction to the Second Pass RO trains. A motorized variable flow static mixer will be used to accommodate the various plant production rates and ensure proper mixing.

- Sodium Hydroxide – for pH adjustment
- Threshold Inhibitor – to prevent membrane scaling. (Reference Threshold Inhibitor Section for proposed dosing control.)

The following instrumentation will be employed in the analysis of the First Pass RO permeate.

- pH analyzer – to ensure correct pH of feed water to maximize boron removal

- Turbidity - to ensure feed water levels are within acceptable range
- Temperature measurement – to aid in the optimization of membrane recovery

The Second Pass RO facility will be equipped with three (3) 2-stage membrane trains. The trains may be manually initiated by an operator (at the plant control screens) or automatically by the Second Pass RO Master PLC. Train operation will be under the control of the Second Pass RO Master PLC. Process definitions and control overview presented below.

Feed Flow: The rate of feed water flow into the train will be controlled by a variable speed horizontal centrifugal pump. The pump will be equipped with pressure switches and gauges on the discharge and suction lines for mechanical protection. A motorized feed valve will serve to isolate the train from the feed system. The pump may be controlled in local manual mode at the LCS or VFD and the valve may be controlled at the actuator. Remote manual and auto control will also be available for both the valve and the pump. In auto mode, the control system will call the pump to run (at minimum speed for a preset time period) and the valve to open simultaneously. Once the preset time period expires, the control system will utilize a compound flow control loop to slowly adjust the pump speed until the train permeate production rate is achieved. A pressure transmitter will be used by the control system to determine feed water pressure and prevent over-pressurization of the train.

Pressure switches will be directly interlocked with each pump's VFD. In addition, given the anticipated size of the pump and pump motors, each pump will be equipped with a monitored vibration transmitter and a motor bearing and winding temperature monitoring array. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

Second Stage Feed Water: A pressure transmitter and conductivity analyzer will be installed on the second stage feed line to track and record pressure and conductivity levels. The pressure transmitter will also be used by the control system to prevent over-pressurization of the second stage membranes and to track the differential pressure across the first stage membranes (in conjunction with the first stage feed pressure transmitter). The conductivity analyzer will also be used to assist with normalization calculations and determine osmotic pressure.

Second Stage Permeate: A magmeter and conductivity analyzer will be installed on the second stage permeate line to track and records the second stage permeate production rate and conductivity levels at the HMI.

Second Stage (Final) Concentrate: The rate of concentrate flow (and hence train recovery rate) will be controlled by a modulating ball valve as measured by a downstream magmeter. The valve may be controlled in local manual mode at the actuator or in remote manual mode at the HMI. In auto mode, the control system will open the valve responsible for concentrate flow control to a preset position when the train is called to run. Once the feed pump achieves minimum speed, the control system will slowly adjust the valve position to achieve the PLC calculated concentrate flow rate, as measured by the magmeter, based on the train production rate and train recovery ratio. A pressure transmitter, in conjunction with the second stage feed pressure transmitter, will be used by the control system to track the differential pressure across the second stage membranes. Conductivity and pH analyzer will be installed on the second stage concentrate line to track and record conductivity levels at the HMI and assist with normalization calculations. Final concentrate will be routed to the MRWPCA pipeline.

Total Permeate: Conductivity and pH analyzers will be installed on the total permeate line to track and record conductivity levels at the HMI and verify achievement of required water quality. The total permeate production rate will be calculated by the control system based on the sum of the measured first stage permeate flow and the measured second stage permeate flow. This value will also be recorded at the HMI.

Pressure Balance: Prior to startup of the Second Pass RO Trains, at least one first Pass RO Train must be in full production. With no Second Pass RO Trains online, the first pass RO high TDS permeate flow will automatically route to the Second pass First stage line – the control valve of which will be maintained in a full open position with no second pass trains online. With confirmation of flow from the first pass, the lead Second Pass Train will be initiated thereby drawing the First Pass RO System Permeate into the Second Pass RO train. (Note: a vacuum assist system will be considered to mitigate potential cavitation of the second pass feed pumps.) As the lead train establishes a permeate production rate the pressure balance line water column will hydraulically mitigate any dramatic pressure changes during the Second Pass RO startup period.

Under Global Plant Auto operation, the number of second pass RO trains brought online shall equal the number of first pass RO trains.

Permeate Production Rate: Each train will have a preset production permeate flow rate setpoint as set by the operator (local train setting), applicable under both “Operator Auto” and “Global Plant Auto” control modes. In “Global Plant Auto” mode, a plant production rate (global plant setting) will be maintained by the control system based on an operator preset production rate target and as evidenced by the current First Pass RO System permeate flow rate. The lead train will remain online until a stop condition is detected in the lead First Pass RO train feed pressure falls below minimum or the Second Pass RO System is called to stop by the operator. The control system will work to operate each train at the maximum production rate without compromising water quality.

Recovery Ratio: Ratio of total permeates flows to total feed flow. It is anticipated that this value will be a maximum of 90% based on the currently proposed membranes (local train setting)

Train Start Sequence: The sequence for train start will be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the “Global Plant Auto” mode of operation will be based on the current number of online first pass RO trains.

Flush Procedure: As a function of the shutdown procedure, the concentrate valve will be opened to a preset position, the feed valve held open and the feed pump engaged at a preset flush rate speed until the train flush timer expires (local train setting). The concentrate valve position setting, the feed pump speed and the permeate flush timer setpoints will be operator adjustable at the HMI.

Second Pass RO Cleaning System: RO cleaning solution preparation, valve adjustments, pumping, purging and disposal will be a manual operation with monitoring and control via the second pass RO cleaning system LCP as shown on the referenced drawings.

Production Rate: Total permeate flow rate setpoint as set by the operator (local train setting) or as determined by the PLC based on the distribution demand as evidenced by the current Finished Water Storage Tank level (plant setting). Note: based on pre-established ground storage tank level setpoints and time delays, the PLC shall bring more trains online as the Finished Water Storage Tank level falls and reduce the number of online trains as the level rises. The control system shall work to operate each train at the maximum production rate while simultaneously working to maximize the blend water flow rate (without compromising water quality).

Recovery Ratio: Ratio of total permeate flow to feed flow. It is anticipated that this value will be 80% based on the proposed membranes (local train setting)

Train Start Sequence: The sequence for train start shall be as manually set by the operator at the HMI or as determined by the PLC based on total elapsed runtime comparisons (plant setting). The number of trains called to run under the plant auto mode of operation shall be based on the current water level in the Finished Water Storage Tank. The number of wells called to run shall be based on the number of wells required to support the trains called to run as measured by the raw water flow meter.

Flush Timer: Feed water flush timer setting. As a function of the shutdown procedure, the concentrate valve shall be opened 100% and the feed pump ramped to 30% of max speed until the flush timer expires (local setting). Concentrate valve position settings and VFD speed settings for the flush operation shall be operator adjustable at the HMI.

25.5 Reverse Osmosis – Clean-in-Place

RO cleaning systems will be manually batched and operated. The membrane cleaning system LCP will provide functions to allow an operator to control and monitor the membrane cleaning process. The feed pumps shall be equipped with pressure switch and gauge assemblies on the discharge and suction lines for mechanical protection at the starter. The cleaning pumps shall be manually operated only at the MCC or LCP.

The cleaning system LCP shall be equipped with a PLC. The plant control system shall monitor the status of the cleaning system equipment and instrumentation via the LCP PLC. No remote controls shall be provided.

25.6 Post Treatment Stabilization

The product water pump station discharge magmeter, monitored by the plant control system, will be used to calculate and transmit instantaneous and total product water flow as well as control post treatment chemical injection. The chemicals listed below may be injected into the product water distribution stream to adjust the alkalinity and hardness of the water and to prevent corrosion in the distribution pipeline.

- Sodium Hypochlorite
- Sodium Hydroxide
- Zinc Orthophosphate
- Carbon Dioxide
- Liquid Lime

The following instrumentation will be employed in the analysis of the distribution product water for reporting purposes:

- pH analyzer – to ensure RFP distribution product water quality requirements have been met or bettered.
- Conductivity – to ensure RFP distribution product water quality requirements have been met or bettered.
- Turbidity – to ensure RFP product water quality requirements have been met or bettered.
- Free Chlorine Residual – to ensure RFP product water quality requirements have been met or bettered
- Total Chlorine Residual – to ensure RFP product water quality requirements have been met or bettered

25.7 Finished Water Storage and Pumping

The Finished Water Storage Facility will consist of two 750,000 gallon tanks, normally hydraulically equalized. The inlet to each tank will include a manually operated butterfly valve. The discharge from the Second Pass RO System will flow to the product water tanks which serves the product water pump station wet well. The Finished Water Pump Station will be equipped with four high-service split-case centrifugal product water pumps that feed the Monterey distribution system and two horizontal end suction pumps that feed the Salinas Valley groundwater basin.

The Finished Water Pump Station (FWPS) will consist of two small pumps (25% of the capacity) and will be equipped with a variable frequency drives (VFD's) and two large pumps (50% of the capacity) equipped with soft starters. A pump may be controlled in local manual mode at VFD. Remote manual and auto control will also be available at the control system HMI. In auto mode the product water pump station PLC will initiate start of the pumps based on a pressure setpoint on the discharge of the pump station. A flow transmitter will also be provided on the discharge of the pump station to track the overall flow to the distribution system.

Two, VFD controlled horizontal end suction pumps will pump finished water from the Finished Water Storage Tanks to the Salinas Valley groundwater basin via the Castroville Seawater Improvement Project (CSIP). The pumps rated capacity of 850 gpm (1.2 mgd) each will be controlled in a 1 + 1 mode by a pump station discharge flowmeter.

Once initiated, the PLC at the FWPS will control the pumps to maintain an operator established product water pressure setpoint. The pumps will be designed to operate in lead/lag1/lag2/standby fashion and, when called to start, will respond to a common speed reference. The pump station PLC control logic will be run the two large soft start pumps first which will operate in a 1 + 1 operation scheme with a smaller VFD pump to control the pumps to the pressure setpoint. The pump station will be called to stop if a

High discharge and low suction pressure switches detection (as output by the pump station PLC) will be provided and directly interlocked with each pump's VFD and soft starter. In addition, given the anticipated size of the pump and pump motors, each pump will be equipped with a monitored vibration transmitter and a motor bearing and winding temperature monitoring array. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

<u>Surge System</u>: A surge system with redundant compressors and receiving tanks has been allowed for. Final sizing and relevance to system operation will be determined during the detailed design phase.

The product water pump station discharge magmeter, monitored by the plant control system, will be used to calculate and transmit instantaneous and total product water flow as well as control post storage chemical injection. The chemicals listed below will be injected into the product water distribution stream to adjust the alkalinity and hardness of the water and to prevent corrosion in the distribution pipeline.

- Sodium Hypochlorite
- Sodium Hydroxide
- Zinc Orthophosphate
- Carbon Dioxide
- Hydrated Lime

25.8 Chemical Storage and Feed

Under Global Plant Control, the primary plant chemicals will be automatically called to run once the process flow is detected to be greater than a preset “start” minimum for longer than a preset time period. If the process flow is detected to be lower than a preset “stop” minimum for longer than a preset time period, the chemical system will be called to stop. A dedicated “start” and “stop” control threshold will be provided for each chemical system to account for the operational requirements of a given chemical system. As indicated above, the Global Plant Auto Control start permissive will require that all chemical system be in auto with the minimum number of equipment ready for operation.

Under Operator Auto Control, the following chemical system control scenarios may be applied:

- Chemical systems operate as per Global Plant Control i.e. as the operator initiates start of the major process areas, the chemical systems will be automatically called to start. If a chemical system is unavailable, operator start control of a given process will not be affected; however, an alarm will be generated which may result in shutdown of the process as may be required by a given process.
- The operator is responsible for manual start of all chemical systems. Once initiated, sequencing/control of pumping and batching equipment will be managed by the control system as per operator preset control setpoints. Note: although the chemical systems will not automatically start, each system will be called to stop if the associated stop threshold is encountered as described under the Global Plant Control mode.

In general, chemical feed shall be flow-paced by the PLC based on the measured process flow rate and an operator entered chemical injection ratio. LCS panel controls and displays shall be PLC driven. Remote manual controls for the feed pumps shall be provided at the HMI. Pumps shall serve their respective injection points in lead/lag fashion.

25.9 Concentrate Disposal

Concentrate flows from the first pass RO systems will be conveyed to the MRWPCA site via a pipeline and disposed of via the existing MRWPCA outfall. Aeration of the concentrate will be accomplished with the use of an air compressor downstream of the concentrate pump discharge. Concentrate flows from the second pass RO system will be recycled to upstream of the cartridge filters.

26.0 PROCESS CONTROL

The following sample points, analyzers, and points of chemical addition are included in the design. A full field instrument list and I/O list are presented in the drawings.

Table 26-1: Points of Chemical Addition

Chemical	Location	Flow Paced	Trim
Sulfuric Acid	First Pass RO Feed	FE-170	AE-285 (pH)
Threshold Inhibitor	First Pass RO Feed	FE-170	
Sodium Hydroxide	Second Pass RO Feed	FE-156	AE-572 (pH)
Threshold Inhibitor	Second Pass RO Feed	FE-156	
Sodium Hydroxide	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	
Carbon Dioxide	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-572 (pH)
Sodium Hypochlorite	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-572 (pH)
Zinc Orthophosphate	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	AE-574 (Total Chlorine)
Hydrated Lime	Upstream of Finished Water Storage Tank	FE-441 FE-442 FE-443	

Table 26-2: Sample Points

Sample Point Location	Analysis	Flow Requirement	Disposal
Cartridge Filter Effluent	--	Grab Sample	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-172 (Temperature)	Continuous	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-280 (Turbidity)	Continuous	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-285 (pH)	Continuous	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-290 (Conductivity)	Continuous	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-295 (Total Chlorine)	Continuous	Purge to Plant Drain System
Cartridge Filter Effluent	AE/AIT-300 (ORP)	Continuous	Purge to Plant Drain System
First Pass Low TDS RO Permeate	AE/AIT-205 (Conductivity)	Continuous	Purge to Plant Drain System
First Pass RO Permeate	AE/AIT-207 (Conductivity)	Continuous	Purge to Plant Drain System
First Pass RO Concentrate	AE/AIT-209 (Conductivity)	Continuous	Purge to Plant Drain System
First Pass ERD High Pressure Concentrate	AE/AIT-222 (Conductivity)	Continuous	Purge to Plant Drain System
First Pass ERD Low Pressure Concentrate	AE/AIT-227 (Conductivity)	Continuous	Purge to Plant Drain System
Second Pass RO Feed	AE/AIT-305 (Conductivity)	Continuous	Purge to Plant Drain System
Second Pass RO Feed	AE/AIT-310 (pH)	Continuous	Purge to Plant Drain System
Second Pass RO Feed (First Stage)	AE/AIT-245 (pH)	Continuous	Purge to Plant Drain System
Second Pass RO Permeate (First Stage)	AE/AIT-248 (pH)	Continuous	Purge to Plant Drain System
Second Pass RO Permeate (First Stage)	AE/AIT-249 (Conductivity)	Continuous	Purge to Plant Drain System
Second Pass RO Concentrate (First Stage)	AE/AIT-256 (Conductivity)	Continuous	Purge to Plant Drain System
Second Pass RO Permeate (Second Stage)	AE/AIT-258 (Conductivity)	Continuous	Purge to Plant Drain System
Second Pass RO Concentrate (Second Stage)	AE/AIT-263 (pH)	Continuous	Purge to Plant Drain System
Second Pass RO Concentrate (Second Stage)	AE/AIT-264 (Conductivity)	Continuous	Purge to Plant Drain System
Blended RO Permeate	AE/AIT-251 (pH)	Continuous	Purge to Plant Drain System
Blended RO Permeate	AE/AIT-252 (Conductivity)	Continuous	Purge to Plant Drain System
RO CIP Feed	AE/AIT-370 (pH)	Continuous	Purge to Plant Drain System
RO Neutralized CIP	AE/AIT-395 (pH)	Continuous	Purge to Plant Drain System

Sample Point Location	Analysis	Flow Requirement	Disposal
Salinas Valley Discharge	AE/AIT-570 (pH)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-571 (Turbidity)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-572 (pH)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-573 (Conductivity)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-574 (Total Chlorine)	Continuous	Purge to Plant Drain System
Finished Water Quality	AE/AIT-575 (Free Chlorine)	Continuous	Purge to Plant Drain System

27.0 INSTRUMENTATION AND CONTROL

The Project will include state-of-the-art instrumentation and control devices that will enable the plant to operate with minimal supervision under automatic control, but, If the operator does need to perform any operations manually, provisions will be made to enable that to occur.

27.1 Programmable Logic Controllers

The Programmable Logic Controllers (PLC's) used on the project shall be Allen Bradley's Logix series. This shall apply to the balance of plant and vendor provided equipment. The PLC digital inputs/outputs (I/O) shall be high density 24VDC with isolated dry relay contacts integral to I/O card provided for all discrete outputs. Interposing relays shall be provided if the voltage for the I/O exceeds 24VDC or the contacts do not have adequate electrical ratings. All analog I/O shall be also be high density with up to 32 inputs per card and shall be 4-20mA. A minimum of 20% spares of each type of I/O shall be provided along with spare I/O slots for each type of I/O.

Networking; No fieldbus or proprietary field networking shall be provided for valve actuators or instruments. For modulating valves, 4-20mA analog control with full open and full closed digital feedback to the PLC shall be provided. The PLC's shall all be networked and communicate using Ethernet protocol over CAT6 copper inside buildings or fiber optic cable between buildings and depending upon the network segment distances. All Ethernet communicated signals shall be routed via Ethernet switches located in the PLC enclosure. Manufacturer of the Ethernet switch shall be Hirschman, Allen Bradley, or approved equal. All of the PLC's shall be connected to a self-healing fiber optic ring maintained by the Ethernet switches. Each fiber optic cable connection shall be terminated on a patch panel inside the PLC enclosure. Fiber optic transceivers shall convert the fiber optic Ethernet signal to CAT 6 copper cable inside the PLC enclosure.

PLC Enclosures; each of the PLC's shall be housed in an environmentally suitable PLC enclosure, manufactured by Hoffman, Saginaw and Rittal, or approved equal. All outdoor enclosures shall be NEMA 4X rated, 316 S.S. or fiberglass with appropriate sunshades and heating and cooling devices designed to keep the enclosure within set temperature limits. Indoor enclosures located in controlled environments shall typically be NEMA 12 rated with cooling recirculation fans and heaters, but, in corrosive environments shall either be NEMA 4X 316 S.S. or fiberglass. The enclosure shall also include door activated fluorescent lighting fixture(s). Multilevel termination blocks will be provided that will allow for a minimum of 20% of each I/O type in each cabinet. A common convenience receptacle shall be provided for maintenance use and a Ground Fault Circuit Interrupting (GFCI) shall be provided for the UPS and laptop computer use only. All 120VAC power cables shall be separated inside each enclosure from the 24VDC and 4-20mA analog signals.

27.2 Uninterruptible Power Supplies

All of the PLC enclosures shall be provided with an Uninterruptable Power Supply (UPS) designed to provide uninterrupted power to the enclosure PLC components for up to 15 minutes. A central UPS shall be provided for the control room Human Machine Interfaces (HMI's) and printers and server room networking equipment including; Ethernet switches, routers and firewalls. The UPS shall include a make-before-break static bypass switch along with a separate maintenance bypass switch to fully isolate the unit for maintenance and/or replacement. The bypass feed shall be provided with transient voltage surge suppression and clean power shall be fed from a shielded isolation transformer to this system. Each UPS shall also be supplied with an Ethernet communication card that shall provide overload, equipment over-temperature, low battery, load on bypass and load transferred to the maintenance bypass alarms.

27.3 Operator Interface Hardware and Software

The plant HMI and Local Operator Interface software shall be ICONICS Genesis 32. It shall be deployed in the control room and at operator interfaces throughout the plant including equipment vendor supplied control panels. Each of the local operator interfaces shall be have a minimum diagonal size of 12" and shall utilize touchscreen technology and no keypads. Each of the HMI's and operator interfaces shall be connected via a separate Ethernet connection from the PLC network and shall communicate using 1000-Base T or 1 Gigabit network communication speed.

27.4 Modes of Operation

All plant equipment that is controlled from the plant control system shall be provided with LOCAL/OFF/REMOTE (L/O/R) switches or HAND/OFF/AUTOMATIC (H/O/A) switches either on a local control panel near the equipment or on a local control station located next to the equipment. An auxiliary contact on the switches shall provide confirmation that the switch is in the Remote or Auto position as feedback to the plant or vendor PLC. Only if the switch is placed in Remote or Automatic will the PLC be able to control the operation of the equipment. When a piece of equipment is placed in the LOCAL position, the equipment will be controlled locally by using Start and Stop buttons at the local control panel or station and if the equipment has adjustable speed capability a local speed control adjustment. When equipment provided with an H/O/A switch is placed in the Hand position the equipment will run. When the LOCAL/OFF/REMOTE switch is placed in Remote, the plant operator will control the equipment at the control room HMI or through the local operator interface provided locally at the equipment. Two modes of remote control shall be provided; Remote Manual where the operator controls the piece of equipment by manual controls provided at the HMI or Local Operator Interface and Remote-Automatic where the plant or vendor provided PLC will control the equipment based on setpoints and operating parameters entered by the plant operator. When an H/O/A switch is placed in Automatic the equipment will be controlled by a vendor provided PLC based on parameters entered at the HMI or Local Operator Interface.

27.5 Operator Interface Functions

Graphic Screens; Descriptions shall be provided of each of the HMI and Operator Interface screens to determine level of detail required from the System Integrator who will be building the graphic screens. The screens shall incorporate the owner standard color conventions for stop, run, open, closed and intermediate conditions.

Alarms; Alarm limits displayed on graphics can be entered by the user at configuration time or from the operator's display during run-time. Alarm limits shall be expressed in engineering units and displayed on an alarm summary page and at the bottom of every graphic screen. An alarm color convention for alarm hierarchy shall be developed in conjunction with the owner.

Reports; Reports shall be provided that will summarize plant operation, electrical consumption, water production, chemical inventory, and regulatory compliance. The HMI software shall be provided with 2 distinct types of report generation: (a) process reporting which generates logs based on processes or equipment scanned or on manually substituted data and (b) management reports which are comprised of lab derived data and process data. The reports shall be provided in forms generated in Microsoft Access. When data that is not generated by the system is required on certain forms, the operator shall be provided with the capability to manually enter this information into the report, or overwrite data that the system has downloaded. Assume that ten (10) reports are required with the ability to update them on a daily, weekly, monthly, quarterly, and annual basis as well as month and year to date basis.

Security; the HMI software shall provide a user-based security system that allows for the creation of users with certain rights and/or privileges. These rights shall include the ability to run any combination or all of the applications in the data acquisition system. The ability to allow or disallow user access to change values, such as setpoints and machine-setups, on an individual tag basis shall be configured in consultation with the owner. Groups of users, such as Operators or Supervisors, shall be created and granted rights. All users assigned to a group obtain the rights of the group, although they are still tracked by the system by their individual ID. Individual members of a group may also be assigned additional rights. The security system will support both centralized and distributed security file management.

27.6 Factory Acceptance Testing

A Factory Acceptance Test (FAT) of the control system equipment shall accomplish two separate goals. The primary goal of a FAT is to ensure that the system has been assembled properly and is in proper working order. The System Integrator shall previously have done their own un-witnessed inspection and testing to ensure the witnessed testing performs without unexpected problems. This will include testing of each individual I/O point and should be witnessed by an Instrumentation & Control staff Engineer and the owner, if requested. The goal shall also allow the Instrumentation &Control staff Engineer and the owner to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the control enclosures, control system network communication systems, special control systems, and other pertinent systems and devices. The second goal is to simulate and test the control logic, and this portion of the FAT should be attended by the design Project manager/Engineer (the "Design Project Manager/Engineer") or someone familiar with the details of the process design and operation of the facility. All graphics, report generation and alarm functions of the system in accordance with the control narratives.

27.7 On-site Testing

Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance with its Manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Instrumentation & Control staff Engineer.

Loop Validation; Controllers shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the HMI. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as published by manufacturer accuracy specifications. Each analog loop shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For loops which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance with the calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test forms attached at the end of this section which include calculated RMS summation system accuracy tolerance requirements for each output. Loop confirmation sheets for each loop covering each active instrument and control device except simple hand switches and lights shall be provided. Loop confirmation sheets shall form the basis for operational tests.

Operational Ready Test (ORT): Following installation of the process control system components and prior to startup, the entire system shall be certified (inspected, wired, calibrated, tested and documented) that it is installed and ready for the ORT. Each loop shall have been checked and validated for proper installation and calibration using prepared forms. The system integrator shall maintain the loop status reports at the Project Site and make them available to the Owner at any time. Upon successful completion of the ORT, the system integrator shall submit a record copy of the test results to the Owner.

Functional Demonstration Test (FDT); The FDT shall be witnessed by the Owner and shall consist of a loop by loop demonstration of the functionality and operability of the control system. Live field data shall be used to the extent possible. The test shall be scheduled and coordinated with Owner's staff to minimize the impact on plant operations. Upon successful completion of the FDT, the system integrator shall submit a record copy of the test results to the Owner. The report shall include as a minimum:

- Cover sheet for the Instrumentation &Control staff Engineer sign-off/date and space for listing of exceptions
- Confirmation of delivery/acceptance of all submittals (hardware and software)
- Completed and signed loop check sheets
- Completed and signed instrument calibration sheet
- Completed and signed certificates of proper installation of instruments/equipment
- Completed and signed wire continuity test sheets (if recorded separately)
- Completed and signed fiber optic cable attenuation test sheets.
- Completed and signed functional test sheets
- Confirmation of rendered manufacturer services
- Signed confirmation of spare parts delivery
- Confirmation of delivery of draft O&M

Site Acceptance Test (SAT); after completion of the ORT and FDT, the system shall undergo a 30-day SAT under conditions of full plant performance without a single non-field repairable malfunction. Owner shall have full use of the system. Only Owner's staff shall be allowed to operate equipment associated with live plant processes. Plant operations remain the responsibility of the Owner. Any malfunction during the SAT shall be analyzed and corrections made. Any malfunction during the 30 day test which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction. All database, process controller logic, and graphical interface system data points must be fully functioning. All reports must be functioning and providing accurate results. No software or hardware modifications shall be made to the system without prior approval. Following successful completion of the 30 day test, and subsequent review and approval of test documentation, the instrumentation and control system shall be considered substantially complete and the warranty period shall commence.

27.8 Training

MWH shall train the owner’s personnel on the maintenance, calibration and repair of all equipment provided as part of this project. The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment. Training shall be for the purpose of familiarizing the owner's technical maintenance staff, with the use, maintenance, calibration, trouble shooting and repair of all components of the PLCS. Training classes shall cover, as a minimum, operational theory, maintenance, trouble-shooting/repair, and calibration of supplied instruments. The training material, including a resume for the proposed instructor(s) (indicating previous instructional experience) and a detailed outline of each lesson shall be submitted to the Instrumentation & Control Staff Engineer at least 30 days in advance of when the lesson is to be given. The Instrumentation & Control Staff Engineer shall review the submitted data for suitability and shall be able to provide comments that shall be incorporated into the course. Final materials will be provided at least two weeks in advance of the training sessions.

Operator training shall achieve the following minimum goals;

- Use of workstations, touch screens and keyboards
- Retrieve and interpret all standard displays including graphics, overview displays, group displays, trends, point summaries, and alarm summaries,
- Enter data manually
- Change control parameters and setpoint values
- Assume manual control of equipment and control it from the HMI
- Print reports
- Acknowledge alarms
- Respond to hardware and software error
- Historical data collection, retrieval, and archival
- Capability and configurability of reports, alarm reporting, passwords, and system hardware configuration
- Database backup and recovery

Maintenance training shall achieve the following minimum goals;

- Power up and shutdown of all hardware devices
- Perform schedule maintenance functions
- Setup and use off line diagnostics to determine hardware failures

- Use workstations, keypad, or keyboards to retrieve and interpret displays which provide online diagnostic information
- Remove and replace all removable boards/modules
- Maintenance training shall be at least 75% hands-on training.

27.9 Instrument Calibration

All instrumentation field devices shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements. Each instrument shall be calibrated at 0, 25, 50, 75 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to the National Institute of Standards and Testing. Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers. Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

- Project name
- Loop number
- Tag number
- Manufacturer
- Model number
- Serial number
- Calibration range
- Calibration data: Input, output, and error at 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of span
- Switch setting, contact action, and dead-band for discrete elements
- Sensing tube leak detection test result (performed at maximum process pressure).
- Space for comments
- Space for sign-off by and date
- Test equipment used and associated serial numbers

A calibration and testing tag shall be attached to each piece of equipment or system. MWH shall sign the tag when calibration is complete and the calibration and testing has been accepted.

27.10 Protection of Sensitive Equipment

The project shall follow the guidelines for powering and grounding of sensitive electronic equipment listed in IEEE Standard 1100-2005.

- Transient Voltage Surge Suppression (TVSS): TVSS units shall be supplied at the point of use for all instrumentation loads. TVSS units shall be required for all 4 wire instruments (such as chlorine analyzer), and placed on the 120VAC branch circuit and on the 4-20 mA portion of the circuit. The transient voltage surge suppression on the 4-20 mA wiring shall be located on the PLC end. For all two wire 4-20 mA instruments that have signal cable running from outdoor to indoor locations (or signal wire between buildings) transient voltage surge suppression on the field side of the 4-20 ma signal shall be provided. All analog signaling shall be shielded cable.

- Grounding: Each PLC cabinet shall be provided with a direct connection to the ground grid via a driven rod in addition to the equipment safety ground required by the National Electrical Code. Daisy chaining of grounds is not acceptable if it is the only grounding source. A grounding detail showing the interface between the PLC cabinet and the proposed grounding system is required. Instrumentation shields shall be grounded at the PLC end only. The electrical grounding specifications must be cross referenced to the instrumentation and control specifications so that it is understood that the system integrator monitors the quality of system grounding. In order to facilitate an electrically active ground mass, provide connections to structural steel and interface them to the grounding system.
- Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the Manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.
- Conduit Spacing: Conduit spacing between power and signal/control cables shall be as listed in IEEE 518-1982.
- Loop Isolators and Converters: Signal isolators shall be provided to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wire-wound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions

27.11 Field Devices

All field instruments shall have a 4-20mA analog outputs that shall be trended and logged at the plant HMI with HART protocol overlaid where available and a field mounted indicator displaying the instrument reading in true in engineering units. The field mounted indicator shall be located at a height and location that provides easy access and viewing. Each instrument shall be provided with a means of calibration including electronic calibration device or gases for analyzer equipment. Preferred manufacturers are provided elsewhere. All transmitter analog signals are to be input to SCADA for monitoring, trending, and logging.

Pressure Transmitters: Microprocessor type; accuracy: 0.075% of span and provided with a 3 valve manifold for field calibration. Manufacturers shall be Rosemount, Endress + Hauser, or equal

Differential Pressure Transmitters: Microprocessor type; accuracy: 0.075% of span and provided with a valve manifold for field calibration. Manufacturers shall be Rosemount, Endress + Hauser, or equal

Flow Meters: Process flowmeters shall be magnetic located in at least 2 pipe diameters upstream and a 5 pipe diameters downstream straight run of pipe. Each magnetic flowmeter shall be provided with grounding rings and a ground and electrode and lining materials per manufacturer’s recommendation. The flowmeter shall not be submerged or direct buried. Manufacturers shall be Rosemount, Endress + Hauser, Siemens, Krohne, ABB, or equal

Level Transmitters: Continuous Level measurement shall preferably use ultrasonic or radar type transducers to continuously monitor level. A head pressure transmitter may be used where an ultrasonic or radar transmitter is not practical with a pressure indicator mounted on or adjacent to the transmitter. The sensors shall be corrosion resistant with appropriate rated enclosures and be mounted at least 1ft above maximum liquid surface. A local indicator at ground level shall be provided. Install per manufacturer's recommendations. Manufacturers shall be Endress + Hauser, Ametek Drexelbrook and Siemens, or equal.

Level Switches: Level switches shall be provided independent of continuous level monitors, when overflows could occur. Level switches shall be used to alarm when fluid has entered a sump and is causing a flood condition in a building. RF admittance types, with self-test feature are preferred in most applications. Float sensors shall be provided for flood switches. Point level switch manufacturers shall be Endress + Hauser, ABB and Ametek Drexelbrook or equal and flood switches shall be Siemens Milltronics, or equal.

Weight Transmitters: Certain tanks (day tanks) shall be weighed to determine losing weight over time to calculate/verify chemical feed rate.

Analytical instruments include conductivity, pH, turbidity, ORP, particle count, and residual chlorine. Mount and provide sample supply, and sample conditioning for good operation. Where possible, provide digital output to SCADA for analytical instrument self- diagnostic alarm. Manufacturers shall be Hach, Rosemount and Siemens, but final selection of the analytical instruments shall be made with consultation of the Owner.

27.12 Control Panels

Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated by the CONTRACTOR. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. Enclosures suitable for the environment shall be provided. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed. The control panel controls shall be 120 VAC. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-phase, the control panel shall be provided with a control panel transformer, no 480V starters shall be provided in Instrumentation control panels. Control conductors shall be provided in accordance with the indicated requirements. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel. A control panel main power feeder disconnect shall have a door-mounted handle unless otherwise indicated. Control panels shall be housed in NEMA rated enclosures. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted. Internal control components shall be mounted on an internal back-panel or side-panel as required. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors.

27.13 Preliminary I/O List

A preliminary I/O list for the 9.6 mgd and 6.4 mgd Base Project is presented in **Appendix H**.

27.14 Instrument Schedule

A preliminary instrument schedule for the 9.6 mgd and 6.4 mgd Base Project is presented in **Appendix I**.

28.0 PHYSICAL SECURITY, ELECTRONIC SECURITY AND SPECIAL SYSTEMS

28.1 Physical Security

The MWH Team will utilize its experts and company's extensive experience in implementation of the required physical facility protection features to deter, detect, and delay vandals, criminals, saboteurs, and insider threats, as outlined in the RFP.

1. Our Team will keep close coordination with the Owner to establish Owner's input on security design at appropriate points during the design phase. In addition, our team's experts will coordinate with the Owner preferred cyber protection and implement management practices.

2. Site Fencing: it is intended that the Project Site will be fenced with 6 ft high fence, constructed out of PVC-coated galvanized steel for salt air corrosion protection. Architectural grade fencing will be provided within 50 feet, either side, of the main entrance.

Gate: The main entrance will be equipped with closed circuit camera, intercom, lighting, and card access. The gate will be electrically actuated, slide-type with electric actuator.

3. It is intended that all wiring and cabling will be run in conduit and protected from tampering.

4. Site Lighting will be designed for safety and security purposes in accordance with local requirements and Owner's expectations, and to allow proper functioning of security cameras.

5. Security features will be incorporated into hatches, vents, and overflows on all water storage tanks

6. Signs will be placed at 50 ft intervals around the Project Site perimeter; content and format of the signs will be coordinated with the Owner.

7. All chemical fill lines will be designed with lock provisions.

8. Site Areas:

   a. The site will be protected with anti-climb security fencing and provided with intrusion detection.

   b. Primary electrical facilities and standby power facilities will be protected with an additional level of anti-climb security fencing. All other facilities located within the site fence line will not be contained by additional security fencing.

9. All the vehicle parking is designed to be located away from the building.

29.0 LANDSCAPING AND IRRIGATION

29.1 Landscape Design General

A landscaping and irrigation/xeriscaping plan will be prepared for the site by a State of California licensed Landscape Architect. The Landscape design will be guided by the conceptual site design prepared by students from the College of Architecture and Environmental Design of California Polytechnic State University and progressed to ensure the layout and concept meets CAW and regulatory requirements.

29.2 Landscape Development Regulatory Requirements

The Landscape design for this project is regulated by a number of Monterey County Code Sections. Monterey County Code, Chapter 21.28.070 Site Development Standards and Chapter 18.50 Residential, Commercial and Industrial Water Conservation Measures. Chapter; 21.28.070 Site development standards stipulate All developments shall have landscaping covering a minimum of ten (10) percent of the site area and parking areas must be landscaped subject to a plan approved by the Director of Planning and the landscaping shall be in place prior to the commencement of use. In addition, the exterior landscape development shall be comprised of, low water use or native drought-resistant plant material. Chapter 18.50 identifies an approved low water use drought tolerant plant list and irrigation system requirements for water conserving landscapes.

29.3 Landscape Design Concept

The landscape and site layout will respond to the functional needs of the facility's operators, provide clear and purposeful vehicular and pedestrian routes, respond to the natural environment and be aesthetically pleasing. Strategic placement of landscape planting materials will enhance the aesthetics of the overall site facility design. Limited ornamental plantings may be used provide additional aesthetic enhancement in key locations such as pedestrian areas in and around the Administration Facilities. Landscape screening of facilities such as the Chemical unloading area, Electrical service substation and above-ground Finished Water storage will further enhance overall site aesthetics. Incorporation of an integrated water feature as described in the conceptual design prepared by students from the College of Architecture and Environmental Design of California Polytechnic State University can be considered as part of the elective landscape features identified in the RFP.

The proposed site layout and landscape design will be integrated with the site drainage and stormwater design. Low Impact Design (LID) drainage techniques used in combination with a native plant palette offer a highly sustainable landscape design, which will minimize the need for supplemental watering, reduce or eliminate the need for fertilizers, and chemical pest management. Typical techniques of bio-infiltration swales, porous paving, and rain gardens are well suited for this project site. The Landscape design layout will also emphasize practices that minimize resources needed for maintenance and water use.

29.4 Plant Material Selection

The planting design will be dominated by drought tolerant native plant material and include upper and middle story trees and shrubs, and a ground cover layer typical of the local natural vernacular. Native plant materials are best adapted to the local climate and offer a great variety of flower, leaf color, and textures. A low water use plant material palette for the project will be selected from the list provided by Monterey County entitled "A Drought-Tolerant Plant List for the Monterey Peninsula"

Other elements such as topsoil, topdressing mulch, signs, paving, lighting, irrigation and accent features make up other components integral to the landscape planting design are described below.

29.5 Planting Aesthetics

As previously stated, the planting design will be dominated by native plant material (as required by regulations) and include upper and middle story trees and shrubs, and a ground cover layer typical of the natural site characteristics A planting theme comprised of native plant material will provide an aesthetic planting design which appeals to the senses of sight, and smell, and respond to the natural surroundings makes for a pleasant working environment and produce an overall site design that fits the natural surroundings. The planting design should soften building edges, shade buildings from solar effects, frame site views, preserve existing view sheds, and compliment the site layout.

29.6 Topsoil and Compost

Planting areas will use existing amended on site topsoils. Following construction of site facilities, scarification of compacted subgrades and incorporation of organic materials into subgrades optimize the soil profile for vegetation growth and groundwater infiltration. Planting beds should receive a 3-inch to 4-inch top dressing layer of organic compost which will significantly to reduce weeds, related maintenance and increase the water holding capacity of the soil.

29.7 Supplemental Landscape Irrigation Design

As described previously, the Landscape design will be comprised of drought tolerant and low water usage plant materials. However, all newly planted plant material (both natives and ornamental plants) require supplemental irrigation during the first two to three years to become established. An automatic irrigation system utilizing low volume, low pressure drip irrigation technology will be designed to provide an efficient water delivery system for the plant material. Native plant materials have lower water demands to maintain health. Over time as the plant material become established, supplemental watering will no longer be needed and the irrigation system can be reduced or eliminated completely.

The proposed low volume, low pressure drip irrigation system will meet the requirements of Monterey County Code chapter 18.50 for water conservation measures.

30.0 SITE DEVELOPMENT

During the development of the site layout, the Project Team will include the following elements into the consideration cost, hydraulic profile, security, aesthetics, future improvements and expansions, and operations. The project team will design the paved roadways to accommodate large loads of liquid treatment chemical deliveries. The chemical unloading area will incorporate design provisions to allow for drainage to the rear outlet of delivery vehicles.

Taking into the account Owner's recommendations and Team' previous experience, the project team will mitigate the not aesthetically-pleasing facilities and structures (Chemical unloading, Electrical service substation, above ground Finished Water storage) from visitors' view.

30.1 Site Layout

The site layout should respond to the functional needs of the facility's operators, provide clear and purposeful vehicular and pedestrian routes, respond to the natural environment and be aesthetically pleasing. Buildings and facilities have been sited to minimize the development footprint, protect native vegetation, reduce impervious surfaces, and maximize available open space and minimize site grading, and minimize disruption of natural drainage patterns.

30.1.1 Roadways

Site roadways will be designed to accommodate pickup trucks, automobiles, commercial refuse trucks, and semi truck-trailer combinations (i.e. chemical delivery vehicles where necessary). Allowance for the larger trucks controls design of vehicular access from the street and within the site. During site layout, drive and apron paved areas will be studied to confirm the ability of vehicles to turn around and make deliveries without impacting parked vehicles or driving onto landscaped areas. The need for fire department access will be addressed in the final design related to roadway layout.

Roadway alignments will fit closely with the existing topography to minimize the need for cuts or fills. The alignment of the access roadways will be designed to provide access to all necessary temporary and permanent portal facilities. Vehicle paving will be in accordance with county road and paving design standards, and where appropriate will include continuous curbing to aid in the definition of the road edge. Non-continuous curbing will be used as necessary to facilitate sheet flow for stormwater drainage design.

30.1.2 Parking

Parking will be provided for the maintenance vehicles and equipment required for operation of the permanent facilities. The number of parking spaces provided will be based on the anticipated number of employees and vehicles expected at the site during construction, during future operation anticipating additional future staff and to meet Monterey County code requirements. Consideration will also be made for tour groups which may use buses or multiple cars.

30.1.3 Pedestrian Walkways

Pedestrian paving surfaces should be smooth and durable. Areas close to building entrances should be hard surfaces such as concrete, asphalt or unit pavers. Areas further away from buildings can be gravel or coarse mulch depending on the amount of use. Pedestrian walkways should be wide enough to allow two people to walk side by side (5-feet wide minimum).

30.1.4 Building and Site Signage

Facility signage should promote a unified, high-quality system of design within the facility which provide clear identification, information and communication to staff and visitors. Overall signage should meet Tacoma Water's guidelines. The guidelines provide a framework for the sign system to provide consistency in sign design, size, materials, and illumination throughout the facility.

30.1.4.1 Overall Sign System

A hierarchy of signs should be created for the facility Signs will be designed to create a unique identity for the facility and to provide a graduated system of orientation into and through the site which match existing sign standards

- Project Identification: Signs shall be located at the primary entrances to buildings
- Safety and Warning Signs: Meeting industry and regulatory requirements.
- Site Information Signs: Providing information to visitors about the facility and context.
- Building Identification Signs: To identify individual buildings
- Interior wall mounted Signs: To further identify individual buildings or major facilities within the facility

30.1.5 Site Lighting

Site lighting will be designed to meet minimum requirements of the security of the outside area being illuminated, and utilize control strategies which minimize overall energy usage. Therefore, a variety of different solutions should be coordinated and integrated to the facility design. Specific lighting requirements for each portion of the site, should be identified, and luminaries will be selected that combine appropriate aesthetic design with relevant lighting performance features.

Site lighting typically falls into four basic lighting areas; roadways, open areas, pedestrian areas, and the site perimeter. Each of these areas should be identified and discussed during the design development process to develop an overall site lighting plan.

A lighting plan for a large complex such as this site should designate certain routes as primary pedestrian routes after dark. Primary routes would be the most direct paths between major spaces or parking lots, or the paths that pedestrians would be expected to utilize when moving about the site. Secondary after-hours routes may also have lighting for basic safety.

30.1.6 Site Layout Aesthetics

As previously stated in the Landscaping section, a planting design will be developed to enhance the overall site aesthetics. The planting design will soften building edges, shade buildings from solar effects, frame site views, preserve existing view sheds, and compliment the site layout. In particular the site layout and building design will appropriately emphasize the curb appeal of facilities such as the Administration Facilities and pedestrian areas and mitigate the not aesthetically-pleasing facilities and structures identified by the Owner (Chemical unloading, Electrical service substation, above ground Finished Water storage, wastewater treatment facilities) from visitors view.

30.1.7 Hydraulic Profile

The site layout has been optimized to the plant's hydraulic profile to minimize site excavation and to minimize distance between facilities. In addition, the change in elevation has been used to minimize pumping where possible.

30.2 Site Drainage and Stormwater Management

The proposed drainage design will integrate stormwater runoff management with planting design, commonly known as Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) drainage design. These drainage techniques will allow the site to perform in a more naturalistic manor, and will result in clean and healthy stormwater discharges from the site. Typical techniques of bio-infiltration swales, porous paving, and rain gardens are well suited for this project site.

Specific stormwater management BMPs to be considered include dispersion of rooftop and pavement stormwater runoff into landscape planting areas, bio-infiltration swales, porous paving, and rain gardens.

30.3 Site Grading

The proposed site occupies the terrace above the Salinas river, and rises gradually east to west and to the north from Charles Benson Road. In our site general arrangement, we have in general used the site topography to best drainage advantage to reduce structures and underground collection systems. The stormwater detention pond is located to the northeast, taking advantage of the general site topography, as the lower collection point for the drainage, before controlled discharge. Surface drainage is controlled within the compressed plant footprint, by a series of measures:

1) All buildings are equipped with gutters and downspouts, controlling the major portion of precipitation and directing it to nearby collection inlets

2) All roadways are constructed with mountable curbs, allowing drainage from intermediate/confined areas to surface flow across and collect into the inverted crown pavement section

3) The pavement section is an inverted crown, essentially using the roadway as a collection and transport of stormwater to an inlet

4) Lastly, the inlet and underground stormwater collection system route the collected drainage to the detention pond, where it is collected for controlled discharge.

30.3.1.1 Segregation of Public and Operations Access

While not expected to be a central function of the facility, the general public may visit the site for tours. Also, non-operations staff use and visit the Administration Facilities on a regular basis. These visitors and employees must be provided with safe, secure, and convenient pathways to the areas of the site that they need to access.

Vehicular access to the site should allow convenient access to the public parking areas in front of the Administration Facilities and more restricted access to process and chemical delivery areas.

30.3.1.2 Use of Site Topography

Due to the site topography, there is limited opportunity or necessity to consider ground elevation when locating facilities. There is a slight fall to the site from west to east and south to north, which generally conforms to the hydraulic grade line for the new facility.

30.3.1.3 Conformance with Hydraulic Profile

With the exception of the RO system, the hydraulic profile follows the slope of the site, to the extent feasible. The filtered water tanks are set at an elevation to be able to receive flow from the slant wells with a HGL of 155 feet at the property line. Downstream of the RO system, the flow is by gravity to the finished water tanks. From there, the water will be pumped back to the property line at a HGL of 425 feet.

30.3.1.4 Yard Piping Required

Process facilities should be located close to the existing transmission pipelines to minimize the length of large-diameter connecting pipelines. Facilities should be oriented such that the process basins convey flows from east to west.

30.3.1.5 Future Expansion

To allow for future expansion of plant capacity, allowances will be made to construct additional RO facilities to treat up to 12.8 mgd. The expansion will be to the east and west of the RO building. Additional pretreatment filters and cartridge filters would be constructed adjacent to the filters included in this project.

30.3.1.6 Protection of Cultural Resources

No existing cultural resources have been identified in the project site area and Archaeological investigations are not planned. But, the project team will be mindful of the potential for discovery of protected cultural materials during the design and construction of the CAW facility, and will advise the Owner regarding appropriate actions to be taken. .

30.3.2 Yard Piping

The additional yard piping required for the Project will generally conform to the design criteria presented in the pipe schedule and in accordance with Appendix 2. Piping materials will be selected for longevity, durability, and economy. For pressure piping, steel, HDPE and ductile iron piping will meet project requirements for performance and reliability, but CAW prefers ductile iron. Selection between these three materials will be based primarily on cost. In the Monterey, area, MWH has found that ductile iron pipe is generally less expensive (on a total installed cost basis) for pipe diameters of 30 inches and less, and at larger diameters, welded steel pipe is less expensive. HDPE will be evaluated on a case by case basis depending on size, depth and fluid being carried (e.g., RO permeate is aggressive to metal piping).

Appendix A
Process Flow Diagram and Hydraulic Profile

Appendix B
Toray Design Systems – Model Runs

Appendix C
Energy Recovery Inc. (ERI) – Model Runs

Appendix D
Energy Recovery Inc. (ERI) – Reference List

Appendix E
Spare Parts List

Appendix F
Normal Power Electrical Loads

Appendix G
Building Schedule

Appendix H
Preliminary I/O List

Appendix I
Instrument Schedule

Appendix J
Justifications for Voluntary Alternatives

D. Drawings Submitted with Proposal

D. Drawings Submitted with Proposal

D. DRAWINGS SUBMITTED WITH PROPOSAL

All drawings can be reviewed in the separate 11 x 17 binder submitted with our proposal package.

Prepared for

CALIFORNIA AMERICAN WATER

E. Listing of Drawings and Specifications

E. Listing of Drawings and Specifications

E. LISTING OF DRAWINGS AND SPECIFICATIONS

The following tables contain the anticipated list of drawing and specifications for the 9.6 mgd base project. The drawings and specifications for the 6.4 mgd alternative and the 9.6 voluntary alternative would be generally conforming to what is shown for the 9.6 mgd base project. Appropriate adjustments would be made to reflect the addition and elimination of systems and facilities unique to each alternative.

MPWSP DESALINATION INFRASTRUCTURE - DESIGN DOCUMENT LIST

DRAWING LIST

GENERAL

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	DRAWING TITLE
	G-1				Cover Sheet
	G-2				List of Drawings - 1
	G-3				List of Drawings - 2
	G-4				Standard Symbols and Abbreviations - 1
	G-5				Standard Symbols and Abbreviations - 2
	G-6				Piping Schedule - 1
	G-7				Piping Schedule - 2
	G-8				Process Flow Diagram/Schematic
	G-9				Hydraulic Profile/Gradeline
	G-10				Hydraulic Profile/Gradeline
	G-11				Design Criteria

INSTRUMENTATION AND CONTROL

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	DRAWING TITLE
	GI-01				GENERAL INSTRUMENTATION SYMBOLS AND NOMENCLATURE-I
	GI-02				GENERAL INSTRUMENTATION SYMBOLS AND NOMENCLATURE-II
	GI-03				GENERAL PIPING SCHEDULE
	GI-04				Update/Issue General Drawings & Details - 4
	GI-05				Update/Issue General Drawings & Details - 5
	GI-06				Update/Issue General Drawings & Details - 6
	05I-01				PRESSURE FILTERS PRESSURE FILTER NO. 1 OF 14
	05I-02				PRESSURE FILTERS PRESSURE FILTER NO. 2 OF 14
	05I-03				PRESSURE FILTERS PRESSURE FILTER NO. 3 OF 14
	05I-04				PRESSURE FILTERS PRESSURE FILTER NO. 4 OF 14
	05I-05				PRESSURE FILTERS PRESSURE FILTER NO. 5 OF 14
	05I-06				PRESSURE FILTERS PRESSURE FILTER NO. 6 OF 14
	05I-07				PRESSURE FILTERS PRESSURE FILTER NO. 7 OF 14
	05I-08				PRESSURE FILTERS PRESSURE FILTER NO. 8 OF 14
	05I-09				PRESSURE FILTERS PRESSURE FILTER NO. 9 OF 14
	05I-10				PRESSURE FILTERS PRESSURE FILTER NO. 10 OF 14
	05I-11				PRESSURE FILTERS PRESSURE FILTER NO. 11 OF 14
	05I-12				PRESSURE FILTERS PRESSURE FILTER NO. 12 OF 14
	05I-13				PRESSURE FILTERS PRESSURE FILTER NO. 13 OF 14
	05I-14				PRESSURE FILTERS PRESSURE FILTER NO. 14 OF 14
	06I-01				FEED WATER FILTERED WATER PUMP STATION - I
	06I-02				FEED WATER FILTERED WATER PUMP STATION - II
	07I-01				CARTRIDGE FILTERS FIRST PASS RO CARTRIDGE FILTERS - I
	07I-02				CARTRIDGE FILTERS FIRST PASS RO CARTRIDGE FILTERS - II
	10I-01				RO TRAINS FIRST PASS FIRST STAGE - TRAIN I
	10I-02				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 2
	10I-03				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 3
	10I-04				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 4
	10I-05				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 5
	10I-06				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 6
	10I-07				RO TRAINS FIRST PASS FIRST STAGE - TRAIN 7
	10I-08				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN I
	10I-09				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 2
	10I-10				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 3
	10I-11				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 4
	10I-12				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 5
	10I-13				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 6
	10I-14				RO TRAINS FIRST PASS RO ISOBARIC ENERGY RECOVERY DEVICE - TRAIN 7
	10I-15				RO TRAINS SECOND PASS RO FIRST STAGE - TRAIN I
	10I-16				RO TRAINS SECOND PASS RO FIRST STAGE - TRAIN 2
	10I-17				RO TRAINS SECOND PASS RO FIRST STAGE - TRAIN 3
	10I-18				RO TRAINS SECOND PASS RO SECOND STAGE - TRAIN I
	10I-19				RO TRAINS SECOND PASS RO SECOND STAGE - TRAIN 2
	10I-20				RO TRAINS SECOND PASS RO SECOND STAGE - TRAIN 3
	15I-01				RO ANCILLIARY SYSTEMS FIRST PASS RO PRE-TREATMENT ANALYZERS
	15I-02				RO ANCILLIARY SYSTEMS SECOND PASS RO PRE-TREATMENT ANALYZERS
	15I-03				RO ANCILLIARY SYSTEMS FIRST & SECOND RO PERMEATE TANK AND FLUSH PUMPS
	15I-04				RO ANCILLIARY SYSTEMS RO CIP SYSTEM - I
	15I-05				RO ANCILLIARY SYSTEMS RO CIP SYSTEM - II
	15I-06				RO ANCILLIARY SYSTEMS NEUTRALIZATION SYSTEM
	15I-07				RO ANCILLIARY SYSTEMS SINGLE ELEMENT TEST AND SYSTEM
	20I-02				UV SYSTEM UV TRAINS 1, 2 AND 3
	21I-01				POST TREATMENT CHEMICALS LIME STORAGE AND SLURRY MIXING TANKS
	21I-02				POST TREATMENT CHEMICALS LIME SLURRY TRANSFER PUMPS AND AGING TANK
	21I-03				POST TREATMENT CHEMICALS LIME FEED SYSTEM
	22I-01				TREATED WATER FINISHED WATER STORAGE TANKS
	22I-02				TREATED WATER HIGH SERVICE PUMP STATION
	22I-03				TREATED WATER SALINAS VALLEY PUMP STATION
	50I-01				CHEMICAL BUILDING ANTI-SCALANT STORAGE SYSTEM
	50I-02				CHEMICAL BUILDING ANTI-SCALANT FEED SYSTEM - I
	50I-03				CHEMICAL BUILDING SODIUM HYDROXIDE BULK TANK AND FEED SYSTEM

	50I-04				CHEMICAL BUILDING SULFURIC ACID BULK TANK AND FEED SYSTEM
	50I-05				CHEMICAL BUILDING SODIUM BISULFITE STORAGE AND FEED SYSTEM
	50I-06				CHEMICAL BUILDING ZINC ORTHOPHOSPHATE STORAGE AND FEED PUMPS
	50I-07				CHEMICAL BUILDING CARBON DIOXIDE STORAGE SYSTEM P&ID
	50I-08				CHEMICAL BUILDING CARBON DIOXIDE FEED SYSTEM P&ID
	50I-09				CHEMICAL BUILDING NON-IONIC POLYMER STORAGE SYSTEM AND FEED PUMPS
	50I-10				CHEMICAL BUILDING SODIUM HYPOCHLORITE BRINE TANK - I
	50I-11				CHEMICAL BUILDING SODIUM HYPOCHLORITE BRINE TANK - II
	50I-12				CHEMICAL BUILDING SODIUM HYPOCHLORITE GENERATION SYSTEM P&ID
	50I-13				CHEMICAL BUILDING SODIUM HYPOCHLORITE STORAGE AND FEED SYSTEM
	50I-14				SODIUM HYPOCHLORITE FEED PUMPS
	55I-01				BACKWASH BASIN BACKWASH WEST BASIN AND PUMPS
	60I-01				BRINE POND BRINE STORAGE POND AND PUMPS
	60I-02				BRINE POND LEAK DETECTION SUMP

CIVIL

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GC-1				Update/Issue General Civil Notes and Symbols
	GC-2				Update/Issue Standard Civil Details - 1
	GC-3				Update/Issue Standard Civil Details - 2
	GC-4				Update/Issue Standard Civil Details - 3
	GC-5				Update/Issue Standard Civil Details - 4
	C-1				Site Plan
	C-2				Horizontal Control and Paving Plan - 1
	C-3				Horizontal Control and Paving Plan - 2
	C-4				Horizontal Control and Paving Plan - 3
	C-5				Horizontal Control and Paving Plan - 4
	C-6				Horizontal Control and Paving Plan - 5
	C-7				Grading and Drainage Plan - 1
	C-8				Grading and Drainage Plan - 2
	C-9				Grading and Drainage Plan - 3
	C-10				Grading and Drainage Plan - 4
	C-11				Grading and Drainage Plan - 5
	C-12				Yard Piping - Plans - 1
	C-13				Yard Piping - Plans - 2
	C-14				Yard Piping - Plans - 3
	C-15				Yard Piping - Plans - 4
	C-16				Yard Piping - Plans - 5
	C-17				Yard Piping - Profiles - 1
	C-18				Yard Piping - Profiles - 2
	C-19				Yard Piping - Profiles - 3
	C-20				Yard Piping - Profiles - 4
	C-21				Yard Piping - Profiles - 5
	C-22				Yard Piping - Profiles - 6
	C-23				Yard Piping - Profiles - 7
	C-24				Yard Piping - Profiles - 8
	C-25				Site Sections - 1
	C-26				Site Sections - 2
	C-27				Site Sections - 3
	C-28				Site Sections - 4
	GL-1				LANDSCAPE AND IRRIGATION GENERAL NOTES AND SYMBOLS
	GL-2				LANDSCAPING AND IRRIGATION SCHEDULE & DETAILS
	L-1				LANDSCAPING AND IRRIGATION SCHEDULE & DETAILS
	L-2				LANDSCAPE AND PLANTING PLAN -1
	L-3				LANDSCAPE AND PLANTING PLAN -2
	L-4				LANDSCAPE AND PLANTING PLAN -3
	L-5				LANDSCAPE AND PLANTING PLAN -4
	L-6				LANDSCAPE AND PLANTING PLAN -5
	L-7				IRRIGATION PLAN -1
	L-8				IRRIGATION PLAN -2
	L-9				IRRIGATION PLAN -3
	L-10				IRRIGATION PLAN -4
	L-11				IRRIGATION PLAN -5

STRUCTURAL

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GS-1				General Structural Sheets
	GS-2				Project Specific GS Details - 1
	GS-3				Project Specific GS Details - 2
	GS-4				Project Specific GS Details - 3
	06S-1				Feed Pump Station Foundation
	06S-2				Bolted Tank Foundations

	07S-3				CARTRIDGE FILTER FOUNDATION
	05S-4				PRESSURE FILTER SADDLE FOUNDATIONS
	01S-5				Raw Water Dosing Station
	55S-6				Backwash basin inlet structure
	60S-7				Brine and Recycle wet well pump station
	50S-8				CHEMICAL UNLOADING CONTAINMENT
	50S-9				GENERATOR, CO2 AND LIME SLABS ON GRADE
	70S-10				TRANSFORMER PADS
	22S-11				HIGH SERVICE PUMP STATION PAD
	22S-12				POST - CHEMICAL INJECTIOIN CONTAINMENT
	10S-1				RO BUILDING
	10S-2				RO BUILDING
	10S-3				RO BUILDING
	70S-1				ADMINISTRATION BUILDING
	70S-2				ADMINISTRATION BUILDING
	70S-3				ADMINISTRATION BUILDING
	70S-4				ADMINISTRATION BUILDING
	70S-5				HV BUILDING
	70S-6				HV BUILDING
	70S-7				HV BUILDING
	70S-8				UV BUILDING
	20S-1				UV BUILDING
	20S-2				UV BUILDING
	50S-1				CHEMICAL BUILDING
	50S-2				CHEMICAL BUILDING
	50S-3				CHEMICAL BUILDING
	50S-4				CHEMICAL BUILDING
	05S-5				PRESSURE FILTER BUILDING
	05S-6				PRESSURE FILTER BUILDING
	60S-1				Brine Pond building

ARCHITECTURAL

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GA-1				ARCHITECTURAL CODE SHEET
	GA-2				ARCHITECTURAL STANDARD SYMBOLS
	GA-3				ARCHITECTURAL STANDARD DETAILS 1
	GA-4				ARCHITECTURAL STANDARD DETAILS 2
	GA-5				ARCHITECTURAL STANDARD DETAILS 3
	GA-6				ARCHITECTURALSCHEDULES 1
	GA-7				ARCHITECTURALSCHEDULES 2
	10A-1				RO BUILDING
	10A-2				RO BUILDING
	10A-3				RO BUILDING
	70A-1				ADMINISTRATION BUILDING
	70A-2				ADMINISTRATION BUILDING
	70A-3				ADMINISTRATION BUILDING
	70A-4				ADMINISTRATION BUILDING
	70A-5				HV BUILDING
	70A-6				HV BUILDING
	70A-7				HV BUILDING
	70A-8				UV BUILDING
	20A-1				UV BUILDING
	20A-2				UV BUILDING
	50A-1				CHEMICAL BUILDING
	50A-2				CHEMICAL BUILDING
	50A-3				CHEMICAL BUILDING
	50A-4				CHEMICAL BUILDING
	05A-5				PRESSURE FILTER BUILDING
	05A-6				PRESSURE FILTER BUILDING
	60A-1				BRINE POND BUILDING

HVAC

Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GH-1				HVAC REQUIREMENTS AND STANDARDS
	GH-2				HVAC STANDARD SYMBOLS
	GH-3				HVAC STANDARD DETAILS 1
	GH-4				HVAC STANDARD DETAILS 2
	GH-5				HVAC SCHEDULES 1
	10H-				RO BUILDING
	10H-				RO BUILDING
	70H-				ADMINISTRATION BUILDING
	70H-				ADMINISTRATION BUILDING
	70H-				ADMINISTRATION BUILDING
	70H-				HV BUILDING
	20H-				UV BUILDING

	50H-				CHEMICAL BUILDING
	50H-				CHEMICAL BUILDING

PLUMBING/FIRE					
Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GM-1				PLUMBING REQUIREMENTS AND STANDARDS AND SYMBOLOGY
	GM-2				PLUMBING STANDARD DETAILS 1
	GM-3				PLUMBING STANDARD DETAILS 2
	GM-4				PLUMBING SCHEDULES 1
	10M-1				RO BUILDING - PLUMBING PLAN
	10M-2				RO BUILDING - RISER DIAGRAM
	70M-1				ADMINISTRATION BUILDING - FIRE SPRINKLER PLAN
	70M-2				ADMINISTRATION BUILDING - PLUMBING PLAN
	70M-3				ADMINISTRATION BUILDING - RISER DIAGRAM
	70M-4				HV BUILDING - FIRE SPRINKLER PLAN
	20M-1				UV BUILDING - PLUMBING PLAN
	50M-1				CHEMICAL BUILDING - PLUMBING PLAN
	50M-2				CHEMICAL BUILDING - PLUMBING PLAN
	50M-3				CHEMICAL BUILDING - FIRE SPRINKLER PLAN

PROCESS MECHANICAL					
Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GP-1				GENERAL MECHANICAL STANDARDS-1
	GP-2				GENERAL MECHANICAL STANDARDS-2
	GP-3				GENERAL MECHANICAL STANDARDS-3
	GP-4				GENERAL MECHANICAL STANDARDS-4
	GP-5				GENERAL MECHANICAL STANDARDS-5
	1P-1				RAW WATER FEED DOSING
	5P-1				PRESSURE FILTERS PLAN
	5P-2				PRESSURE FILTERS SECTIONS
	6P-1				FEED WATER PLAN
	6P-2				FEED WATER SECTIONS
	6p-3				PRE-CARTRIDGE FILTER DOSING
	7P-1				CARTRIDGE FILTERS PLAN AND SECTION
	10P-1				RO TRAINS PLAN
	10P-2				RO TRAINS SECTION-I
	10P-3				RO TRAINS SECTION-II
	10P-4				RO TRAINS SECTION-III
	15P-1				RO ANCILLIARY SYSTEMS PLAN
	15P-2				RO ANCILLIARY SYSTEMS SECTION
	20P-1				UV SYSTEM PLAN
	20P-2				UV SYSTEM SECTIONS
	22P-1				POST UV DOSING STATION
	22P-1				TREATED WATER PLAN
	22P-2				TREATED WATER SECTION I
	22P-3				TREATED WATER TANK BAFFLE PLAN
	22P-4				TREATED WATER EXAMPLES OF BAFFLE WALL CONNECTION DETAIL
	50P-1				CHEMICAL BUILDING PLAN
	50P-2				CHEMICAL BUILDING ENLARGED PLANS
	50P-3				CHEMICAL BUILDING SECTION I
	50P-4				CHEMICAL BUILDING SECTION II
	50P-5				CHEMICAL SYSTEM DETAILS
	50P-1				CARBON DIOXIDE STORAGE SYSTEM PLAN AND ELEVATION
	55P-1				BACKWASH BASIN PLAN
	55P-2				BACKWASH BASIN SECTION
	60P-1				BRINE POND PLAN
	60P-2				BRINE POND SECTION

ELECTRICAL					
Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	GE-1				Area Classification Drawings
	GE-2				Electrical Site Plan
	GE-3				Electrical Single Line Diagrams - 21KV SWITCHGEAR
	GE-4				Electrical Single Line Diagrams - 480 V DISTRIBUTION
	GE-5				PRIMARY SWITCHYARD PLAN
	GE-6				PRIMARY SWITCHYARD ELEVATION AND DETAILS
	GE-7				Electrical AREA Plan -1
	GE-8				Electrical AREA Plan - 2
	GE-9				Electrical AREA Plan - 3
	GE-10				Electrical AREA Plan - 4
	GE-11				Electrical AREA Plan - 5
	GE-12				SINGLE LINE DIAGRAM - 5KV SWGR
	GE-13				SINGLE LINE DIAGRAM - 4160V - SUS - 1A/1B
	GE-14				SINGLE LINE DIAGRAM - 480V SWGR - 1A/1B
	GE-15				SINGLE LINE DIAGRAM - 480V MDS
	GE-16				SINGLE LINE DIAGRAM - 480V MCC
	GE-17				SINGLE LINE DIAGRAM - 480V MCC
	GE-18				SINGLE LINE DIAGRAM - GENERATOR
	GE-19				SINGLE LINE DIAGRAM - UPS

	GE-20				SINGLE LINE DIAGRAM - ADMINISTRATION BUILDING
	GE-21				SINGLE LINE DIAGRAM - UV BUILDING
	GE-22				SINGLE LINE DIAGRAM - BLOWER BUILDING
	GE-23				SINGLE LINE DIAGRAM - CHEMICAL BUILDING
					CONDUIT DEVELOPMENT PLANS:
	01E-1				RAW WATER FEED DOSING
	05E-2				PRESSURE FILTERS PLAN
	06E-3				FEED WATER PLAN
	07E-4				PRE-CARTRIDGE FILTER DOSING
	07E-5				CARTRIDGE FILTERS PLAN AND SECTION
	10E-6				RO TRAINS SECTION-I
	10E-7				RO TRAINS SECTION-II
	10E-8				RO TRAINS SECTION-III
	15E-9				RO ANCILLIARY SYSTEMS PLAN
	20E-10				UV SYSTEM PLAN
	22E-11				POST UV DOSING STATION
	22E-12				TREATED WATER PLAN
	50E-13				CHEMICAL BUILDING PLAN
	50E-14				CARBON DIOXIDE STORAGE SYSTEM PLAN AND ELEVATION
	55E-15				BACKWASH BASIN PLAN
	55E-16				BRINE POND PLAN
					CONDUIT AND CONDUCTOR SCHEDULES:
	1E-20				RAW WATER FEED DOSING
	05E-21				PRESSURE FILTERS PLAN
	06E-22				FEED WATER PLAN
	07E-23				PRE-CARTRIDGE FILTER DOSING
	07E-24				CARTRIDGE FILTERS PLAN AND SECTION
	10E-25				RO TRAINS SECTION-I
	10E-26				RO TRAINS SECTION-II
	10E-27				RO TRAINS SECTION-III
	15E-28				RO ANCILLIARY SYSTEMS PLAN
	20E-29				UV SYSTEM PLAN
	22E-30				POST UV DOSING STATION
	22E-31				TREATED WATER PLAN
	50E-32				CHEMICAL BUILDING PLAN
	50E-33				CARBON DIOXIDE STORAGE SYSTEM PLAN AND ELEVATION
	55E-34				BACKWASH BASIN PLAN
	60E-35				BRINE POND PLAN
	GE-24				PANEL BOARD SCHED - 1
	GE-25				PANEL BOARD SCHED - 2
	GE-26				PANEL BOARD SCHED - 3
	GE-27				SCHEMATIC DIAGRAMS -1
	GE-28				SCHEMATIC DIAGRAMS -2
	GE-29				SCHEMATIC DIAGRAMS -3
	GE-30				SCHEMATIC DIAGRAMS -4
	GE-31				SCHEMATIC DIAGRAMS -5
	GE-32				SCHEMATIC DIAGRAMS -6
	GE-33				SCHEMATIC DIAGRAMS -7
	GE-34				SCHEMATIC DIAGRAMS -8
	GE-35				SCHEMATIC DIAGRAMS -9
	GE-27				SCHEMATIC DIAGRAMS -10
					PROCESS POWER AND CONTROL PLANS:
	01E-40				RAW WATER FEED DOSING
	05E-41				PRESSURE FILTERS PLAN
	06E-42				FEED WATER PLAN
	07E-43				PRE-CARTRIDGE FILTER DOSING
	07E-44				CARTRIDGE FILTERS PLAN AND SECTION
	10E-45				RO TRAINS SECTION-I
	10E-46				RO TRAINS SECTION-II
	10E-47				RO TRAINS SECTION-III
	15E-48				RO ANCILLIARY SYSTEMS PLAN
	20E-49				UV SYSTEM PLAN
	22E-50				POST UV DOSING STATION
	22E-51				TREATED WATER PLAN
	50E-52				CHEMICAL BUILDING PLAN
	50E-53				CARBON DIOXIDE STORAGE SYSTEM PLAN AND ELEVATION
	55E-54				BACKWASH BASIN PLAN
	60E-55				BRINE POND PLAN
					LIGHTING RECEPTICLES AND GROUNDING:
	01E-60				RAW WATER FEED DOSING
	05E-61				PRESSURE FILTERS PLAN
	06E-62				FEED WATER PLAN
	07E-63				PRE-CARTRIDGE FILTER DOSING
	07E-64				CARTRIDGE FILTERS PLAN AND SECTION
	10E-65				RO TRAINS SECTION-I
	10E-66				RO TRAINS SECTION-II
	10E-67				RO TRAINS SECTION-III
	15E-68				RO ANCILLIARY SYSTEMS PLAN
	20E-69				UV SYSTEM PLAN
	22E-70				POST UV DOSING STATION
	22E-71				TREATED WATER PLAN
	50E-72				CHEMICAL BUILDING PLAN
	50E-73				CARBON DIOXIDE STORAGE SYSTEM PLAN AND ELEVATION

	55E-74				BACKWASH BASIN PLAN
	60E-75				BRINE POND PLAN
	GE-30				FIRE ALARMS DIAGRAMS
	GE-31				SECURITY DIAGRAMS

MPWSP DESALINATION INFRASTRUCTURE - SPECIFICATION LIST					
SPECIFICATION LIST					
CIVIL					
Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE
					Testing and Disinfection
	311000				Site Preparation
	313000				Earthwork
	321113				Pavement Systems
	330516				Manholes and vaults
	334600				Underdrains
	333600				utility septic tanks
	333633				Septic Drainage Field
	339010				reinforced concrete piping
	339220				ductile iron piping
	339534				Large Polyethylene Pressure Piping
	334713				pond and reservoir lining
	323113				Fences, Gates, Site Appurtenances
	338300				Irrigation Systrems
	338300				Landscaping
	331626				Wire Wrapped Prestressed Concrete tank
INSTRUMENTATION AND CONTROL					
Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE
	409100				Process Control and Instrumentation Systems
	409102				In-Line Liquid Flow Measuring Devices
	409103				Liquid Flow Detection Devices
	409106				Level Measuring Systems
	409107				Level Detection Switches
	409108				Pressure Measuring Systems
	409109				Pressure Detection Switches
	409112				Process Analysis Measuring Systems
	409200				Control Panels
	409220				Control Panel Instrumentation
	409510				PLC based control system hardware
	409520				PLC based control system soft ware
	409300				Control Strategies^
MECHANICAL					
Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE
	460100				Equipment General Provisions
	464114				In-Line Mixing
	463300				Chemical Feeding Equipment, General
	463340				Metering Pumps
	463333				Polymer Blending Units
	463645				Lime Storage and Feed Systems
	463337				Calibration Columns
	463332				Chemical Feeder Control Stations
	463113				Chlorination Equipment
	463114				Dechlorination Equipment
	463314				Large Hypochlorite Generation System
	466613				Low Pressure/High Output Ultraviolet Disinfection
	463143				Carbon Dioxide Feed System
	463319				Sulfuric Acid Feed System
	XXXXXX				Zinc Orthophosphate Feed System
	46612X				Pressure Filters
	466324				Low Pressure Reverse Osmosis
	466326				High Pressure Osmosis
	431050				Piping, General
	431051				Piping Identification
	431052				Pipe Supports
	431053				Steel Pipe (ASTM A 53/A 106, Modified)
	431054				Stainless Steel Pipe (ASTM A 312, Modified)
	431061				Poly Vinyl Chloride Pressure Pipe (ASTM D 1785, Modified)
	431062				Chlorinated Poly Vinyl Chloride Pressure Pipe (ASTM F 441, Modified)
	431063				Fiber Glass Reinforced Plastic Pipe (ASTM D 2996/D 2997, Modified)
	431065				Double Containment Piping Systems
	431070				Pipe and Equipment Insulation
	431200				Blowers, Compressors, and Vacuum Pumps, General
	431230				Blowers, Centrifugal, Multistage
	431240				Compressors, Base-Mounted, Reciprocating
	432000				Pumps, General

	432001				Mechanical Variable Speed Drives
	432203				Horizontal ANSI End Suction Pumps
	432219				Horizontal Split Case Pumps
	432220				Large Horizontal Split Case Pumps
	432246				Chemical Pumps, Metal Body
	432249				Chemical Pumps, Plastic Body
	432293				Submersible Sump Pumps
	432500				Cartridge Filters
	432502				Strainers
	433000				Valves, General
	433008				Gauges
	433012				Valve and Gate Actuators
	433014				Butterfly Valves
	433016				Check Valves
	433018				Ball Valves
	433020				Diaphragm Valves
	433022				Gate Valves
	433024				Plug Valves
	433036				Rate of Flow Control Valves
	433038				Pump Control Valves
	433040				Pressure Reducing Valves
	433056				Hydraulic Gates, General
	433060				Cast Metal Slide Gates (AWWA C560, Modified)
	434000				Bolted Steel Tanks
	434002				Ground Storage Tanks
	435200				Hoists and Cranes, General
	435201				Electric Monorail Systems
	435203				Fixed Hoists
	433054				Fire hydrants

STRUCTURAL

Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE
	031100				Concrete Formwork
	032100				Reinforcing Steel
	033200				Joints in Concrete
	033100				Cast-In-Place Concrete
	036000				Grout
	051200				Structural Steel Framing
	055000				Miscellaneous Metals
	055200				Aluminum Railings
	068000				FRP Fabrications

ARCHITECTURAL

Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE
	072113				Building Insulation
	074113				Preformed Metal Roofing
	074213				Preformed Metal Wall Paneling
	077200				Roof Accessories
	078100				Firestopping
	079213				Sealants and Caulk
	079500				Expansion Control
	081113				Steel Doors and Frames
	083616				Overhead Doors and Fire Shutters
	084113				Aluminum Entrances and Storefronts
	087100				Finish Hardware
	088100				Glazing
	089100				Louvers and Vents
	092900				Gypsum Board
	093013				Ceramic Tile
	095113				Accoustical Ceiling
	096500				Resilient flooring
	096800				Carpeting
	099600				Protective Coatings
	101400				Signage
	102113				Metal Toilet Partitions
	102813				Toilet and Bath accessories
	104400				Fire Protection Specialties
	115300				Laboratory Equipment
	123100				Metal Laboratory Casework
	133413				Pre-Engineered Buildings

HVAC

Sr. No	Spc. No.	Rev. Description	Rev.	Rev. Date	SPECIFICATION TITLE

	230500				HVAC testing and balancing
	235000				HVAC General
	235200				Air Handling
	235300				Air conditioning
	235400				Ductwork
	236000				HVAC Instrument and Control

PLUMBING/FIRE					
Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	211010				Plumbing piping and specialties
	223000				Plumbing equipment
	224200				Plumbing fixtures
	211000				Water Based Fire Suppression
	211313				Wet Pipe Sprinkling
ELECTRICAL					
Sr. No	Drg. No.	Rev. Description	Rev.	Rev. Date	TITLE
	260000				Electrical Work, General
	2600533				Electrical Raceways
	260543				Underground Raceways Systems
	260519				Wire and Cable
	260536				Wiring Devices
	262313				Engine/Generator Switchgear
	261300				Electrical Service and Distribution
	260573				Protective Devices Study
	260526				Grounding
	262923				Variable Frequency Drives
	262940				MV Variable Frequency Drives
	260510				Electric Motors
	262200				Panel Boards and general purpose Dry Type Transformers
	262900				Low Voltage Motor Control Centers
	262913				Solids State Reduced Voltage STarters
	260515				Local Control Stations and electrical devices
	265000				Lighting
	263353				Uninteruptable Power Supplies
	263213				Standby Generator Systems
	264123				Lightning Protection Systems
	260126				Electrical Tests

F. Preliminary External Architecture Treatment, Renderings and Landscaping Plan

F. Preliminary External Architecture Treatment, Renderings and Landscaping Plan

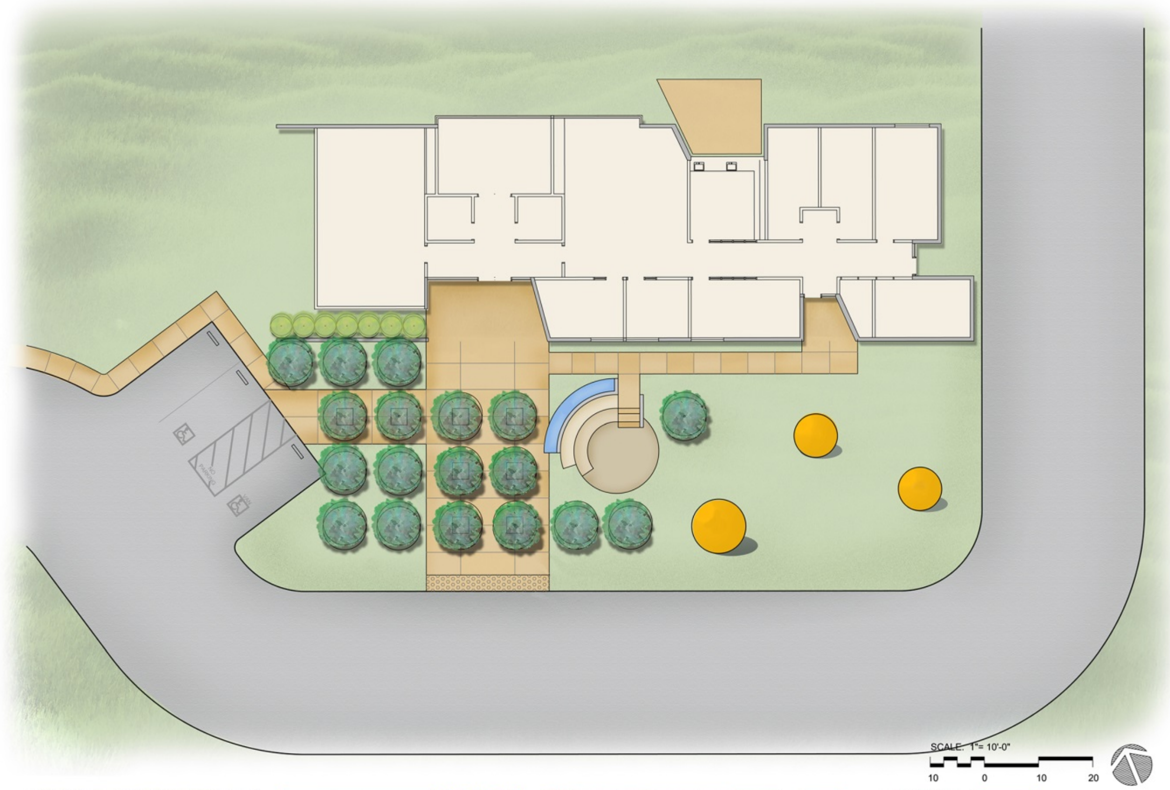
F. PRELIMINARY EXTERNAL ARCHITECTURE TREATMENT, RENDERINGS AND LANDSCAPING PLAN

Landscape Development Summary

The site and landscape designs provide the setting for the building and play off the clean, streamlined architectural lines of the administration building. The simplicity of the site layout complements the architecture and promotes ecological storm-water function while providing clear vehicle and pedestrian circulation patterns, minimizing site impacts and maximizing planted areas. The landscape development focuses on fundamental themes of "molecular structure" to highlight the scientific nature of the facility; as well as "patchwork agriculture" to incorporate the surrounding regional landscape (For landscape/irrigation plan, see Section 3.D. Drawing L-3 Irrigation and Planting Plan).

From the parking areas, visitors proceed to the visitor reception area in the administration building. Plantings in the front of the administration building shall be comprised of a single ornamental, architectural grass, also reminiscent of agricultural patterns. An interpretive site walk is provided to facilitate public tours of the facility and highlight notable details of the region and treatment process. The site walk begins from the administration building and routes the visitors to the southeast corner curtain wall of the RO building where the reverse osmosis equipment can be viewed. The site walk extends along the south face of the RO building along a landscaped berm, elevating the visitor and allowing a unique vantage point into the RO building at two locations. From the RO building, the walk extends to the north edge of the plant providing the visitor a view of the Salinas River. This location contemplates an interpretive garden as part of a future educational program. The walk proceeds east behind the finished water pump station and storage facility, the disinfection building, the concentrate pond and then back to the administration building.

MWH has prepared a landscaping plan for the Base Project that includes a specified number or trees and assorted native grasses and shrubs that includes 120, 5 gallon Cypress trees and 330,239 SF of native grasses and shrubs. As a voluntary alternative, MWH is proposing an enhanced entrance to the administration building. The courtyard is anchored by an attractive water feature symbolizing the hydrological significance of the building. The courtyard surfacing is integrally colored, saw cut, exposed concrete and is interlaced with seeded concrete bands imitating the agricultural row crops of the area. Concrete seating benches and planting in the courtyard will follow the geometry of the seeded bands. Planting will be comprised of a single ornamental architectural grass, also reminiscent of agricultural patterns. The entrance courtyard would include an integrated water feature, "molecular" architectural features, and patchwork native plantings – see renderings below and Section 3.D. Drawing L-2 Administration Facilities Conceptual Landscape Site Plan.




① Teaching Amphitheater


③ Molecule Sculptures


⑥ Native Grass Planting


⑦ Courtyard Trees

Preliminary External Architecture Treatment

The administration building is conceived as a simple, flexible structure that seamlessly engages the desalinization plant's infrastructure and reflects its sustainable mission. Sited off the main entry/access road, the administration building will serve as the plant's control center and lab, as well as the public face of the overall facility. The building is intended to demonstrate, elegantly and subtly, a sustainable and resilient approach to building design, construction and operations as well as sensitivity to the site and surrounds. The interior planning and materials will reflect the precepts of biomimicry and sustainability.

The plan will incorporate load bearing perimeter CMU walls that support a long span system of open web trusses to allow for a column-free plan and maximum flexibility in interior space planning. The exterior CMU walls will add significant thermal mass to the design resulting in reduced mechanical heating/cooling needs, provide a durable exterior envelope, and will be locally sourced.

The building will reduce its energy demand with its use of good building envelope design and proper window placement, thus minimizing the dependency on artificial lighting and mechanical ventilation and cooling. Daylighting strategies will be maximized including high performance interior and exterior glazing that will optimize daylight transfer and good views for the Administration Building occupants.

Additionally, please reference section 3.G Approach to Sustainable Building for details of alternate possibilities to highlight specific sustainability features of the administration facility. These items include solar tubes placed in the locker rooms, toilet rooms, and maintenance area to allow natural light into these interior spaces that do not have direct access to a window. Roof mounted Photovoltaic cells and solar water heaters will reduce the building's electricity costs as well as the mechanical equipment sizes and required spaces. Natural ventilation will be achieved through the use of operable windows and a fan assist system. Potable water use will be reduced by capturing storm water for irrigation. Green (vegetated) roofs will be designed to reduce storm water runoff, increase building thermal capacity, and support diversity and a restorative habitat.

Upon CAW's implementation of a public educational platform, the administration building can support the story of CAW's mission by incorporating environmental graphics and signage that describe the importance of water in this specific region of the State, how the plant serves to conserve potable water, and the specific sustainable features of the administration building.

G. Approach to Sustainable Building

G. Approach to Sustainable Building

G. APPROACH TO SUSTAINABLE BUILDING

As an industry leader in environmental technology for more than half a century, MWH has naturally extended its services to encompass sustainable design in every aspect of our work. MWH is a member of the United States Green Building Council (USGBC) and supports the LEED approach to project delivery. MWH has over **75 LEED Accredited Professionals** throughout company offices that provide sustainable design services for our clients who demand cutting edge technology solutions in today's sustainability conscious world. As an example of our LEED experience MWH achieved LEED Gold Certification on both the Vineyard Surface Water Treatment Plant for the, Sacramento County Water Agency and the Corona Del Mar WTP Phase 2 Upgrades and Modifications for the Goleta Water District in Goleta, CA.

Enhancing our sustainable resources, MWH has teamed up with WRNS Studio, a San Francisco based architectural and planning firm known for its high quality and sustainable designs. WRNS designs can be found in college campuses, hospitals, transit centers, parking structures as well as the Watsonville Water Resources Centers that included significant sustainability and educational components and was an **AIA/COTE Top Ten Green Project in 2010**. Their design ethic is informed by sensitivity to place, contextual engagement, technical proficiency and resource conservation. **WNRS was recently ranked the No. 1 architectural firm in the country by the American Institute of Architects (AIA) for 2013**.

Our approach to sustainable design reconciles the project goals with available resources and the constraints of any given project, i.e., location, schedule and budget that will truly define the effort. For this project, the MWH design-build team will collaborate with CAW to establish the sustainable goals and bench marks our team will need to achieve.

*"Great design is sustainable design—and it begins with the simple ingredients of place, program, and budget. This is reflected in our recent recognition by **Architect Magazine as the #1 overall architecture firm in the country** – which includes WRNS as one of the **top 5 leaders in sustainable design**. Every effort we undertake incorporates a strategy that manifests our commitment to environmental responsibility and our client's mission. We employ a variety of tools and concepts to inform our design including the Living Building Challenge, the Natural Step, and various building benchmark systems, such as Leadership in Energy and Environmental Design (LEED) and Labs21. These tools help us guide robust discussions that result in appropriate sustainability targets."*

WRNS Sutdio

MWH's Proposed Design

The plan of the building has been shaped and oriented to best take advantage of views, daylighting autonomy, and natural ventilation. The narrow rectilinear shape of the building primarily faces south toward the main entry of the facility and the southern sunlight. The building is placed back, away from the entry drive, providing space for short term and visitor parking, and a more generous public entry experience.

The building will reduce its energy demand with its use of good building envelope design and proper window placement, thus minimizing the dependency on artificial lighting and mechanical ventilation and cooling. Daylighting strategies will be maximized including high performance interior and exterior glazing that will optimize daylight transfer and good views for the Administration Building occupants.

Seawater desalination uses considerably more power than other types of water treatment facilities. This raises not only cost concerns but also environmental concerns about greenhouse gas emissions and carbon footprint. Our design includes the most energy efficient pumps, membranes and energy recovery devices available, and it minimizes system losses and provides controls that enable the operators to minimize power consumption on a real-time basis. Additionally, compared to the base project design, **our alternative design will save over 9 million kilowatt hours (kWh) per year in power consumption for a 9.6 mgd facility. Our Voluntary Alternative Proposal No. 2 proposes solar panel arrays in the open space. The solar panels will produce more that 2.5 million kWh of electricity annually, enough energy to supply power to 350 homes**. The reduction in energy consumption combined with the solar power production equates to over $1M in annual energy savings.

Final Design Process

During the final design process we will analyze the opportunities of the site, and the ability of the project to maximize all sustainable elements and installations including available assets such as wind patterns, stormwater management, regional material sources and other bioclimatic considerations. We will use benchmarking tools such as the LEED checklist and Net Zero Energy (NZE) strategies/data from previous projects to work with CAW to identify and communicate target goals and expected results. This information will be used to develop a LEED and NZE target summary to be used in the final design process while performance expectations for every sustainable element will be established through the checklist/target process.

In addition to the sustainable features included in the base bid, our building design can be adapted if CAW desires to access the Elective Interior or Exterior Features allowances. Multiple sustainable features have been provided as alternate options and can be seamlessly incorporated into the final design of the facility. These options include:

- <u>Solar Tubes.</u> Placed in the locker rooms, toilet rooms, and maintenance area, will bring natural light to these interior spaces that do not have direct access to a window.
- <u>Radiant Heating</u>. Provide radiant in-floor heating and cooling in the Admin Building. Addition of radiant heating will provide more consistent ambient temperature while reducing the loads required by the conventional HVAC systems.
- <u>Curtain Window Wall at Admin Visitor Area</u>. Addition of curtain window wall at the visitor area in the Admin Building, as portrayed in the architectural rendering, will allow for increased natural lighting as well as provide a platform for information tours and public use.
- <u>Photovoltaic Array at Admin Roof</u>. With the incorporation of a flat roof, the design of the administration building provides flexibility for the incorporation of a solar PV array. This array will augment the building's electricity costs and reduce mechanical equipment sizes and required spaces.
- <u>Vegetative Roof at Admin Building</u>. As an alternate to a PV array; a vegetative roof may also be incorporated into the construction of the Administration facility. This will reduce stormwater runoff, increase building thermal capacity, and support diversity and a restorative habitat.

Minimizing power consumption will be the most important environmental benefit MWH can bring to the project, but there are many other design features that can provide environmental enhancements. MWH has designed numerous water and wastewater facilities that have achieved LEED certification and can bring that experience to CAW's project. Some of the opportunities we have identified include:

- An integrated approach to building envelope, glazing, daylighting, HVAC system and controls resulted in performance over 30% better than the State's Title 24 energy code requirements
- Heat recovery for in-plant heating
- Use of natural daylight – natural lighting through skylights and glass walls in the lobby, solar tube skylights throughout internal building areas, resulting in less electric lighting
- Innovative light pollution reduction
- Specification of recycled content for select building materials containing post-consumer and post-industrial recycled content
- Materials made of highly renewable resources (casework included no added urea-formaldehyde cores, bamboo veneers, counters were made with recycled glass)
- Specification of low-VOC products complying with Green Seal Environmental Standard GS-11
- Computer-controlled lighting and heating, ventilation, and air conditioning systems,
- Reduced potable water consumption – all flush and flow water fixtures demonstrate efficient technologies, reducing potable water consumption by 44% over conventional fixtures
- Provision of alternative transportation
- Maximizing open space on site
- Preferred parking for fuel-efficient vehicles
- Reduced parking requirements
- Highly reflective pavement colors were specified to reduce the heat island effect
- Reflective roofing materials to control heat gain
- Construction waste debris recycled or reused, diverting it from the landfill – approximately 75% of construction waste to be diverted from landfills and recycled
- Materials and components specified to include locally manufactured products that saved time and energy on transportation costs
- All wood used in the project certified by the Forest Stewardship Council (FSC).
- A stormwater detention basin on site to provide water quality storage through a combination of a permanent pool and extended detention storage for flood control
- Natural storm water management systems consisting of bio-swales and pervious pavement (i.e. "green" roads)
- Native landscaping and new trees planted to offset greenhouse gas emissions and to provide an aesthetically pleasing environment for occupants
- If available, irrigate landscaping with recycled wastewater to conserve water

Efficient Use of Water and Energy

Saving water is part of being a responsible contractor and has become a key component of project planning and execution. On every project there are key water using processes that need to be taken into consideration:

- General site activities
- Groundworks, including grouting and drilling
- Dust suppression, including road and wheel washing
- Cleaning of tools and plant equipment
- Commissioning and testing of building plant and services

MWH will use a behavior based approach and Best Management Practices (BMPs) to conserve water and energy by raising awareness through briefings, posters and notices to all project personnel. Water conservation BMPs will also become topics of discussion at daily toolbox talks and during weekly construction coordination meetings with subcontractors and vendors. By continuously keeping water and energy conservation at the forefront of project topics we can change attitudes and behaviors towards conservation through the implementation of BMPs. BMPs for water conservation that will be implemented during construction include:

- Keeping water equipment in good working condition
- Vacuuming or sweep paved roadways rather than flushing with water
- Using admixtures for dust suppression that bind particles to reduce watering frequency
- Stabilizing water truck filling area
- Repairing water leaks promptly
- Installing high efficiency restroom fixtures in construction trailers
- Using a closed-loop water recycling system for wheel wash station and concrete washout
- Washing of vehicles and equipment on the construction site is discouraged
- Locking water tank valves to prevent unauthorized use.
- Repairing water equipment as needed to prevent unintended discharges
    - Water trucks
    - Water reservoirs/tanks
    - Irrigation systems
    - Hydrant connections
- Recycling water during commissioning activities

Water and energy use are inextricably linked on construction sites. Energy conservation BMPs that will be utilized on the project site include:

Office trailers – Temporary office trailers are often poorly insulated and consume substantial amounts of energy for cooling and heating. We will search for office trailers that:

- Are well insulated
- Use LED and Eco energy saving light bulbs
- Include occupancy sensors in offices, restrooms and conference rooms

Efficient use of machinery - Encourage subcontractors to select the most energy efficient equipment and utilize strategies for its efficient use during construction. This action focuses on encouraging efficient operations of construction equipment and includes:

- Choosing the right machine for the task – avoid inefficiently oversized machines
- Selecting equipment that is more fuel efficient
- Proper service and maintenance
- Using sustainable low carbon fuels
- Operating equipment efficiently (e.g. minimizing idling time and using appropriate power)

Site toolbox talks - Develop site tool box talks that raise operator awareness of the benefits and savings of fuel efficient operations.

Construction Site Activities - Good practice energy efficiency on a construction site includes:

- Eliminate night time construction activities
- Controlling generators to meet only current electricity needs
- Avoiding unnecessary night time site and accommodation lighting
- Installing energy efficient security and task lighting such as fluorescent, LED and metal halide lamps

Recycling Plan

We understand that landfill capacity and waste reduction are very important issues and we are committed to implementing a robust waste management program. By employing well planned waste prevention techniques, material reuse, recycling and JIT inventory management, we can minimize total waste and recycle up to 90% of what's left. With the Monterey Peninsula Landfill adjacent to the project site, we have an ideal opportunity to maximize our recycling efforts during construction.

We can achieve the highest rates of recycling through source separation of materials at the project site. This is accomplished by providing separate dumpsters for clean concrete, wood, metals, asphalt, and soil. This approach provides two primary benefits:

- Monterey Regional Waste Management District (MRWMD) fee schedule offers discounted rates for clean loads containing source separated wood, concrete, asphalt, or soil.

- The landfill's Materials Recovery Facility (MRF) tracks the diversions and provides a scale receipt for actual diversion percentages that we can use for reporting on the project which has been accepted by the US Green Building Council for LEEDs projects.

The MRWMD will provide the monthly diversion calculation to certify diversions for our load(s) that go to the MRF based on the month our load(s) were delivered.

Natural Materials That Originate From a Local or Regional Source

As the demand for healthy buildings grows, resources and materials are quickly becoming more accessible. To assist in identifying local and regional natural materials The USGBC Monterey Bay Committee serves the counties of Santa Cruz, Monterey and San Benito and assists in identifying local and regional natural material suppliers in the three-county region. A partial list of natural material suppliers includes:

Hayward Lumber, Pacific Grove - Currently the only Monterey County outlet for Forest Stewardship Council-certified lumber, Hayward also has formaldehyde-free fiberglass installation and medium density fiberboard (for cabinets), recycled cotton insulation, and Trex decking made of recycled plastic and wood, hardwood and bamboo flooring

Big Creek, Watsonville - This lumber producer in Santa Cruz County takes about half of its highly-coveted redwood from Forest Stewardship Council-certified forest lands.

Granite Rock, Seaside - Pervious concrete, limestone, high-fly-ash content concrete, interlocking pavers, Turfstone, ECO-Block, and erosion control construction products located in Seaside.

Greenspace, Santa Cruz - No and very low VOC Paints and finishes, Forest Stewardship Council certified, natural and reclaimed flooring, recycled content countertops and tile.

Eco Design Resources, Santa Cruz - Here they provide kitchen, office and construction products "created with natural materials that do not compromise personal health, design or the environment

Central Home Supply, Santa Cruz - One of the largest natural stone suppliers in the tri-county region that includes flagstone, slate, tumbled stone, limestones, fieldstone, ledgestone, pebbles, cobbles, boulders, and numerous others.

Peninsula Building Materials, Mountain View - Is the premiere supplier of natural stone and brick in northern California.

Cemex, Marina - Top provider of crushed stone, gravel, sand and recycled concrete. Lapis Lustre Sands are a top quality product, derived directly from the seashore. Lapis Lustre Sands are preferred over other manufactured sands due to low dust content and eco-friendly attributes. Lapis Lustre Sands are used in gardens and nurseries, golf courses, recreational facilities, water filtrations systems and many other construction uses.

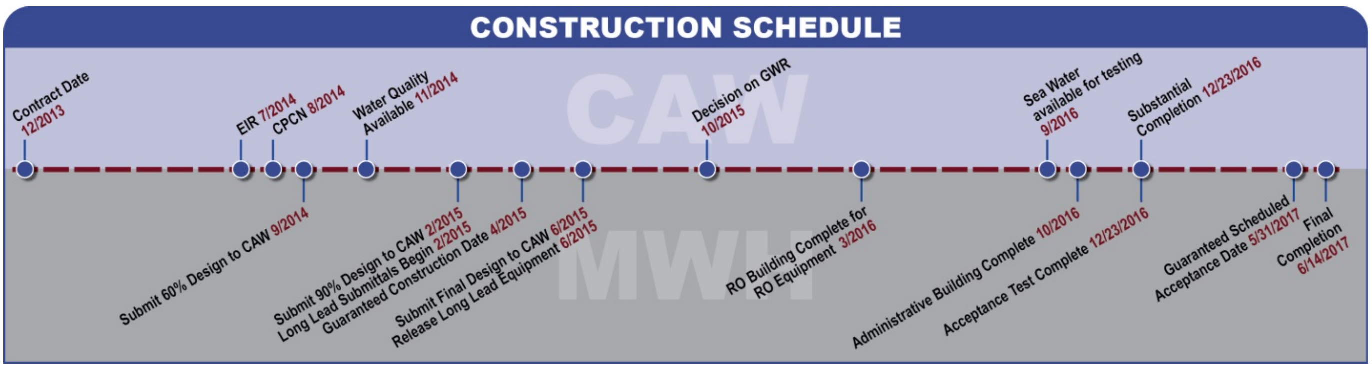
MWH will endeavor to maximize the use of natural materials from local sources such as those identified by the USGBC Monterey Bay Committee. This approach to local sourcing of construction materials provides the duel benefit of creating a more sustainable project and bolstering the local economy.

H. Proposal Form 12: Preliminary Project Schedule, Scheduled Construction Date and Scheduled Acceptance Date

H. Proposal Form 12: Preliminary Project Schedule, Scheduled Construction Date and Scheduled Acceptance Date

H. PROPOSAL FORM 12: PRELIMINARY PROJECT SCHEDULE, SCHEDULED CONSTRUCTION DATE AND SCHEDULED ACCEPTANCE DATE

MWH has developed an aggressive yet achievable schedule which leverages the advantages of the design build process to deliver CAW an operating plant prior to the Cease and Desist Order deadline. Completing Acceptance Testing and achieving Substantial Completion prior to of December 23, 2016 will eliminate CAWs exposure to fines from the CPUC. With the project achieving Guaranteed Scheduled Acceptance Date by May 31, 2017 this allows CAW to reduce its diversion from the Carmel River before flows reach their critical stage in 2017. Our detailed schedule is attached and a summary timeline is provided below.



Assuming a Contract Date by December 23, 2013, we have developed the following tasks to be completed during the first 60 days:

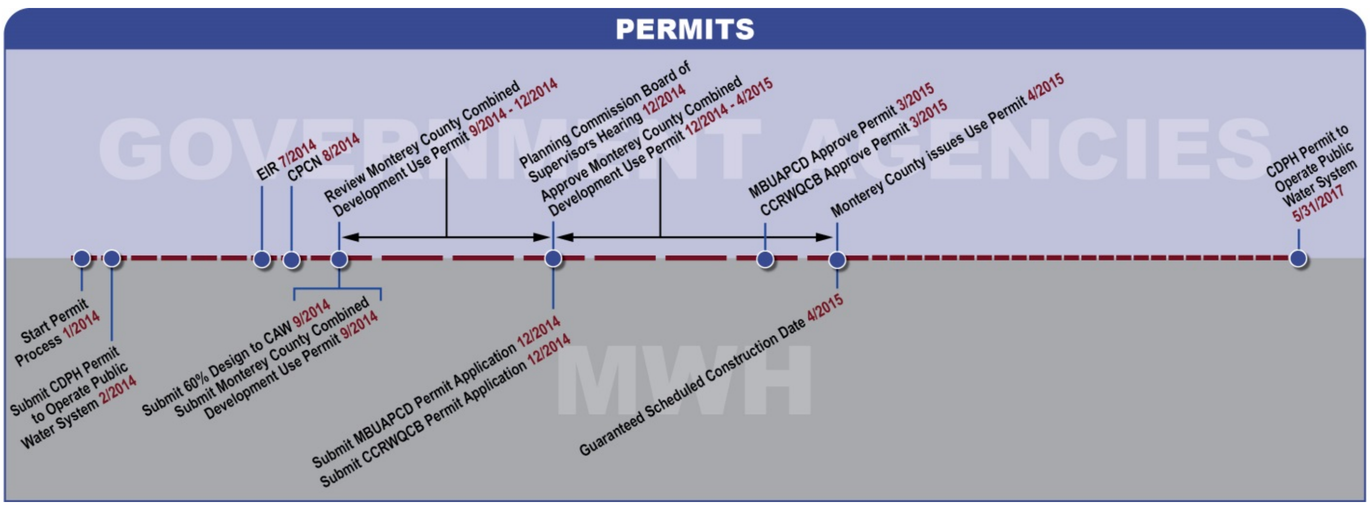
Development of a project-specific Management Administration Plan (MAP). As discussed in Section 3.I of this Proposal, MWH prepares a MAP for every project to properly manage, control and document the processes and procedures for effectively managing every aspect the project. The MAP is jointly developed with CAW to capture the project's goals and objectives and reporting processes and procedures. Included in this process is the further development of the project schedule. The project schedule will be detailed to better describe the projects logical and manageable components. Design, procurement, permitting and Owner driving activities will be refined to confirm delivery/ approval dates in order to show a defined critical path. With the construction planning process having been extensively evaluated, detailed development of each component of the project depicting the critical path shall be completed during this time.

Project Kickoff Meetings. An initial kickoff meeting will be held, and with the assistance of a facilitator, the team will develop the foundation for their partnership. They will establish a partnering charter, common project objectives and working arrangements for future project team meetings, and finalize standard protocols to be used for the duration of the project. MWH has found it very helpful to discuss roles and responsibilities of the team members at the kickoff meeting to ensure rapid resolution of any issues that may develop during the project and who has what authority to resolve issues during the project. Also during the kickoff meeting, the team will focus on the details of the project reviewing the project schedule, permit schedule, design issues, project procedures, community relations, submittals, pay applications and maintaining the project files and documents.

Permitting is one of the most critical activities to the success of this project. MWH will develop a Permitting Quality Management Plan as part of our Design-Build Quality Management Program and will start the permitting process on day-one to ensure meeting the project schedule. As multiple responsible parties are involved, this is going to take close coordination with CAW to ensure all parties stay on schedule.

By the end of the first 60 days, MWH will conduct the Value Engineering Workshop and complete the 30% design.

The Monterey County Combined Land Use Permit is the most time-critical permit on the project. As shown in our schedule, and in the timeline below, completing the application is dependent upon completion of the 60% design, certification of the EIR, and issuance of the CPCN. Our schedule assumes completion of these three key activities and submission of the Monterey County Combined Land Use Permit by September 12, 2014. Per agency communications with Luke Connolly, typical durations for Monterey County to review the application, hold the commissioning hearings and approve the application is 6 – 9 months. MWH has allowed approximately 7 ½ months in our schedule. While our duration is aggressive, it is reasonable given the strategy we plan to employ as detailed in Section 3 I.



The 60% design will be based on the assumed water quality data. With water quality data available by November 13, 2014; MWH will be able to progress with the 90% design. Since a number of equipment packages have significant lead time requirements, MWH's focus during the 90% design development is to begin the submittal process of the long lead equipment by the end of January, 2015. This equipment includes the VFD's for the high pressure feed pumps, RO Equipment (including the Feed Pumps, Skids, Vessels, Membranes and Energy Recovery Devices), Pad mounted Transformers, Generators and the Finished Water pumps. MWH will commence coordination efforts with the long lead equipment vendors providing the team the ability to work through issues during live meetings instead of traditional review cycles. This will reduce the time required for submittal review, and assist in reducing potential time and cost impacts associated with too many RFIs. These unique coordination meetings provide us the ability to include changes deemed necessary for the final design documents.

Concurrent with the Monterey County land application approval process, MWH will be obtaining, or assisting CAW in obtaining, all other government approvals necessary for construction. MWH's proposed schedule is based on receipt of all necessary approvals and MWH meeting all contractual requirements for a Construction Date by April, 27, 2015.

MWH understands the decision on the GWR is not scheduled until November, 2015 however establishing a Construction Date prior to GWR decision is critical for two reasons:

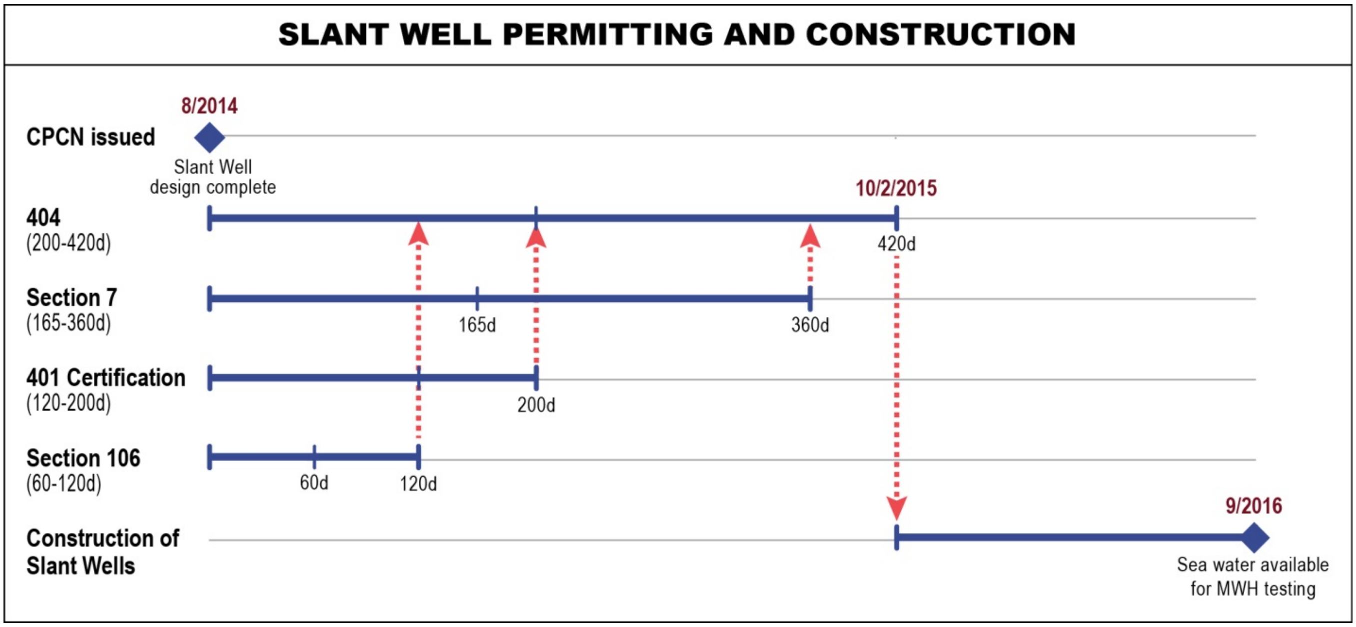
1. First, it allows MWH to mobilize to the site in the summer of 2015 to establish the SWPPP and environmental controls, clear and grub the site, and perform the mass excavation. Once complete, construction facilities such as the laydown areas, construction parking and the full construction trailer complex can be installed, followed by construction on portions of the project that are not contingent upon the GWR sizing. These areas include:
    a. Chemical Building
    b. HV Building
    c. Feed Tanks & Feed Pumps
    d. Selected Yard Piping

Once the GWR is sized, MWH can immediately progress to the construction of the size dependent facilities. Sequencing the project in this manner significantly reduces the project duration.

2. Second, MWH can release selected long lead equipment for fabrication. With fabrication times as long as 7-1/2 months for some equipment, releasing even a portion of this equipment will have a significant positive impact on the schedule. As an example of our approach is that we would release 5 of the RO Feed pumps for fabrication, enough for the 6.4 mgd plant. Once the GWR decision is made, if the project size is 9.6 mgd, the remaining 2 pumps would be released. Installation of all 5 would not happen at once so the project would not be hindered by the lag in the fabrication of the remaining 2 pumps. We would employ this same strategy for the other long lead equipment. Another example is the Pad Mounted Transformers, Generator and Main Distribution Switchgear. MWH would start these submittals in late January and February of 2015 so equipment can go into the production cue for fabrication. Most electrical equipment requires several months before going into the production after approved submittals. Per the specifications these items will be designed and built for the capacity of 12.8 and would not change once the decision is made on the 9.6 or 6.4 plant.

The construction sequence was created based on the longest path which is defined as the RO building, Chemical Building, Pressure Filters, Electrical Structures, Cartridge Filters, Feed Tanks and Pumps, Administration Building, UV, Backwash Settling Basins and Brine Pond.

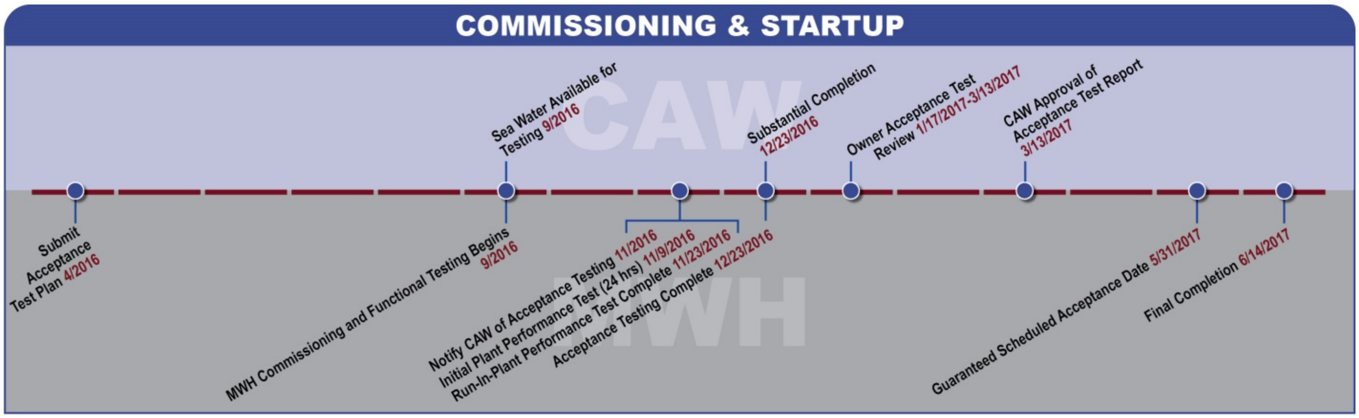
MWH's proposed schedule also identifies owner milestones such as the completion of the slant wells. The Slant Well design must be complete when the CPUC is issued in August 2014 so that the permit process can begin for the Section 404 permit. The 404 permitting process can take from 200 to 420 days after the approval of the CPUC. Therefore, assuming the full 420 days, CAW will receive the 404 permit in October 2015. This will allow construction of the slant wells to take place from October 2015 thru September 2016 which should be sufficient time. This will allow sea water available for testing at the plant site in September 2016.



Slant Well Design, Permitting and Construction

MWH understands that commissioning and startup is always part of the critical path of every project. The schedule timeline below highlights the critical activities of the commissioning and startup activities within the schedule. To complete the Acceptance Test by December 23, 2016 MWH has identified the following interim milestones:

- Sea water available for testing in September 2016
- October 2016 starts functional testing of equipment
- Perform 24 hr. Initial Plant Performance Test on 11/9/2016
- Complete Run-In-Plant Performance Test by November 23, 2016.
- Complete Acceptance Testing December 23, 2016.
- Substantial Completion/Beneficial Usage Starts December 23,02016



MWH has included additional time during the commissioning and startup for review of the process by CDPH as part of their Permit to Operate process. Upon completion of the acceptance testing, MWH will prepare the Acceptance Test Report for review and approval. Allowing for to 60 day CAW review period, MWH will meet all the requirements of Guaranteed Scheduled Acceptance Date by May 31, 2017.

PROPOSAL FORM 12

PRELIMINARY PROJECT SCHEDULE, SCHEDULED CONSTRUCTION DATE AND SCHEDULED ACCEPTANCE DATE

The Proposer shall submit a Preliminary Project Schedule with the Proposal that includes important design, procurement and construction activities and milestones from the Contract Date through Final Completion. This Preliminary Project Schedule shall be submitted in both written and electronic formats. The level of detail shall be in summary level for major procurement, permitting, design and construction activities. Major milestones throughout the Design-Build Period shall be included. The Proposer shall also guarantee the Scheduled Construction Date and the Scheduled Acceptance Date.

The Preliminary Project Schedule shall consist of, but not be limited to, the following:

(i) Important design activities and milestones

(ii) Important procurement activities and milestones

(iii) Important construction activities and milestones

(iv) It shall indicate the sequence of Design-Build Work and the time of starting and completing each part.

The Preliminary Project Schedule shall identify each applicable Governmental Approval and the estimated calendar time required to submit a complete Governmental Approval application, and the estimated calendar time required to obtain the Governmental Approval. The Proposer shall specify the "Governmental Approval Application Dates" to be set forth in subsection 4.5(J) of the draft DB Agreement. In addition, the Proposer shall summarize and provide a list of proposed major milestones and completion dates including, but not limited to:

- Contract Date
- Basis of Design Report
- 40-50% Facility Specifications & Drawings complete
- 80-90% Facility Specifications & Drawings complete
- 100% Governmental Approvals received (MWH obtained permits except CDPH)
- On-site delivery of all major equipment
- Guaranteed Scheduled Construction Date
- Completion of major structures

- Commissioning and functional testing commencement
- Substantial Completion Date ~~(including CDPH approval)~~
- Run-in Period commencement
- Acceptance Test
- Guaranteed Scheduled Acceptance Date (including CDPH approval)
- Final Completion

The Proposer shall use the following format to provide this information:

TABLE 12-1 MAJOR ACTIVITIES AND MILESTONES[1]

ACTIVITY NUMBER	ACTIVITY/MILESTONE	DATE[2]
MS-395	Contract Date	20-Dec-13
A1540	Basis of Design Report	21-Feb-14
DMS-100	60% Facility Specifications & Drawings Complete	11-Sep-14
DMS-110	90% Facility Specifications & Drawings Complete	25-Feb-15
DMS-150	100% Governmental Approvals Received (MWH obtained permits except CDPH)	24-Apr-15
MS-535	Guaranteed Scheduled Construction Date	27-Apr-15
MS-145	On-Site Delivery of all Major Equipment	16-Jun-16
MS-155	Completion of Major Structures	25-Oct-16
SC-150	Commissioning & Functional Testing Commencement	26-Oct-16
SC-110	Run-In Period Commencement (RIPPT) (14D)	10-Nov-16

Footnotes:
1 List each major activity and milestone separately.
2 Indicate the end of activity or date milestone achieved.

SC-120	Acceptance Testing (AT) (16D)	23-Dec-16
MS-545	Substantial Completion Date ~~(including CDPH approval)~~	23-Dec-16
MS-445	100% Governmental Approvals Received (including CDPH approval)	31-May-17
MS-445	Guaranteed Scheduled Acceptance Date	31-May-17
MS-525	Final Completion	17-Jun-17

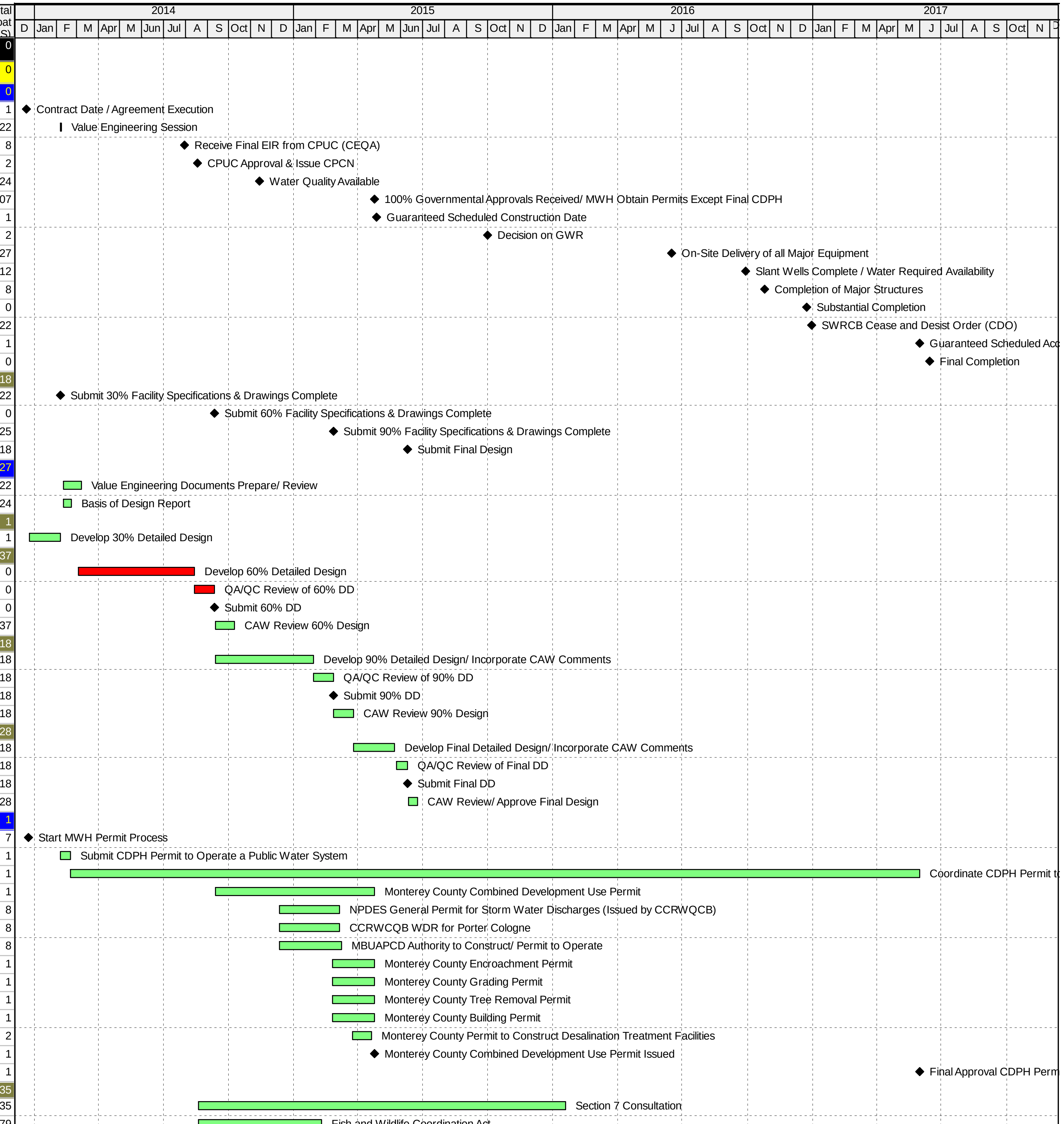
MWH Constructors, Inc.
Name of Proposer

Blair M. Lavoie
Name of Designated Signatory

Signature

President, MWH Constructors
Title

Activity ID	Activity Name	Orig Dur (WKS)	Start	Finish	Total Float (WKS)
Total		176	20-Dec-13	14-Jun-17	0
Desalination Infrastructure Project		176	20-Dec-13	14-Jun-17	0
Milestones		176	20-Dec-13	14-Jun-17	0
MS-395	Contract Date / Agreement Execution	0		20-Dec-13*	1
DMS-140	Value Engineering Session	0	06-Feb-14	07-Feb-14	22
MS-255	Receive Final EIR from CPUC (CEQA)	0		31-Jul-14*	8
MS-135	CPUC Approval & Issue CPCN	0		18-Aug-14*	2
MS-405	Water Quality Available	0		13-Nov-14*	24
DMS-150	100% Governmental Approvals Received/ MWH Obtain Permits Except Final CDPH	0		24-Apr-15	107
MS-535	Guaranteed Scheduled Construction Date	0	27-Apr-15		1
MS-295	Decision on GWR	0		01-Oct-15*	2
MS-145	On-Site Delivery of all Major Equipment	0		16-Jun-16	27
MS-195	Slant Wells Complete / Water Required Availability	0		28-Sep-16	12
MS-155	Completion of Major Structures	0		25-Oct-16	8
MS-545	Substantial Completion	0		23-Dec-16*	0
MS-425	SWRCB Cease and Desist Order (CDO)	0		30-Dec-16*	22
MS-445	Guaranteed Scheduled Acceptance Date (including Final CDPH)	0		31-May-17*	1
MS-525	Final Completion	0		14-Jun-17*	0
Design Milestones		68	05-Feb-14	10-Jun-15	18
DMS-160	Submit 30% Facility Specifications & Drawings Complete	0		05-Feb-14	22
DMS-100	Submit 60% Facility Specifications & Drawings Complete	0		11-Sep-14	0
DMS-110	Submit 90% Facility Specifications & Drawings Complete	0		25-Feb-15	25
DMS-120	Submit Final Design	0		10-Jun-15	18
Detailed Design		76	24-Dec-13	24-Jun-15	27
A1530	Value Engineering Documents Prepare/ Review	4	10-Feb-14	07-Mar-14	22
A1540	Basis of Design Report	2	10-Feb-14	21-Feb-14	24
30% Detailed Design		6	24-Dec-13	05-Feb-14	1
DD-290	Develop 30% Detailed Design	6	24-Dec-13	05-Feb-14	1
60% Detailed Design		31	03-Mar-14	09-Oct-14	37
DD-170	Develop 60% Detailed Design	23	03-Mar-14*	13-Aug-14	0
DD-180	QA/QC Review of 60% DD	4	14-Aug-14	11-Sep-14	0
DD-190	Submit 60% DD	0		11-Sep-14	0
DD-200	CAW Review 60% Design	4	12-Sep-14	09-Oct-14	37
90% Detailed Design		27	12-Sep-14	25-Mar-15	18
DD-210	Develop 90% Detailed Design/ Incorporate CAW Comments	19	12-Sep-14	28-Jan-15	18
DD-220	QA/QC Review of 90% DD	4	29-Jan-15	25-Feb-15	18
DD-230	Submit 90% DD	0		25-Feb-15	18
DD-240	CAW Review 90% Design	4	26-Feb-15	25-Mar-15	18
Final Design		13	26-Mar-15	24-Jun-15	28
DD-250	Develop Final Detailed Design/ Incorporate CAW Comments	8	26-Mar-15	22-May-15	18
DD-260	QA/QC Review of Final DD	2	26-May-15	10-Jun-15	18
DD-270	Submit Final DD	0		10-Jun-15	18
DD-280	CAW Review/ Approve Final Design	2	11-Jun-15	24-Jun-15	28
Permitting Requirements		174	23-Dec-13	31-May-17	1
PER-110	Start MWH Permit Process	0	23-Dec-13		7
PER-290	Submit CDPH Permit to Operate a Public Water System	2	06-Feb-14	19-Feb-14	1
PER-380	Coordinate CDPH Permit to Operate a Public Water System	166	20-Feb-14	31-May-17	1
PER-270	Monterey County Combined Development Use Permit	31	12-Sep-14	24-Apr-15	1
PER-230	NPDES General Permit for Storm Water Discharges (Issued by CCRWQCB)	12	12-Dec-14	06-Mar-15	8
PER-240	CCRWCQB WDR for Porter Cologne	12	12-Dec-14	06-Mar-15	8
PER-320	MBUAPCD Authority to Construct/ Permit to Operate	12	12-Dec-14	09-Mar-15	8
PER-260	Monterey County Encroachment Permit	9	24-Feb-15	24-Apr-15	1
PER-280	Monterey County Grading Permit	9	24-Feb-15	24-Apr-15	1
PER-310	Monterey County Tree Removal Permit	9	24-Feb-15	24-Apr-15	1
PER-340	Monterey County Building Permit	9	24-Feb-15	24-Apr-15	1
PER-300	Monterey County Permit to Construct Desalination Treatment Facilities	4	24-Mar-15	20-Apr-15	2
PER-350	Monterey County Combined Development Use Permit Issued	0		24-Apr-15	1
PER-250	Final Approval CDPH Permit to Operate a Public Water System	0		31-May-17	1
Owner Requirements		84	19-Aug-14	19-Apr-16	35
PER-100	Section 7 Consultation	72	19-Aug-14	19-Jan-16	35
PER-120	Fish and Wildlife Coordination Act	24	19-Aug-14	09-Feb-15	79



Remaining Level of Effort
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaini...
Milestone

California American Water Desalination Infrastructure Project
Proposal Schedule

Activity ID	Activity Name	Orig Dur (WKS)	Start	Finish	Total Float (WKS)
PER-130	USACE Section 404 CWA	84	19-Aug-14	19-Apr-16	35
PER-160	CDFW Incidental Take Statement / Streambed Alteration Agreement	40	19-Aug-14	02-Jun-15	79
PER-170	CCC Coastal Development Permit	72	19-Aug-14	22-Jan-16	47
PER-190	CCRWQCB NPDES 402 CWA	30	19-Aug-14	23-Mar-15	2
PER-200	Water Quality Certification Section 401	40	19-Aug-14	02-Jun-15	79
PER-210	MPWMD Water System Expansion Permit	47	19-Aug-14	20-Jul-15	72
PER-220	Monterey Regional Wastewater PCA Brine Line Connection to PCA Outfall	47	19-Aug-14	20-Jul-15	72
PER-360	Planning Commission/ Board of Supervisor's Hearing for Use Permit	0	12-Dec-14		20
PER-180	SHPO Section 106 Consultation	24	22-Oct-15	19-Apr-16	35
Procurement		87	15-Dec-14	02-Sep-16	40
A1520	Execute Subcontracts/ Purchase Agreement	4	15-Dec-14	13-Jan-15	123
ROEM Equipment		59	29-Jan-15	24-Mar-16	0
PRO-2060	Prepare ROEM Equipment	16	29-Jan-15	20-May-15	0
PRO-2070	MWH Review/ Approve ROEM Equipment	4	21-May-15	18-Jun-15	0
PRO-2080	Vendor Resubmit ROEM Equipment	3	19-Jun-15	09-Jul-15	0
PRO-2090	MWH Review Resubmittal ROEM Equipment	3	10-Jul-15	30-Jul-15	0
PRO-2100	Collaborative Review/ Final Submittal Acceptance	1	31-Jul-15	06-Aug-15	0
PRO-2110	Fabricate/ Deliver ROEM Equipment	32	07-Aug-15	24-Mar-16	0
MV VFD's		59	12-Mar-15	05-May-16	1
PRO-1880	Prepare MV VFD's	10	12-Mar-15	20-May-15	1
PRO-1890	MWH Review/ Approve MV VFD's	3	21-May-15	11-Jun-15	1
PRO-1900	Vendor Resubmit MV VFD's	2	12-Jun-15	25-Jun-15	1
PRO-1910	MWH Review Resubmittal MV VFD's	3	26-Jun-15	16-Jul-15	1
PRO-1920	Collaborative Review/ Final Submittal Acceptance	1	17-Jul-15	23-Jul-15	1
PRO-1930	Fabricate/ Deliver MV VFD's	40	24-Jul-15	05-May-16	1
Pad Mount Transformer		71	14-Jan-15	03-Jun-16	5
PRO-2000	Prepare Pad Mount Transformer	10	14-Jan-15	26-Mar-15	5
PRO-2010	MWH Review/ Approve Pad Mount Transformer	3	26-Mar-15	15-Apr-15	5
PRO-2020	Vendor Resubmit Pad Mount Transformer	2	16-Apr-15	29-Apr-15	5
PRO-2030	MWH Review Resubmittal Pad Mount Transformer	3	30-Apr-15	20-May-15	5
PRO-2040	Collaborative Review/ Final Submittal Acceptance	1	21-May-15	28-May-15	5
PRO-2050	Fabricate/ Deliver Pad Mount Transformer	52	29-May-15	03-Jun-16	5
Generator		55	19-Mar-15	14-Apr-16	2
PRO-1940	Prepare Generator	6	19-Mar-15	30-Apr-15	1
PRO-1950	MWH Review/ Approve Generator	3	30-Apr-15	20-May-15	2
PRO-1960	Vendor Resubmit Generator	2	21-May-15	04-Jun-15	2
PRO-1970	MWH Review Resubmittal Generator	3	05-Jun-15	25-Jun-15	2
PRO-1980	Collaborative Review/ Final Submittal Acceptance	1	26-Jun-15	02-Jul-15	2
PRO-1990	Fabricate/ Deliver Generator	40	03-Jul-15	14-Apr-16	2
Pressure Filters		33	07-Aug-15	31-Mar-16	2
PRO-1100	Prepare Pressure Filters	6	07-Aug-15	18-Sep-15	2
PRO-1110	MWH Review/ Approve Pressure Filters	3	21-Sep-15	09-Oct-15	2
PRO-1120	Vendor Resubmit Pressure Filters	2	12-Oct-15	23-Oct-15	2
PRO-1130	MWH Review Resubmittal Pressure Filters	1	26-Oct-15	30-Oct-15	2
PRO-1140	Collaborative Review/ Final Submittal Acceptance	1	02-Nov-15	06-Nov-15	2
PRO-1150	Fabricate/ Deliver Pressure Filters	20	09-Nov-15	31-Mar-16	2
Cartridge Filters		29	02-Oct-15	27-Apr-16	4
PRO-1220	Prepare Cartridge Filters	6	02-Oct-15	12-Nov-15	4
PRO-1230	MWH Review/ Approve Cartridge Filters	3	13-Nov-15	04-Dec-15	4
PRO-1240	Vendor Resubmit Cartridge Filters	2	07-Dec-15	18-Dec-15	4
PRO-1250	MWH Review Resubmittal Cartridge Filters	1	21-Dec-15	28-Dec-15	4
PRO-1260	Collaborative Review/ Final Submittal Acceptance	1	29-Dec-15	05-Jan-16	4
PRO-1270	Fabricate/ Deliver Cartridge Filters	16	06-Jan-16	27-Apr-16	4
Large Tanks		32	30-Apr-15	10-Dec-15	2
PRO-1280	Prepare Large Tanks	6	30-Apr-15	11-Jun-15	1
PRO-1290	MWH Review/ Approve Large Tanks	3	12-Jun-15	02-Jul-15	2
PRO-1300	Vendor Resubmit Large Tanks	2	03-Jul-15	16-Jul-15	2
PRO-1310	MWH Review Resubmittal Large Tanks	1	17-Jul-15	23-Jul-15	2
PRO-1320	Collaborative Review/ Final Submittal Acceptance	1	24-Jul-15	30-Jul-15	2
PRO-1330	Fabricate/ Deliver Large Tanks	16	19-Aug-15	10-Dec-15	2
UV System		33	23-Oct-15	16-Jun-16	8
PRO-1340	Prepare UV System	6	23-Oct-15	04-Dec-15	8

Project ID: CALAM - CUR-4
Run Date: 11-Oct-13
Data Date: 02-Jan-12
Page 2 of 7

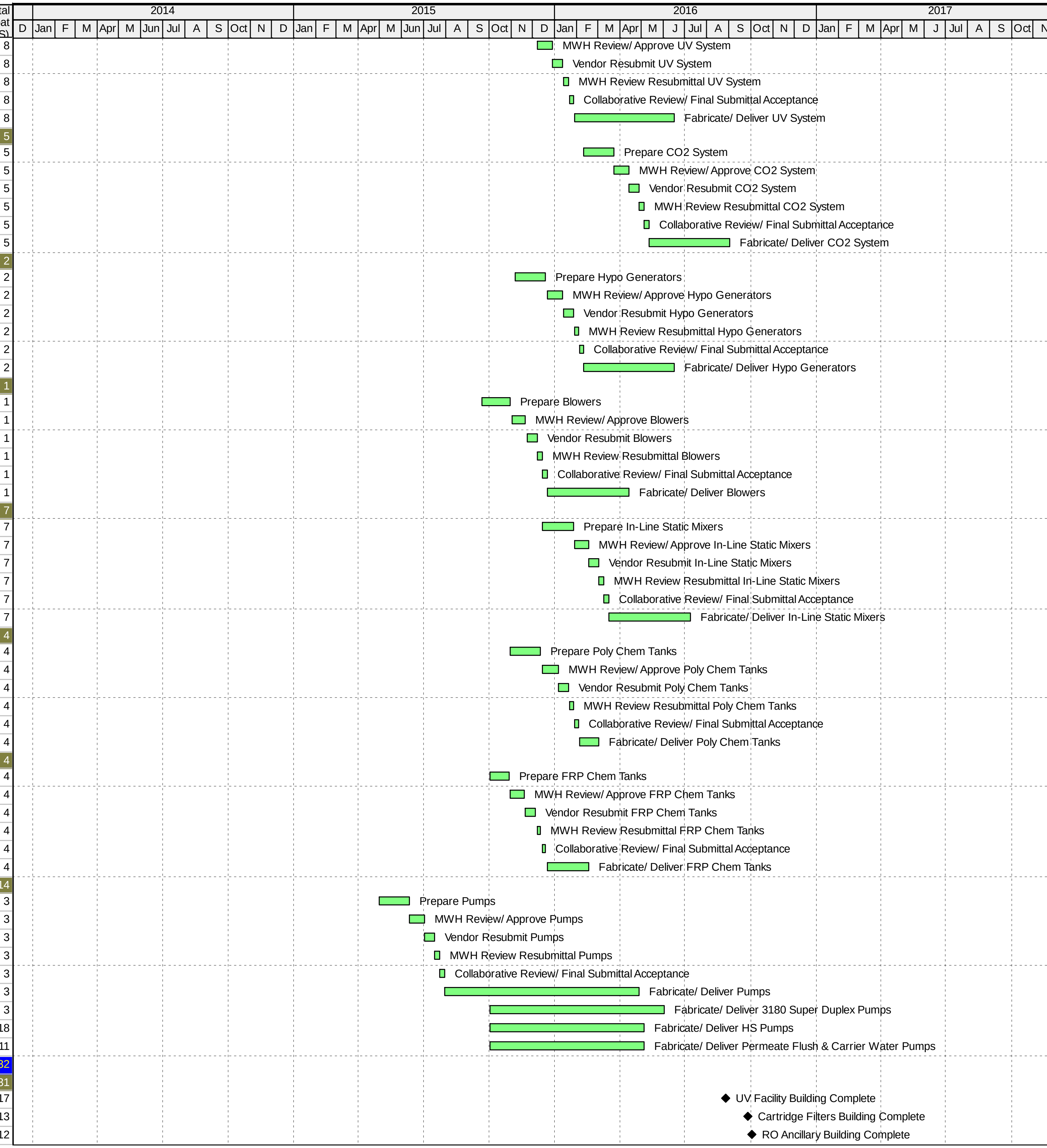
Remaining Level of Effort
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaini...
Milestone

California American Water Desalination Infrastructure Project
Proposal Schedule

MWH CONSTRUCTORS BUILDING A BETTER WORLD

CALIFORNIA AMERICAN WATER

Activity ID	Activity Name	Orig Dur (WKS)	Start	Finish	Total Float (WKS)
PRO-1350	MWH Review/ Approve UV System	3	07-Dec-15	28-Dec-15	8
PRO-1360	Vendor Resubmit UV System	2	29-Dec-15	12-Jan-16	8
PRO-1370	MWH Review Resubmittal UV System	1	13-Jan-16	20-Jan-16	8
PRO-1380	Collaborative Review/ Final Submittal Acceptance	1	21-Jan-16	27-Jan-16	8
PRO-1390	Fabricate/ Deliver UV System	20	28-Jan-16	16-Jun-16	8
CO2 System		**29**	**11-Feb-16**	**02-Sep-16**	**5**
PRO-1400	Prepare CO2 System	6	11-Feb-16	23-Mar-16	5
PRO-1410	MWH Review/ Approve CO2 System	3	24-Mar-16	13-Apr-16	5
PRO-1420	Vendor Resubmit CO2 System	2	14-Apr-16	27-Apr-16	5
PRO-1430	MWH Review Resubmittal CO2 System	1	28-Apr-16	04-May-16	5
PRO-1440	Collaborative Review/ Final Submittal Acceptance	1	05-May-16	11-May-16	5
PRO-1450	Fabricate/ Deliver CO2 System	16	12-May-16	02-Sep-16	5
Hypo Generators		**31**	**06-Nov-15**	**16-Jun-16**	**2**
PRO-1460	Prepare Hypo Generators	6	06-Nov-15	18-Dec-15	2
PRO-1470	MWH Review/ Approve Hypo Generators	3	21-Dec-15	12-Jan-16	2
PRO-1480	Vendor Resubmit Hypo Generators	2	13-Jan-16	27-Jan-16	2
PRO-1490	MWH Review Resubmittal Hypo Generators	1	28-Jan-16	03-Feb-16	2
PRO-1500	Collaborative Review/ Final Submittal Acceptance	1	04-Feb-16	10-Feb-16	2
PRO-1510	Fabricate/ Deliver Hypo Generators	18	11-Feb-16	16-Jun-16	2
Blowers		**29**	**21-Sep-15**	**14-Apr-16**	**1**
PRO-1580	Prepare Blowers	6	21-Sep-15	30-Oct-15	1
PRO-1590	MWH Review/ Approve Blowers	3	02-Nov-15	20-Nov-15	1
PRO-1600	Vendor Resubmit Blowers	2	23-Nov-15	07-Dec-15	1
PRO-1610	MWH Review Resubmittal Blowers	1	08-Dec-15	14-Dec-15	1
PRO-1620	Collaborative Review/ Final Submittal Acceptance	1	15-Dec-15	21-Dec-15	1
PRO-1630	Fabricate/ Deliver Blowers	16	22-Dec-15	14-Apr-16	1
In Line Static Mixers		**29**	**14-Dec-15**	**08-Jul-16**	**7**
PRO-1640	Prepare In-Line Static Mixers	6	14-Dec-15	27-Jan-16	7
PRO-1650	MWH Review/ Approve In-Line Static Mixers	3	28-Jan-16	17-Feb-16	7
PRO-1660	Vendor Resubmit In-Line Static Mixers	2	18-Feb-16	02-Mar-16	7
PRO-1670	MWH Review Resubmittal In-Line Static Mixers	1	03-Mar-16	09-Mar-16	7
PRO-1680	Collaborative Review/ Final Submittal Acceptance	1	10-Mar-16	16-Mar-16	7
PRO-1690	Fabricate/ Deliver In-Line Static Mixers	16	17-Mar-16	08-Jul-16	7
Poly Chem Tanks		**17**	**30-Oct-15**	**02-Mar-16**	**4**
PRO-1700	Prepare Poly Chem Tanks	6	30-Oct-15	11-Dec-15	4
PRO-1710	MWH Review/ Approve Poly Chem Tanks	3	14-Dec-15	05-Jan-16	4
PRO-1720	Vendor Resubmit Poly Chem Tanks	2	06-Jan-16	20-Jan-16	4
PRO-1730	MWH Review Resubmittal Poly Chem Tanks	1	21-Jan-16	27-Jan-16	4
PRO-1740	Collaborative Review/ Final Submittal Acceptance	1	28-Jan-16	03-Feb-16	4
PRO-1750	Fabricate/ Deliver Poly Chem Tanks	4	04-Feb-16	02-Mar-16	4
FRP Chem Tanks		**19**	**02-Oct-15**	**17-Feb-16**	**4**
PRO-1760	Prepare FRP Chem Tanks	4	02-Oct-15	29-Oct-15	4
PRO-1770	MWH Review/ Approve FRP Chem Tanks	3	30-Oct-15	19-Nov-15	4
PRO-1780	Vendor Resubmit FRP Chem Tanks	2	20-Nov-15	04-Dec-15	4
PRO-1790	MWH Review Resubmittal FRP Chem Tanks	1	07-Dec-15	11-Dec-15	4
PRO-1800	Collaborative Review/ Final Submittal Acceptance	1	14-Dec-15	18-Dec-15	4
PRO-1810	Fabricate/ Deliver FRP Chem Tanks	8	21-Dec-15	17-Feb-16	4
Pumps		**56**	**30-Apr-15**	**02-Jun-16**	**14**
PRO-1820	Prepare Pumps	6	30-Apr-15	11-Jun-15	3
PRO-1830	MWH Review/ Approve Pumps	3	12-Jun-15	02-Jul-15	3
PRO-1840	Vendor Resubmit Pumps	2	03-Jul-15	16-Jul-15	3
PRO-1850	MWH Review Resubmittal Pumps	1	17-Jul-15	23-Jul-15	3
PRO-1860	Collaborative Review/ Final Submittal Acceptance	1	24-Jul-15	30-Jul-15	3
PRO-1870	Fabricate/ Deliver Pumps	38	31-Jul-15	28-Apr-16	3
PRO-2120	Fabricate/ Deliver 3180 Super Duplex Pumps	34	02-Oct-15	02-Jun-16	3
PRO-2130	Fabricate/ Deliver HS Pumps	30	02-Oct-15	04-May-16	18
PRO-2140	Fabricate/ Deliver Permeate Flush & Carrier Water Pumps	30	02-Oct-15	04-May-16	11
Construction Phase		**77**	**27-Apr-15**	**01-Nov-16**	**32**
Construction Milestones		**9**	**26-Aug-16**	**01-Nov-16**	**31**
CMS-1500	UV Facility Building Complete	0		26-Aug-16	17
CMS-1320	Cartridge Filters Building Complete	0		26-Sep-16	13
CMS-1410	RO Ancillary Building Complete	0		03-Oct-16	12



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CALIFORNIA AMERICAN WATER

Activity ID	Activity Name	Orig Dur (WKS)	Start	Finish	Total Float (WKS)
CMS-1800	Admin Building Complete	0		07-Oct-16	11
CMS-1400	High Service Pump Station & Tanks Complete	0		14-Oct-16	10
CMS-1300	HV Building Complete	0		18-Oct-16	9
CMS-1310	Pressure Filters Building Complete	0		18-Oct-16	9
CMS-1810	Brine Pond Complete	0		21-Oct-16	9
CMS-1600	Chemical Building Complete	0		24-Oct-16	9
CMS-1700	RO Building Complete	0		25-Oct-16	8
CMS-1200	Backwash Basin & Recycle Pumps Complete	0		01-Nov-16	31
Site Development		60	27-Apr-15	08-Jul-16	47
SD-1090	Clear/ Grub Site	3	27-Apr-15	15-May-15	1
SD-1100	Silt Fencing	2	18-May-15	01-Jun-15	1
SD-1110	Relocate Gate	1	18-May-15	22-May-15	103
SD-1120	Temporary Access	1	18-May-15	22-May-15	2
SD-1130	Mobilize Construction Trailers	1	02-Jun-15	08-Jun-15	1
SD-1140	SWPPP	55	02-Jun-15	08-Jul-16	46
SD-1380	Prep Asphalt Subgrade	2	02-Jun-16	15-Jun-16	46
SD-1450	Install Roadbase	2	16-Jun-16	29-Jun-16	46
SD-1460	Asphalt Paving	1	30-Jun-16	07-Jul-16	46
10 - RO Building		69	09-Jun-15	25-Oct-16	8
Sitework		66	09-Jun-15	29-Sep-16	2
RO-05440	Site Prep/ Mass Excavate - RO Bldg	3	09-Jun-15	29-Jun-15	1
RO-05470	Underground Structures Yard Piping - RO Bldg	5	30-Jun-15	03-Aug-15	1
Elevation (-9.67)		7	30-Jun-15	17-Aug-15	8
RO-05530	Excavate to Elevation (-9.67) - RO Bldg	1	30-Jun-15	06-Jul-15	2
RO-05535	FRP Slab & Walls at Elev (-9.67 to +0.00) - RO Bldg	4	14-Jul-15	10-Aug-15	1
RO-05545	Backfill - RO Bldg	1	11-Aug-15	17-Aug-15	8
Elevation (-5.00)		7	30-Jun-15	17-Aug-15	8
RO-05710	Excavate to Elevation (-5.00) - RO Bldg	1	30-Jun-15	06-Jul-15	2
RO-05715	FRP Slab & Walls at Elev (-5.00 to +0.00) - RO Bldg	4	14-Jul-15	10-Aug-15	1
RO-05650	Backfill - RO Bldg	1	11-Aug-15	17-Aug-15	8
Elevation (+0.00)		6	18-Aug-15	29-Sep-15	8
RO-05450	FRP Slab on Grade at Elev (+0.00) - RO Bldg	6	18-Aug-15	29-Sep-15	8
Neutralization Tank Area		56	18-Aug-15	29-Sep-16	2
RO-05455	FRP Tank Pad - RO Bldg	2	18-Aug-15	31-Aug-15	51
RO-05465	Set Neutralization Tank & Pumps - RO Bldg	2	01-Sep-16	15-Sep-16	2
RO-05475	Mechanical Piping - RO Bldg	2	16-Sep-16	29-Sep-16	2
Structure		59	18-Aug-15	25-Oct-16	8
RO-05460	Erect Metal Building - RO Bldg	10	18-Aug-15	27-Oct-15	16
RO-05560	FRP Equipment Pads - RO Bldg	3	30-Sep-15	20-Oct-15	8
RO-05490	Roofing - RO Bldg	3	28-Oct-15	19-Nov-15	16
RO-05700	Set FRP Chem Tanks - RO Bldg	1	11-Dec-15	18-Dec-15	2
RO-05550	Mechanical Piping & Supports - RO Bldg	35	21-Dec-15	31-Aug-16	2
RO-05720	Install Cable Trays & Supports - RO Bldg	8	22-Jan-16	21-Mar-16	22
RO-05620	Climate Control Rough-In - RO Bldg	4	22-Feb-16	21-Mar-16	29
RO-05540	Set Membrane Filter Skids - RO Bldg	16	25-Mar-16	18-Jul-16	0
RO-05570	Install Overhead Doors - RO Bldg	2	19-Jul-16	01-Aug-16	20
RO-05590	Pull/ Term Wire - RO Bldg	12	19-Jul-16	11-Oct-16	0
RO-05730	Set Doors/ Hardware - RO Bldg	2	19-Jul-16	01-Aug-16	20
RO-05610	Set Static Mixers - RO Bldg	2	18-Aug-16	31-Aug-16	2
RO-05600	Startup Equipment - RO Bldg	2	12-Oct-16	25-Oct-16	0
VFD Area		29	14-Oct-15	19-May-16	30
RO-05520	Construct VFD Room - RO Bldg	2	14-Oct-15	27-Oct-15	33
RO-05500	Install Cable Trays & Supports @ VFD Room - RO Bldg	3	22-Jan-16	12-Feb-16	22
RO-05580	Set Doors @ VFD Room - RO Bldg	1	15-Feb-16	19-Feb-16	43
RO-05510	Set VFD Electrical Equipment - RO Bldg	2	06-May-16	19-May-16	8
5 - Pressure Filters		44	30-Nov-15	18-Oct-16	9
PF-1030	Site Prep/ Excavate - PF Bldg	3	30-Nov-15	22-Dec-15	5
PF-1040	Yard Piping - PF Bldg	3	23-Dec-15	15-Jan-16	5
PF-1000	FRP Slab on Grade - PF Bldg	5	19-Jan-16	23-Feb-16	5
PF-010	FRP Pressure Vessel Piers - PF Bldg	6	19-Jan-16	01-Mar-16	5
PF-1340	FRP Blower Pad - PF Bldg	1	24-Feb-16	01-Mar-16	7
PF-1020	Set Pressure Vessels - PF Bldg	2	01-Apr-16	14-Apr-16	2

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PF-1330	Set Blowers - PF Bldg	1	15-Apr-16	21-Apr-16	1
PF-1050	Mechanical Piping & Supports - PF Bldg	20	22-Apr-16	13-Sep-16	1
PF-1060	Pull/ Term Wire - PF Bldg	12	19-Jul-16	11-Oct-16	1
PF-1350	Set Static Mixers - PF Bldg	3	23-Aug-16	13-Sep-16	5
PF-1070	Set Canopy - PF Bldg	2	14-Sep-16	27-Sep-16	12
PF-1080	Startup Equipment - PF Bldg	1	12-Oct-16	18-Oct-16	1
50 - Chemical Building		56	08-Sep-15	24-Oct-16	8
CB-03210	Site Prep/ Excavate - Chem Bldg	3	08-Sep-15	28-Sep-15	1
CB-03200	FRP Concrete Slab/ Containment Walls - Chem Bldg	12	29-Sep-15	29-Dec-15	3
CB-05160	Backfill - Chem Bldg	1	30-Dec-15	06-Jan-16	3
CB-05100	Construct Metal Building - Chem Bldg	6	07-Jan-16	22-Feb-16	3
CB-05120	Set FRP Chem Tanks - Chem Bldg	2	23-Feb-16	07-Mar-16	3
CB-05140	Set Poly Chem Tanks - Chem Bldg	2	08-Mar-16	22-Mar-16	3
CB-05130	Set Metering Pumps - Chem Bldg	1	23-Mar-16	29-Mar-16	3
CB-05110	Roofing - Chem Bldg	2	30-Mar-16	12-Apr-16	3
CB-05320	Complete Hypo Generator Room - Chem Bldg	3	13-Apr-16	03-May-16	8
CB-05360	Set Interior Stairs/ Handrails - Chem Bldg	2	13-Apr-16	26-Apr-16	3
CB-05370	FRP Chem Unloading Concrete - Chem Bldg	1	13-Apr-16	19-Apr-16	31
CB-05290	Process Piping & Supports - Chem Bldg	20	20-Apr-16	09-Sep-16	3
CB-05340	Set Exterior Stairs/ Handrails - Chem Bldg	2	20-Apr-16	03-May-16	31
CB-05380	Install Elevated Catwalk - Chem Bldg	2	27-Apr-16	10-May-16	31
CB-05350	Set Doors/ Hardware - Chem Bldg	1	04-May-16	10-May-16	31
CB-05170	Install Hypo Generators - Chem Bldg	3	17-Jun-16	08-Jul-16	2
CB-05300	Set Electrical Equipment - Chem Bldg	2	11-Jul-16	22-Jul-16	2
CB-05310	Pull/ Term Wire - Chem Bldg	12	25-Jul-16	17-Oct-16	2
CB-05430	Startup Equipment - Chem Bldg	1	18-Oct-16	24-Oct-16	2
HV Building		43	04-Dec-15	18-Oct-16	9
HV-03450	Site Prep/ Excavate - HV Bldg	2	04-Dec-15	21-Dec-15	1
HV-02210	Install Yard Piping/ Underground Electrical - HV Bldg	3	22-Dec-15	14-Jan-16	1
HV-03420	FRP Slab on Grade - HV Bldg	3	15-Jan-16	05-Feb-16	8
HV-04100	Set Metal Building - HV Bldg	3	08-Feb-16	29-Feb-16	8
HV-04140	Roofing - HV Bldg	2	01-Mar-16	15-Mar-16	10
HV-04170	Set Switchgear/ Generator - HV Bldg	2	15-Apr-16	28-Apr-16	2
HV-04120	Set VFDs/ MCC Equipment - HV Bldg	2	06-May-16	19-May-16	1
HV-04130	Rough-In Electrical - HV Bldg	2	20-May-16	03-Jun-16	1
HV-04150	Pull/ Term Wire - HV Bldg	8	06-Jun-16	01-Aug-16	1
HV-04180	Energize HV Building - HV Bldg	2	28-Sep-16	11-Oct-16	1
HV-04160	Startup Equipment - HV Bldg	1	12-Oct-16	18-Oct-16	1
Primary Transformer		35	15-Jan-16	27-Sep-16	12
A1380	Site Prep/ Excavate @ TX - HV Bldg	2	15-Jan-16	29-Jan-16	1
A1390	FRP Slab on Grade @ TX - HV Bldg	2	01-Feb-16	15-Feb-16	20
A1400	Set Primary Transformer #1 - HV Bldg	2	06-Jun-16	17-Jun-16	5
A1410	Set Primary Transformer #2 - HV Bldg	2	20-Jun-16	01-Jul-16	5
A1440	Install Security Fence & Gate @ TX - HV Bldg	3	05-Jul-16	25-Jul-16	20
A1430	Lay Gravel @ TX - HV Bldg	1	26-Jul-16	01-Aug-16	20
A1510	Pull/ Term Power @ TX - HV Bldg	8	02-Aug-16	27-Sep-16	1
7 - Cartridge Filters		33	01-Feb-16	26-Sep-16	4
CF-1360	Site Prep/ Excavate - CF Bldg	3	01-Feb-16	22-Feb-16	1
CF-1370	Excavate to Elev (-7.00) HDPE - CF Bldg	1	23-Feb-16	29-Feb-16	6
CF-1390	Install 2(ea) 42" HDPE at Elev (-7.00) - CF Bldg	1	01-Mar-16	07-Mar-16	6
CF-1450	Backfill to Elev (+0.00) - CF Bldg	1	08-Mar-16	15-Mar-16	6
CF-1440	FRP Slab on Grade/ Drain Trench/ Curb Wall - CF Bldg	4	16-Mar-16	12-Apr-16	6
CF-1400	Set Cartridge Filters - CF Bldg	3	28-Apr-16	18-May-16	4
CF-1410	Mechanical Piping & Supports - CF Bldg	14	19-May-16	26-Aug-16	4
CF-1420	Pull/ Term Wire - CF Bldg	6	08-Aug-16	19-Sep-16	4
CF-1430	Startup Equipment - CF Bldg	1	20-Sep-16	26-Sep-16	4
6 - Feed Tanks & Feed Pumps		32	16-Feb-16	03-Oct-16	3
FT-05670	Site Prep/ Excavate - Feed Tank/Pmp Bldg	2	16-Feb-16	29-Feb-16	3
FT-11380	Yard Piping - Feed Tank/Pmp Bldg	4	01-Mar-16	29-Mar-16	3
FT-05680	FRP Concrete Pads - Feed Tank/Pmp Bldg	6	30-Mar-16	10-May-16	3
FT-05690	Set Large Tanks/ Ladders - Feed Tank/Pmp Bldg	3	11-May-16	01-Jun-16	3

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FT-11390	Set Backwash & Feedwater Pumps - Feed Tnk/Pmp Bldg	4	03-Jun-16	30-Jun-16	3
FT-11400	Process Piping - Feed Tank/Pmp Bldg	6	01-Jul-16	12-Aug-16	3
FT-11410	Pull/ Term Wire - Feed Tank/Pmp Bldg	6	15-Aug-16	26-Sep-16	3
FT-11420	Startup Equipment - Feed Tank/Pmp Bldg	1	27-Sep-16	03-Oct-16	3
15 - RO Ancilliary System		22	13-Apr-16	16-Sep-16	5
FT-05740	Site Prep/ Excavate - RO Ancillary	2	13-Apr-16	26-Apr-16	5
FT-11430	Yard Piping - RO Ancillary	2	27-Apr-16	10-May-16	5
FT-05750	FRP Concrete Pads - RO Ancillary	3	11-May-16	01-Jun-16	5
FT-05760	Set Flush Tank - RO Ancillary	2	02-Jun-16	15-Jun-16	5
FT-11440	Set Permeate Flush & Carrier Water Pumps - RO Ancilliary	2	16-Jun-16	29-Jun-16	5
FT-11450	Process Piping - RO Ancillary	4	30-Jun-16	28-Jul-16	5
FT-11460	Pull/ Term Wire - RO Ancillary	6	29-Jul-16	09-Sep-16	5
FT-11470	Startup Equipment - RO Ancillary	1	12-Sep-16	16-Sep-16	5
Admin Building		36	25-Jan-16	07-Oct-16	10
AD-02030	Site Prep/ Excavate - Admin Bldg	2	25-Jan-16	05-Feb-16	10
AD-02200	Underground Mechanical/ Electrical - Admin Bldg	4	08-Feb-16	07-Mar-16	10
AD-03430	Structural Concrete - Admin Bldg	4	08-Mar-16	05-Apr-16	10
AD-04110	Masonry - Admin Bldg	8	06-Apr-16	01-Jun-16	10
AD-05400	Roofing - Admin Bldg	3	02-Jun-16	22-Jun-16	10
AD-04420	Architectural Exterior Finishes - Admin Bldg	7	23-Jun-16	11-Aug-16	14
AD-05420	Frame Interior Walls - Admin Bldg	4	23-Jun-16	21-Jul-16	10
AD-05410	MEP Rough-In - Admin Bldg	4	22-Jul-16	18-Aug-16	10
AD-02240	Set Doors/ Windows/ Hardware - Admin Bldg	2	22-Jul-16	04-Aug-16	13
AD-04410	Hang & Tape Drywall - Admin Bldg	4	29-Jul-16	25-Aug-16	10
AD-02230	Site Improvements - Admin Bldg	4	12-Aug-16	09-Sep-16	14
AD-04430	Finishes - Admin Bldg	6	26-Aug-16	07-Oct-16	10
20 - UV Building		36	04-Dec-15	26-Aug-16	16
UV-04190	Site Prep/ Excavate - UV Bldg	3	04-Dec-15	29-Dec-15	11
UV-04210	Yard Piping/ Containment Culvert - UV Bldg	3	31-Dec-15	25-Jan-16	11
UV-04200	FRP Concrete Slab/ Containment Wall - UV Bldg	3	26-Jan-16	16-Feb-16	11
UV-04180	Construct Metal Building - UV Bldg	4	17-Feb-16	16-Mar-16	11
UV-05310	Roofing - UV Bldg	2	17-Mar-16	30-Mar-16	11
UV-11260	Set UV Reactor CP Equipment - UV Bldg	4	31-Mar-16	27-Apr-16	18
UV-11270	Mechanical Piping/ Supports - UV Bldg	8	31-Mar-16	25-May-16	11
UV-11230	Install UV Reactors - UV Bldg	3	17-Jun-16	08-Jul-16	8
UV-11280	Pull/ Term Wire - UV Bldg	6	11-Jul-16	19-Aug-16	8
UV-11300	Set Doors/ Hardware - UV Bldg	1	11-Jul-16	15-Jul-16	22
UV-11290	Startup Equipment - UV Bldg	1	22-Aug-16	26-Aug-16	8
22 - High Service Pump Station		36	01-Feb-16	14-Oct-16	1
HS-05640	Site Prep/ Excavate - HS Pmp Sta	2	01-Feb-16	15-Feb-16	1
HS-11370	Yard Piping - HS Pmp Sta	3	16-Feb-16	07-Mar-16	1
HS-11320	Process Piping & Supports - HS Pmp Sta	12	23-Jun-16	16-Sep-16	1
HS-05670	FRP Pump Slab - HS Pmp Sta	3	23-Jun-16	14-Jul-16	8
HS-11380	Set High Service Pumps - HS Pmp Sta	2	15-Jul-16	28-Jul-16	8
HS-11340	Pull/ Term Wire - HS Pmp Sta	3	19-Sep-16	07-Oct-16	1
HS-11360	Startup Equipment - HS Pmp Sta	1	10-Oct-16	14-Oct-16	1
Treated Water Storage Tanks		15	08-Mar-16	22-Jun-16	1
HS-05650	FRP Concrete Pads - HS Pmp Sta	3	08-Mar-16	29-Mar-16	1
HS-05660	Construct Prestressed Concrete Treated Water Storage Tanks - HS Pmp Sta	12	30-Mar-16	22-Jun-16	1
55-A/B - Backwash Settling Basin & Recycle Pumps		42	30-Dec-15	01-Nov-16	0
BW-1140	Site Prep/ Excavate - BW/ Rcyc Pmps	3	30-Dec-15	22-Jan-16	1
BW-1160	Yard Piping - BW/ Rcyc Pmps	8	25-Jan-16	22-Mar-16	1
BW-1170	FRP Drain Pump - BW/ Rcyc Pmps	6	23-Mar-16	03-May-16	9
BW-1210	FRP Channel - BW/ Rcyc Pmps	10	23-Mar-16	01-Jun-16	1
BW-1180	Set Drain Pump - BW/ Rcyc Pmps	1	04-May-16	10-May-16	9
BW-1230	Set Submersible Pumps - BW/ Rcyc Pmps	3	11-May-16	01-Jun-16	9
BW-150	Install Basin Liner - BW/ Rcyc Pmps	10	02-Jun-16	11-Aug-16	1
BW-1320	Pull/ Term Wire - BW/ Rcyc Pmps	10	02-Jun-16	11-Aug-16	9
BW-1190	Set Catwalk/ Handrail - BW/ Rcyc Pmps	2	12-Aug-16	25-Aug-16	1
BW-1200	Install Slide Gates - BW/ Rcyc Pmps	2	26-Aug-16	09-Sep-16	1
BW-1220	Fill Basin/ Test - BW/ Rcyc Pmps	4	12-Sep-16	07-Oct-16	1
BW-1360	Set Floating Skimmer Intakes - BW/ Rcyc Pmps	2	12-Sep-16	23-Sep-16	3

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BW-1250	Startup Equipment - BW/ Rcyc Pmps	2	19-Oct-16	01-Nov-16	0
60 - Brine Pond		38	25-Jan-16	21-Oct-16	2
BP-1260	Mass Excavation - Brine Pond	6	25-Jan-16	07-Mar-16	2
BP-1270	Yard Piping - Brine Pond	12	08-Mar-16	01-Jun-16	2
BP-1330	Prep Sub Base - Brine Pond	2	08-Mar-16	22-Mar-16	7
BP-1340	Install Liner - Brine Pond	12	23-Mar-16	15-Jun-16	14
BP-1350	Fill Pond/ Test - Brine Pond	4	15-Jul-16	11-Aug-16	10
Pump Station		18	08-Mar-16	14-Jul-16	10
BP-1280	FRP Submersible Pump Area - Brine Pond	12	08-Mar-16	01-Jun-16	10
BP-1290	Set Submersible Pumps - Brine Pond	1	02-Jun-16	08-Jun-16	10
BP-1300	Process Piping - Brine Pond	2	09-Jun-16	22-Jun-16	10
BP-1310	Pull/ Term Wire - Brine Pond	3	23-Jun-16	14-Jul-16	10
Elec Room/ Air Compressor Building		30	23-Mar-16	21-Oct-16	2
BP-1450	Site Prep/ Excavate @ Air Comp Bldg - Brine Pond	2	23-Mar-16	05-Apr-16	7
BP-05730	FRP Slab on Grade - Brine Pond	3	06-Apr-16	26-Apr-16	7
BP-05710	Construct Metal Building - Brine Pond	6	02-Jun-16	14-Jul-16	2
BP-05720	Roofing - Brine Pond	2	15-Jul-16	28-Jul-16	2
BP-11430	Set Electrical/ Air Compressor Equipment - Brine Pond	6	29-Jul-16	09-Sep-16	2
BP-11440	Electrical/ Mechanical Rough-in - Brine Pond	6	29-Jul-16	09-Sep-16	2
BP-11450	Pull/ Term Wire - Brine Pond	4	12-Sep-16	07-Oct-16	2
BP-11460	Startup Equipment - Brine Pond	2	10-Oct-16	21-Oct-16	2
Carbondioxide Pad		23	06-Apr-16	19-Sep-16	5
BP-1520	Site Prep/ Excavate @ Carbondioxide Pad - Brine Pond	2	06-Apr-16	19-Apr-16	18
BP-05740	Drill Piers @ Carbondioxide Pad - Brine Pond	6	20-Apr-16	01-Jun-16	18
BP-05150	Install CO2 Storage Tank @ Carbondioxide Pad - Brine Pond	2	06-Sep-16	19-Sep-16	5
System Startup Testing & Commissioing		59	22-Apr-16	14-Jun-17	0
SC-140	CAW Review and Approve Acceptance Test Plan	26	22-Apr-16	26-Oct-16	2
SC-200	Submit Acceptance Test Plan	0	22-Apr-16		28
SC-160	MWH Requires Water	0	28-Sep-16		6
SC-150	Start MWH Commissioning & Functional Testing Period	2	26-Oct-16	08-Nov-16	0
SC-130	Notify CAW of Acceptance Testing	0	08-Nov-16		30
SC-100	Initial Plant Performance Tests (IPPT) (24HRS)	0	09-Nov-16	09-Nov-16	0
SC-110	Run-In Plant Performance Tests (RIPPT) (14D)	3	10-Nov-16	23-Nov-16	0
SC-180	Coordinate with CDPH for Testing Procedures	3	24-Nov-16	07-Dec-16	0
SC-120	Acceptance Testing (AT) (16D)	3	08-Dec-16	23-Dec-16*	0
SC-210	Substantial Completion	0		23-Dec-16	0
SC-170	Prepare/ Submit Acceptance Test Report	3	26-Dec-16	13-Jan-17	12
SC-190	CAW Review & Approval of Acceptance Test Report	8	17-Jan-17	13-Mar-17	12
SC-220	Guaranteed Scheduled Acceptance Date (including Final CDPH)	0		31-May-17	2
SC-230	Final Completion	0		14-Jun-17	0
Project Closeout		1	01-Jun-17	06-Jun-17	1
PC-100	Project Closeout Procedures	1	01-Jun-17	06-Jun-17	1

Project ID: CALAM - CUR-4
Run Date: 11-Oct-13
Data Date: 02-Jan-12
Page 7 of 7

Remaining Level of Effort | Remaining Work
Actual Level of Effort | Critical Remaini...
Actual Work | Milestone

California American Water Desalination Infrastructure Project
Proposal Schedule

MWH CONSTRUCTORS
BUILDING A BETTER WORLD

CALIFORNIA AMERICAN WATER

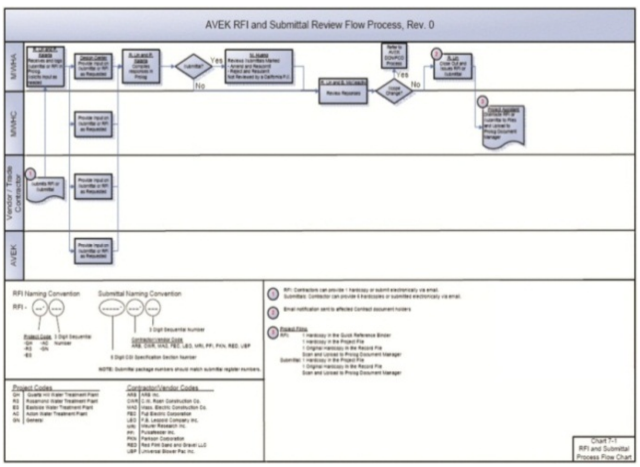
I. Plan for the Performance of the Design-Build Work

I. Plan for the Performance of the Design-Build Work

I. PLAN FOR THE PERFORMANCE OF THE DESIGN-BUILD WORK

MWH's Management Administration Plan (MAP) serves as a "roadmap" for the successful execution of the Project

MWH prepares a project-specific Management Administration Plan (MAP) for every project to properly manage, control and document the processes and procedures for effectively managing every aspect the project. Refined over numerous treatment plant design-build projects, the MAP begins as a template to define and specify daily, weekly and monthly project activities and the respective roles and responsibilities of the project team. The plan merges MWH's best practices and standard operating procedures with the specific requirements of the project and is broken down into sections — Introduction and Background, Safety, Quality, Project Setup, Cost, Schedule, Documentation, Commissioning and Startup, Completion and Closeout.



The flowchart shown here is an example of one of many plans and procedures developed during the administration planning process, in this case an RFI and submittal

MAP development **begins upon notice-of-award and serves as a "roadmap" for the project team's execution of the entire project.** Approximately 30 days prior to starting construction, we finalize the MAP as we shift from preconstruction to field work.

The MAP is **jointly developed with CAW to capture the project's goals and objectives and reporting processes and procedures.** Our project manager, Mike Price, leads this activity, with all designers, discipline superintendents, project engineers operations and maintenance staff and additional construction support staff that join the team at this stage.

The Flowchart in the figure is an example of one of many plans and procedures developed during the process, in this case a request for information (RFI) and submittal process.

a. Composition and organization of the MWH Design-Build Team provides CAW with a fully integrated Design-Builder with the in-house resources to provide design, permitting, RO Systems, construction and commissioning

As a fully integrated design-build firm, MWH has the in-house resources to provide permitting, design, construction, commissioning and short-term operations for all our projects without the complexities and complications inherent with joint ventures and partnerships. Individual firms, even under carefully orchestrated and highly complex arrangements, have their own separate business objectives, risk tolerances, and profit incentives that inhibit this kind of collaboration. Void of these inhibitions, the MWH design-build team shares the same policies, procedures and principles, as well as a common culture, goals and objectives. Full integration provides two major benefits to CAW primarily through efficiencies resulting from:

- Enhanced Communications - Our designers and construction professionals sit side-by-side in MWH offices. This creates an environment where thousands of issues are identified, discussed, and resolved with the perspective of both the designer and builder as a natural course of business. This environment cannot be replicated when a contractor and engineer are in a prime/sub or JV arrangement.

  Single Management Structure - A single-entity integrated design-build firm provides the ability to respond to vital project issues and client needs via a single decision maker. Additionally, roles and responsibilities are simplified and risk allocation between the CAW and the guarantor is eliminated.**Additional benefits include:**

- Same policies, procedures and principles
- Same culture, goals and objectives
- Uninhibited movement of resources
- Responsiveness to vital project issues and client needs
- Unencumbered collaboration
- Schedule and cost savings
- A higher quality product
- Faster resolutions

MWH will not be participating in any joint ventures or partnerships but has enhanced our team with capable WMDVBE/Local firms that provide additional skill sets and expertise needed for this project:

- Denise Duffy and Associates – Permitting and environmental compliance
- Lee Incorporated – Surveying, site controls and as-builts
- Katz and Associates – Public Relations and outreach
- Dr. Mike Nelson, PE – Technical consultant, commissioning and post-acceptance assistance
- Westland Management Solutions – Project controls

While our project executive, John Cevaal, will ultimately be responsible for the overall project success and CAW satisfaction, our project manager, Mike Price, will be responsible for the coordination and execution of the project team during preconstruction, construction, post construction and the warranty period. The balance of our team is discussed in Section 2.

b. MWH's team mechanisms of reporting and internal communications plan ensure efficient and effective communications among key personnel

As a fully integrated design-build firm, MWH has reporting mechanisms and internal communication plans already in place. However, each project is unique with its own set of challenges. The MAP process mentioned above will develop more detailed mechanisms of reporting and a formal internal communications plan designed specifically for the Project. A key outcome of the MAP is the development of a Roles and Responsibilities

Matrix that further identifies lines of authority and clarifies lines of communication and reporting as described in more detail in the next section.

MWH's reporting mechanisms provide continuous status updates and early warnings of potential delays

Fundamentals of a successful project are the constant reporting of Key Performance Indices (KPI). MWH uses the following reporting mechanisms to report key project parameters to the management team.

Trend log - We do monthly design reviews to proactively monitor and identify design and scope decisions that affect the budget. When the design is changed or new scope is added, we are able to apply appropriate cost/benefit analysis to the change so that project budgets are either maintained or adjusted, as appropriate. We keep a running record of all such decisions as well as their impact to the budget. Trend logging benefits the project by identifying potential budget impacts in time to react and adjust. We also track the trends in material and labor pricing so that we include realistic escalation factors when pricing is expected to occur in the future.

"[The] North Cape team (City of Cape Coral and MWH) have worked to successfully manage and resolve construction challenges presented during the design process. Challenges were addressed in a positive and effective manner by finding mutually agreeable solutions for involved parties."

– William Peak
Acting Utilities Manager
City of Cape Coral

Schedule - MWH uses schedule development as a tool to help the design-build team make strategic decisions; analyze critical milestones for project procurement; level resource requirements for manpower and equipment and; develop plant commissioning and start-up strategies. Our level of schedule detail will result in activities of no more than 15 days duration each, to provide a manageable level of resolution for both CAW and our field team to eventually manage the work during the construction phase. All schedules, including those prepared during preconstruction, will be time-scaled, critical path method networks using the industry standard Primavera P6. Short-term schedules are reviewed and updated weekly with the project team and CAW. Lagging schedule activities are quickly identified, a root cause analysis is performed and corrective actions developed and executed. These weekly reviews are used to update the master schedule and are summarize in a monthly report.

Risk register - Risk management is critical to the success of any project and must be developed during the planning stages of the project management process. **MWH uses the risk register as a management tool through a review and updating process that identifies, assesses, and manages risks down to acceptable levels.** It provides a framework in which problems that threaten the delivery of the anticipated benefits are captured. Actions are then initiated to reduce the probability and the potential impact of specific risks. The risk register is an iterative working document that will be used by the design-build team to record project risks and associated actions. It will be maintained collectively by the integrated project team and regularly updated during the project lifecycle to reflect risk management actions and outcomes.

Submittal log - The administrative submittal review process starts during design development with a **focus on identifying critical submittal items that can be difficult to procure, have a long lead time or may need multiple iterations during the review process.** After critical submittals are identified, MWH uses the baseline schedule to anticipate the "need by" dates. During the weekly project management meetings, the design-build team reviews the submittal list and the status of each and prioritizing them according to need, flagging troubled submittals and developing corrective actions. These continuous updates provide indications if any are lagging.

Procurement log – The procurement log **ensures that all project equipment has been purchased and tracks anticipated delivery dates, warranty requirements, spare parts, and O&M information**. Weekly review with the design-build team provides early warning of delivery dates that may be slipping.

Cost Tracking - This is an **essential element to the overall accuracy and consistency of developing accurate cost estimates** and providing the design-build team with a historical record of how we arrive at the final cost of construction. MWH will utilize the following process:

- Comprehensive trend logging tracks issues that have the potential to impact project costs such as an increase in copper or steel prices, and/or catastrophic events allowing us to make informed decisions.
- Ongoing constructability reviews provides us with the latest design and specification changes allowing us to make and track appropriate adjustments to the project costs
- Design change log tracks the design changes and allows us to identify cost variances and the drivers behind them.
- Detailed estimates are performed at design iterations throughout the preconstruction phase, typically at 30, 60 and 90%. These detailed cost estimates are provided to the design-build team as "checks" to prevent "scope creep" and determine if the design is in line with the project budget

Financial Review - Each month, the project financials undergo an internal review by the project executive team. Subcontractor and vendor agreements, self-performance costs, invoices, payments and any changes are also managed in Prolog and available online. Linked to RFIs, submittals, deliveries and contract terms and conditions, our design-build team is plugged into any aspect of a subcontractor's or vendor's contract and performance status through our Prolog system.

"Although this contract period was extremely short, communication between parties was never an issue. There were no secrets between the owner and contractor. All information was exchanged as required. The contractor was very aware of the owner's time constraints and provided the services required to meet the goals. Project was completed on time, within budget and claim free. The Plant operates beyond the owner's expectations. MWH delivered a facility that does exactly what they said it would do!"

– Mike Stone, PE
City Engineer
City of Wilsonville, OR

MWH's Internal Communications Plan keeps all team members informed and updated on the project status

To enhance communications and coordination between the CAW, the design-build team and our subcontractors and vendors, MWH sponsors periodic meetings, workshops and reviews that will take place during preconstruction, construction, project closeout, start up and commissioning to nurture relationships and foster communications. Following is a partial list:

CAW and MWH Partnering Meeting establishes common goals and objectives of all stakeholders

An initial partnering workshop, with an experienced facilitator, is the initial step in our process. Project stakeholders are provided the opportunity to meet and understand the needs and issues of each other, including roles and responsibilities. Project goals are defined, barriers to achievement of those goals are identified and mitigation strategies are developed for mutual success. Issue escalation rules and matrices are developed to ensure issues are quickly identified and resolved at appropriate levels. Continuing this process quarterly will sustains the partnering gains.

Frequency: Kickoff meeting; quarterly throughout design and construction
Attendees: MWH and CAW

MWH Project Management Meetings ensure interdisciplinary coordination occurs among key personnel

Three separate, weekly meetings that focus on; a) process lead to ensure all project facilities i.e., RO, filters, chemical feed, etc., are being coordinated among each the respective leads, b) discipline lead to ensure electrical, structural, mechanical, etc., is being coordinated among each respective lead and, c) project management to review overall project status.

Frequency: Weekly during preconstruction
Attendees: MWH and CAW

Design Progression/Constructability Reviews/Value Analysis enhances the quality of design

Meetings to monitor and assess the progress of the critical design elements of the project, and provide constructability ideas and value analysis suggestions. The goal is to ensure the final design contains no surprises and provides the most efficient cost model for the project.

Frequency: Bi-weekly meetings hosted and facilitated by MWH during preconstruction
Attendees: MWH, CAW and major subs

"I am convinced we made an excellent decision to select MWH to participate as a key part of our integrated program management team. For over three years, MWH has made tremendous contributions to the success of the Southern Delivery System. Our program is on schedule to begin operations in April 2016, and we are forecasting completion under budget by $89 million."

—John Fredell
Program Director
Southern Delivery System
Colorado Springs Utilities

Permitting Reviews track permit application status and ensure timely approvals

Meetings to review the permitting requirements and associated documentation for each permitting agency. The objective is to review the status of each application regardless of whether the permit is the responsibility of MWH or CAW. The goal is to ensure MWH is properly preparing the appropriate permit application and/or supporting CAW via providing required documentation for its permits to maintain the project schedule.

Frequency: Bi-weekly during preconstruction
Attendees: MWH, CAW and Denise Duffy & Associates

Construction Coordination Meetings enhances communication, collaboration and cooperation among all stakeholders

Generally, the meeting agenda will be as follows:

- Safety – Review project safety issues.
- Public Concerns – Review activities that will either indirectly or directly impact the public or neighboring operations
- Critical Items – Identify items needing resolution immediately so as not to impact construction progress. Once identified, post with responsibility for resolution and resolution date. To the fullest extent possible, items required for resolution are "cleared" prior to the beginning of each weekly meeting.

- Three-Week, Look-Ahead Schedule – Review in detail past week's progress and projected work to occur within the next three-week timeframe, including expected equipment deliveries, critical submittals, etc.
- Quality Items – Review outstanding quality issues as well as upcoming installations
- Submittal Status – Review current status of submittal schedule.
- RFIs – Review current status of RFIs (critical RFIs are discussed under "critical items").
  - General discussion

Frequency: Weekly meetings hosted and facilitated by MWH throughout construction
Attendees: MWH, CAW, and all subcontractors

Quality Control Meetings keep quality at the forefront of construction installations delivering a high-quality product that is both reliable and dependable

Items of discussion will include:

- Review of the three-week, look-ahead schedule
- Quality issues and concerns
- Non-conformance reports and resolutions
- Develop Inspection and Test plans (ITPs) with CAW inspection staff to ensure all elements of the contract specifications are identified and an inspection procedure/responsibility matrix is developed for the individual elements of work

Frequency: Weekly meetings hosted and facilitated by MWH throughout construction
Attendees: MWH, CAW, subcontractors and other stakeholders, as appropriate

"One of the most important outcomes our elected officials expected was a project that could be built within budget, producing high quality drinking water using the best technology available, and just as importantly a project built with quality workmanship. When this project was completed ahead of schedule, we were extremely surprised that all of the city council goals had been achieved. In my experience it is unusual to meet our goals and still stay within budget with a project this size."

— Bruce Williams
City Manager
City of Steubenville, Ohio

Commissioning and Startup Meetings ensure a fully operational and functional facility immediately upon completion with a properly trained staff prepared to take ownership of the new facility

These meetings will ensure planning for plant and systems startup is a collaborative approach, ensuring CAW operations personnel to become familiar with and understand the new plant process. The weekly meetings will be more detailed and provide for CAW input on the SPQS (Safety, Productivity, Quality and Startup) planning for the commissioning phase. Daily meetings during the process will ensure CAW is kept fully informed of the planned activities for the day.

Frequency: Periodically during design and then monthly during early stages of construction; weekly as startup grows closer; daily during commissioning and startup
Attendees: MWH, CAW, appropriate vendor and the I&C subcontractor

"There seems to be a genuine commitment [from MWH] to providing a high quality product that will meet the high expectations of the District...We are appreciative of the efforts and working relationship of the highly qualified, experienced and professional staff members of MWH."

—Kevin Cowan, PE
District Manager,
North Davis Sewer District

Progress and Status Reporting provide a historical narrative of daily construction activities

It is critical that accurate daily reports are kept current throughout the construction and commissioning periods. The construction manager is responsible for ensuring the project team and major subcontractors complete a Prolog daily report each day for every subcontractor working on site. Manpower; equipment; material deliveries; work accomplished each day; weather conditions; quality, safety or labor issues; scope or work sequence changes; punchlist items; and photos documenting milestones are accurately recorded each day.

Frequency: Daily
Recipients: MWH and CAW will have access electronically to these daily reports

MWH Monthly Update Progress Report and the Client Monthly Project Report keeps CAW and the governance committee informed of the key performance indices for the project

Monthly reports provide CAW a snapshot of the overall progress of the project. This report highlights critical elements and activities of the project that provide CAW with an overall assessment of all aspects of the project including:

- Safety statistics, incidents and near misses and ongoing cases
- Schedule progress, delays and corrective actions
- Budget burn for the month, total to date and remaining
- Quality concerns, non-conformance and resolutions
- Public concerns, involvement and resolutions

Frequency: Monthly
Recipients: MWH, CAW and Katz & Associates

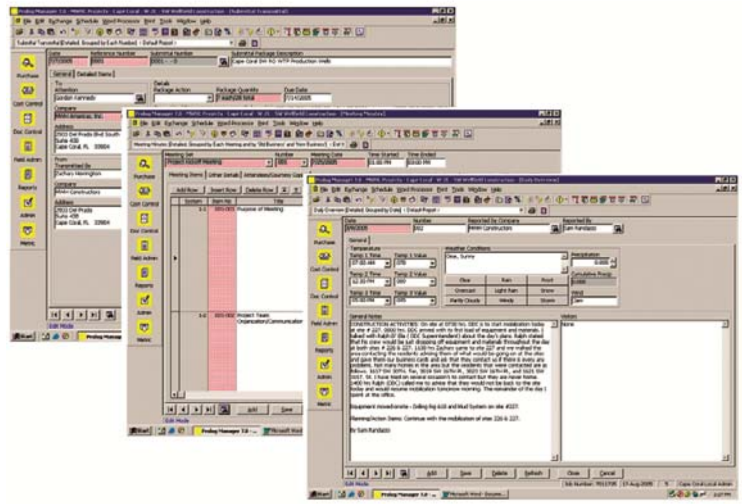
Tools for Communication improve document control and provides avenues to share information, promote remote collaboration among stakeholders, and public involvement

MWH uses state of the art communication tools to implement our reporting and communication plans. These include:

ProjectWise and Prolog

MWH's standard project management information system software is ProjectWise for design development and Meridian Project Systems Prolog during construction. ProjectWise is a project collaboration and information management system developed explicitly for the design and construction of architecture, engineering, construction, and operations (AECO) of infrastructure projects similar to the Project. Unlike traditional document management and collaboration software, ProjectWise is a system of collaboration servers and services for AECO information for the design and construction of infrastructure projects while the work is in progress. It provides scalable, industry-proven, advantages in work-sharing, content re-use, and dynamic feedback.

ProjectWise serves as a repository for design drawings and specifications during design development. Version control allows each document to be checked out by only one person at a time while noting ownership, date and time of each revision. It helps to manage the complex relationships among project files while protecting the quality of work and work schedules. ProjectWise is an efficient system for organizing documents while ensuring that the results of the work are properly communicated and distributed to the project team. This provides an effective means to get stakeholder feedback faster and more frequently during design development and/or prevent lost valuable feedback that later results in costly change orders and potential schedule delays.



Using Prolog, we will track daily construction activities and conditions.

Prolog is used to track all project documentation beginning with preconstruction, such as correspondence, RFIs, submittals, safety notices and meeting minutes. All the information from Prolog is accessible through iPads or computers. The system has a highly secure web-enabled component, Prolog website which allows authorized users access for to post RFIs and other project documents, as well as access to relevant reports. This system is especially useful for collaboration and feedback while providing real-time information to key stakeholders.

Microsoft Lync Online (Lync)

Lync is a hosted communications service that connects people anytime and from virtually anywhere by delivering the collaboration capabilities as a cloud-based service. It gives users access to instant messaging, audio and video calling, screen sharing, online meetings, and extensive web conferencing capabilities. It is hosted on multi-tenant servers that support multiple customers simultaneously while getting real-time presence information—including photos, availability status, and location—and enhanced instant messaging (IM) to connect efficiently and effectively. Additionally, Lync has provisions to include non-Lync Online customers to participate in conference. This allows the MWH design-build team and its partners to hold a meeting regardless of each participant's location and view drawings, specifications, memos, reports, presentations, etc. through its screen sharing capabilities.

MWH Constructors' MPC provides field personnel with up-to-the minute information, increasing collaboration and making it easy to transfer information

Mobile Project Collaboration Connects Stakeholders in Real Time

Traditionally, information is stored on paper documents or electronically on a computer in an office. Communicating changes to project documents consistently and correctly throughout construction of a large project like the Project can become a challenge. Documents that are brought into the field become outdated as the project evolves, presenting the opportunity for quality errors, costly rework, schedule delays and frustration. **MWH uses its real time data management tool, the Mobile Project Collaboration system, to improve communication by *supplying the right information to the right people in real time.***

MWH's Mobile Project Collaboration system deploys wireless touch-screen tablets (iPads) to connect our clients, our design team, and construction personnel in real time, to retrieve project information and transfer field information to other project team members. The ability to effectively transfer information in real time increases collaboration between field and office staff as well as CAW staff involved on the project. MWH will use Prolog® software as the primary project management information and controls system to automate day-to-day tasks and processes — this information is also accessible through a tablet/iPad.

Project Website

One of the foremost challenges when executing a project is communicating basic information to a large number of stakeholders such as CAW, governance committees, potential employees, unions, regulatory agencies, special interest groups, neighboring businesses, potential subcontractors and suppliers and the general public. A project-specific website is an efficient solution to aid in the dissemination of public information to all project stakeholders. This is especially efficient and valuable during preconstruction to provide pre-qualification and bidding information to potential subcontractor and suppliers. During construction, it provides a venue for all interested parties to check the latest developments and upcoming activities.

The homepage will contain a basic project description of the overall MPWS Program and a more detailed description of the Desalination Infrastructure Project. This information will consist of a text narrative describing the project, a design drawing, and renditions of the future plant. From the homepage, we will include links to provide specific project information such as MWH contact information, project schedule and calendar, 24/7 hotline, project updates, bidding information, and other project related information. In addition to a direct link to the project website, we will also provide access through a link embedded in the CAW MPWS Project website.

c. Specific Responsibilities, Authority and Accountability of Key Personnel and How They Will Interact With Each Other and Other Entities

As previously mentioned, a key component of our MAP is the development of a Roles and Responsibility Matrix to identify specific responsibilities, authority and accountability of our key personnel as well as the means and methods of communication. Effective communication and interaction are both key components to the success to a well-coordinated project. The organization chart on in Section 2, Part A, General Project Team Information illustrates the project structure and lines of authority between team members as well as the part of the project each individual is accountable for. Their respective roles and responsibilities are listed below:

Key Team Member	Role	Responsibilities
John Cevaal	Project Executive	Mr. Cevaal is responsible for the overall success of the project and for CAW's overall satisfaction; understands and address the key issues and factors critical to the successful completion of this project; safety; ensures project meets schedule, quality and budget; commissioning and training; completion of punch list; closeout and warranty services. Mr. Cevaal has complete authority to make any and all decisions associated with all aspects of the project and reports directly to the President, Blair Lavoie.
Michael Price, PE	Project Manager	Mr. Price is the primary interface with CAW during the project and is responsible for overall project execution regarding design, construction, commissioning and turnover. This includes all preconstruction activities including design and constructability reviews, value engineering workshops schedule development; all construction activities including safety, schedule, budget and quality; subcontracting evaluation and selection; meeting WMDVBE/Local participation goals, interfacing with the public, special interest groups and the governance committee when required; supporting commissioning activities; project closeout and warranty services. Mr. Price has complete authority to make decisions affecting the daily operations of the project. Mr. Price reports directly to John Cevaal.
Michael Haarmann	Design-Build Manager	As the design-build manager, Mr. Haarmann will be responsible for ensuring the successful integration of design, construction and commissioning and startup activities, he will facilitate construction reviews and input, develop and maintain the project schedule and develop early-out packages and maintain trend logs. During construction, he will facilitate design team involvement including quality reviews, monthly progress reports and planning. Mr. Haarmann will report to Michael Price, project manager.
Michael Nelson, PE, PhD	Technical Advisor	Mr. Nelson will serve as a technical advisor during design for the treatment process and Reverse Osmosis System working directly with Ron Cass. Additionally, Mr. Nelson will provide guidance and assistance during the commissioning phase working directly with Terry Tobel.
Pauline Souza AIA, LEED Fellow WRNS Studio	Architect	Ms. Souza will be the lead architect responsible for providing the design for structures and ensuring the incorporation of LEED and other sustainable elements. Ms. Souza will work with the project team to sure the alignment of cost, quality, schedule and client expectations with the designs and will report to Jim Borchardt
Owais Andrabi, MSI	QA/QC Manager	Mr. Andrabi will participate in the preconstruction services to support design development and formulate the project QA/QC plan and work with the subcontractors to ensure installations are completed correctly and in compliance with design specifications and state and federal regulations. Mr. Andrabi reports directly to John Cevaal maintaining his independence and autonomy from the project staff and has the authority to stop non-conforming work when and where necessary.
Jim Borchardt, PE	Design Principal Engineer of Record	Mr. Borchardt is responsible for the overall design of the project; discipline leads for civil, structural, mechanical, electrical and I&C; permitting; maintaining the design schedule to meet critical milestones; scheduling and executing design and constructability reviews; scheduling and executing value engineering workshops; ensuring design meets project specifications and requirements; reviewing submittals, RFIs, shop drawings and providing clarifications; supporting QA, and; supporting commissioning activities. Mr. Borchardt has the authority to make and approve design decisions benefiting the project. Mr. Borchardt reports directly to Mike Price.

Key Team Member	Role	Responsibilities
Shon Fandrich, PE, PMP	Construction Principal	Mr. Fandrich is responsible for executing the project to its timely completion. Mr. Fandrich will participate in the preconstruction services providing valuable input into planning, sequencing and scheduling the project providing a contractor's perspective to the design and facility layout to achieve economies and efficiencies during construction. Mr. Fandrich will participate in assembling bid packages and evaluating and selecting subcontractors; is responsible for safety; day-to-day activities on the project site; coordinating construction activities; maintaining and updating the master schedule; quality; supporting commissioning and training; punch list, and; closeout. Mr. Fandrich has complete authority to manage daily field operations. Mr. Fandrich reports directly to Mike Price.
Ronald Cass, PE, PMP	Water Treatment Process Designer	Mr. Cass is responsible for the design of the seawater desalination treatment process; facility layout; equipment evaluation and selection including Factory Acceptance Testing; ensuring proper equipment installation; supporting Mr. Tobel during commissioning planning, sequencing and execution. Mr. Cass reports directly to Jim Borchardt.
Martin Hind	Reverse Osmosis System Designer	Mr. Hind is responsible for the design of the Reverse Osmosis System; RO equipment evaluation and selection including Factory Acceptance Testing; ensuring proper RO Skid equipment installation; supporting Mr. Tobel during commissioning planning, sequencing and execution. Mr. Hind reports directly to Jim Borchardt.
Charlie Randolph	Construction Superintendent	Mr. Randolph is responsible for the execution of all field activities while ensuring safety and quality and maintaining schedule and budget. Mr. Randolph will participate in the preconstruction services providing valuable insight into planning, sequencing and scheduling the project from a contractor's perspective; is responsible for safety; coordinating subcontractor activities; schedule updates; maintaining site cleanliness and organization; completion of punch list items; and supporting commissioning efforts. Mr. Randolph has authority to manage subcontractor activities. Mr. Randolph reports directly to Shon Fandrich.
Denise Duffy Denise Duffy & Associates	Permitting and Environmental Compliance and Monitoring	Ms. Duffy is responsible for all filings, applications and reports necessary to obtain and maintain governmental approvals necessary to commence, continue and complete the project and achieve acceptance; attend all required meetings and hearings; develop and monitor mitigation plans and measures; immediately report to CAW and other governmental bodies all violations of the terms and conditions of any governmental approval, environmental mitigation measures or applicable law pertaining to the project, and; prepare all reports for CAW and governing bodies. Ms. Duffy reports directly to Mike Price.
Terry Tobel, PE	Commissioning Manager	Mr. Tobel is responsible for planning, sequencing and scheduling the commissioning and startup process of the Project; will meet with CAW O&M staff to verify the current level and type of training and determine additional training requirements; develop appropriate training courses to ensure CAW'S O&M staff is sufficiently prepared to assume ownership of the new facility, and; participate in preconstruction services providing his insights to facility layout and functionality from an O&M perspective. If necessary and/or requested by CAW, Mr. Tobel and his group can provide short-term O&M services. Mr. Tobel has complete authority over planning, sequencing and executing all commissioning activities. Mr. Tobel reports directly to Mike Price.

Key Team Member	Role	Responsibilities
Laura Casey	Safety Manager	Ms. Casey is responsible for developing and implementing the overall project safety plan. Ms. Casey will participate in preconstruction services to provide her valuable insight into the design and plant layout from a safety perspective; review subcontractor safety plans; will be a resource to the project staff and subcontractors for safety related issues; investigate and perform root cause analysis for incidents and near misses; lead safety meetings; provide appropriate training as well as verify training certification from outside sources; and monitor and enforce safety standards. Ms. Casey has complete authority to stop any unsafe work practices and remove anybody from site for unsafe behaviors. Ms. Casey reports directly to Mike Price.

d. MWH's construction and operations teams are integrated with the design team in all phases of the project to promote constructability, operability, maintainability, value engineering and efficiency of design and construction

*"I have been especially impressed with the **high level of coordination** with our local contractors as you worked with us to **reorganize** the project into smaller bid packages and pre-purchase major equipment in an effort to attract qualified bidders, **obtain more bids** and **reduce the cost** of the project."*

—Mike Flood
Agency Engineer,
Antelope Valley-East Kern Water Agency

A key benefit of the design-build delivery is the interaction between construction, operations and design during preconstruction. A significant factor to our success is the integration of our design, construction and commissioning teams. This provides CAW with two primary benefits: first, **single source accountability without the complications and complexities inherent with join ventures** and; second, **the efficiency of communication and co-location of design, construction and commissioning teams** during design and preconstruction.

Full integration and co-location of MWH's key individuals improves communication, coordination and cooperation resulting in a more efficient and cost effective facility

MWH is a single entity with key individuals representing safety, design, construction, commissioning, and quality to our design center located in Walnut Creek, CA. Several of the key individuals are already located in our Walnut Creek office and have collaborated on numerous successful projects throughout the country such as CAW's Moss Landing Coastal Water Project, the West Basin Ocean Desalination Demonstration Plant, Point Fortin Seawater RO Plant, and San Francisco's Sunol Water Treatment Plant Expansion. This familiarity among team members and experience on past and present design-build projects provide continuity among the design-build team while eliminating learning curves typically found with joint ventures and partnerships. As a result, **the MWH design-build team is already intimately familiar with the policies, procedures and processes to improve communications, promote constructability, operability, maintainability, value engineering and efficiency of design and construction**. These existing relationships assist with **expedited resolutions** to any issues that may develop over the course of a large project such as this. MWH utilizes this methodology to improve:

1. **Engagement** during the design process. Key construction personnel participation in the design process allows them a better understanding of the design purpose and the opportunity to suggest alternative ways to achieve it. Participating in and understanding the background of decisions and inputs that go into the finalization of the design eliminates re-consideration of alternatives after design is complete. This interaction consistently leads to more efficient design and fewer problems during construction.
2. **Communication** between design, construction and commissioning is greatly enhanced resulting in better clarity, efficiencies and knowledge transfer.
3. **Coordination** of the different specialties through a logic sequence of information transfer, avoiding incorrect assumptions, and giving a priority level for changes in order to avoid lack of coordination and to improve the design compatibility.
4. **Standardization** of design information, to avoid the omissions, errors and continuous changes that affect the normal development of the project.
5. **Control** of the flow of information, verifying that the requirements of previous processes are fulfilled, in order to avoid that design defects arrive to the construction site.

Co-location of MWH's key individuals during the Design Phase facilitates collaboration and early resolution of issues

Our team members have collaborated on numerous successful design-build projects. The camaraderie among our team members eliminates the learning curves typically experienced with Joint Ventures.

Key individuals will be located in the same office space in close proximity to ease communication, foster collaboration, and expedite approvals. Additionally, we will provide office space for CAW project personnel to actively participate in over-the-shoulder reviews, design task forces, planning, sequencing and scheduling the project; all formal workshops and design reviews will occur in an office designated by CAW. This approach will facilitate communication and collaboration for all administrative and design activities as well as promote team building and innovation while increasing CAW's contributions to project design, construction and operations. Additionally, this early collaboration is critical for early resolution of constructability, scope, budget, and schedule issues and will be particularly important in finalizing the selection and procurement of long-lead equipment for the Project.

Throughout preconstruction there are important activities that will include key team members other than project management and design, specifically safety, QA/QC and commissioning. These activities include:

- Design reviews at 30%, 60%, and 90%
- Value Engineering
- Constructability reviews
- Schedule development
- Quality planning

Their involvement provides invaluable input and feedback during design development from a safety, quality and O&M viewpoint.

Co-location of MWH's key individuals during Construction plays an important role in quality management

Members of our design team will co-locate with the construction team to the project site. Their involvement plays an important role in quality management and maintaining schedule through the reviews of shop drawings and submittals; responding to RFIs; interpretation of specifications; providing clarifications; defining and approving corrective actions; quality assurance; testing and; commissioning the new facility. As an integrated design-builder, MWH has an inherent advantage to achieve efficiencies for turn-around times for RFIs, submittals, shop drawing reviews, etc., reducing the potential for schedule, quality and budget impacts.

e. MWH's plan for handling communications will provide the local residents a fair and balanced understanding of the water supply project

MWH has teamed with Katz & Associates (K&A) to facilitate communication with the public. K&A is a nationally recognized public affairs consulting firm specializing in issues-based communication programs for public and private sector clients with a special emphasis on water. K&A is intimately familiar with the water issues on the Monterey Peninsula. Having been the selected communications team to support the prior Regional Desalination Project, and then also on the selected engineering team to support the Marina Coast Water District's pursuit of a seawater desalination water facility, K&A has tracked and studied for the past few years the evolution and challenges of providing water to this region.

Description of the Plan for Handling Communications

Our plan for handling communications begins with what message we are trying to communicate and why. As with many major infrastructure projects, particularly when new and unfamiliar technologies are involved, public awareness efforts are critical to gain community buy-in and ultimate project success. As the topic of desalination has become more prominent in public dialogue, it is increasingly important to balance the conversation through public awareness activities focused on the realities of water supply challenges, the options to address demands, and desalination technology.

It is widely understood that water users will face water shortages due to regulatory restrictions on water diversions from the Carmel River and pumping from the Seaside Groundwater Basin, and that action must be taken to diversify the local water supply portfolio. Most recently, the public dialogue has been focused on costs, legal issues regarding pumping restrictions and settlement agreements, and logistical issues regarding process. For the Monterey region, a need exists to educate the community on critical water issues, their associated risks to health, safety, economic viability, and the environment, and CAW proposed solutions. It is also important to leverage the existing efforts of the Governance Committee into the development and operation of a new water supply project to ensure efficient and effective public input.

Therefore, the following message themes are central to the education and awareness efforts for this project and should be delivered against

> *"One of the most effective communication methods MWH Constructors used to deliver excellent client service was a single point of contact. Because we had one individual who served as our go-to person for every need, we were able to easily provide input on the project and have our questions answered immediately."*
>
> ***— Clifford A. Goins, Assistant Director of Water Production, Augusta Utilities Department (N. Max Hicks-Tobacco Road WTP)***

the backdrop of a “no action” alternative:

- Presenting the need to couple water conservation efforts with a long-term water supply solution
- Explaining the benefits of desalination operational scenarios and flexibility
- Generating an understanding of the environmental review and associated mitigation measures
- Describing desalination costs and impacts to water rates
- Educating the public on the range of alternatives being considered, the screening process, and environmental impacts of a desalination project
- Disclosing the consequences of doing nothing

MWH will work with K&A to support CAW in providing local residents a fair and balanced understanding of the water supply options within the context of existing water supply and ecosystem realities.

To communicate this message, MWH and K&A have developed strategies for municipal water projects based on a core set of communication tactics: Coordination, Public Awareness/Education, Multicultural Outreach, Media Relations/Social Media Outreach, and Creative Services/Graphic Design. For this project, MWH will coordinate with K&A and CAW, to develop and implement a robust public awareness and involvement program.

Public Awareness/Education

MWH will work with CAW to develop a program to keep the public informed of the project. Public participation activities such as office hours, educational workshops, and community events help push appropriate themes out to the broader public and gather feedback to help shape the project. For this project, MWH will focus on public awareness and education to the following target audiences:

During construction of the Piedmont Regional Wastewater Treatment Plant in South Carolina, MWH and the Owner hosted a community outreach event, which welcomed community members from the surrounding area on site to see the progression of the project.

- The general public/rate payers
- Public agencies, such as the California Coastal Commission, Monterey County, Department of Rate Payer Advocacy, and the Public Utilities Commission, among other local government agencies and elected officials
- Special interest groups, such as environmental and business who have a direct stake in the outcome of the project

MWH will also plan for targeted updates to and input from the Governance Committee that was assembled specifically for this project. K&A has key staff that are experienced in conflict resolution and issues management who can guide CAW through the public awareness and education efforts associated with constructing a desalination plan.

Multicultural Outreach

The population of Monterey County is comprised of 82 percent White, 56 percent of Hispanic or Latino origin, and 7 percent Asian; 52 percent of Monterey County residents speak a language other than English at home (2011 U.S. Census Data). In order to ensure full and fair community involvement across all income levels, races, ethnicities and languages, MWH will work with K&A, who implements multicultural outreach activities aimed at the full cross-section of community profiles. Outreach tactics include translation services, attendance at multicultural community events, and multicultural community organization/leader briefings.

Our outreach team includes fluent Spanish speakers who have implemented dozens of environmental justice and multicultural outreach programs across the state and are available to translate key materials and attend multicultural events on behalf of the project.

Media Relations/Social Media Outreach

Local media coverage often sets the tone for a project and, whether welcome or not, affects public opinion on local issues. MWH will organize media campaigns to shape this coverage through targeted briefings, rapid fire responses to correct misinformation, implementing a robust social media outreach effort, and conducting paid advertising when necessary. Together, these tactics help balance public conversation on controversial issues by clearly presenting facts, dispelling myths, and clarifying complex issues.

MWH will work with K&A staff, which includes former reporters and media experts who specialize in the full range of media relations services, including news conferences, media spokesperson training, op-ed articles, public service announcements, news releases and editorial board briefings. MWH will aggressively support the communication of CAW's messages to the public in order to raise awareness of important issues.

Creative Services/Graphic Design

Effective public involvement strategies rely on creative services such as designing informational materials that can translate complex information into clear, easily understood terms. K&A specializes in developing print- and web-based communication tools to brand projects and build an educational platform to guide outreach efforts. From the outset of a project, its key staff will incorporate project themes into all materials – fact sheets, frequently asked questions, website features, etc. – to help shape the public conversation.

Implementation of our communication plan will be led by Rebecca Nicholas, is a long-time resident of Pacific Grove. Ms. Nicholas has ten years' experience in public affairs and government relations, including grassroots coalition building, stakeholder engagement, community outreach, risk communication, and media relations. Ms. Nicholas has experience working with landowners, state and local elected officials, special interest groups, environmental justice communities, and tribal governments, on projects of all shapes and sizes. In addition to stakeholder engagement, her areas of expertise include: public education; community outreach; stakeholder coordination; risk communication; media relations; government relations; communication materials; meeting facilitation; workshops/focus groups; strategic planning; event planning; key message development, writing/editing; public policy analysis. Ms. Nicholas is a seasoned practitioner that has worked on several high profile water and infrastructure projects in Northern California and will manage communications with the public on behalf of the MWH Design-Build Team.

f. MWH's relationship and communications with CAW and all other appropriate Governmental Bodies fosters and enhances clear and concise communication

MWH's experience in the management of large complex construction projects, from design through project closeout and warranty implementation, has enabled it to develop a communications and reporting model that fosters and enhances clear and concise communication between stakeholders. With the number of federal, state, local and private stakeholders involved in this project, it is essential that these relationships, communications and the responsible party be clearly delineated. We recommend a tiered, zippered communication approach that matches appropriate roles and responsibilities across the two primary entities. "Zippered communication" means that relationships are formed and issues are resolved at the appropriate level based on a communication matrix. To provide consistency throughout the project, MWH recommends establishing clear points of communication and relationship ownership between CAW, government bodies and MWH (see table below for CAW/MWH).

CAW	MWH	Role
Robert McLean	Blair Lavoie/John Cevaal	Project Executives
Richard Svindland	Mike Price	Project Management
Ian Crooks	Jim Borchardt	Design/Permitting
Eric Sabolsice	Terry Tobel	Commissioning , O&M
Lori Gerard	Michael Cavanaugh	Legal
Catherine Bowie	Rebecca Nicholas	Public Relations

Governmental Bodies

In Appendix 3, Attachment 1, of the MPWS PROJECT Permitting Status Update Memorandum, dated January 9, 2013, RBF has identified 35 federal, state, local and private entities that will all be involved in the MPWS Program, 24 of which are associated with the Project. With so many stakeholders invested in the project, establishing a clear understanding of relationship ownership with each entity is paramount. In pursuit of this project, there are relationships that will be owned exclusively by CAW, some by MWH and others that will be jointly owned. For example, relationships and communications with the California Coastal Commission (CCC) will be owned exclusively by CAW with MWH providing supporting documentation. Monterey County will be owned exclusively by MWH while both CAW and MWH will be interfacing with the Central Coast Regional Water Quality Control Board; CAW for the NPDES permit and MWH for the NPDES General Permit for Stormwater Discharge and Waste Discharge Requirements.

Table 3-2 in Appendix 3 has identified those government agencies that will require MWH's direct involvement and interface. To maintain consistency and continuity throughout the project, MWH has assigned primary points of contact to interface with each agency, whose relationship is owned by MWH, as identified in the table below. In cases where both CAW and MWH interface with the same agency such as the Regional Water Quality Control Board as mentioned above, MWH will coordinate our efforts with CAW to ensure there is no overlap or conflicting pursuits. Where MWH is supporting CAW with permits such as the Coastal Development Permit from the California Coastal Commission, MWH will defer all communications and contact to CAW.

Government Bodies	
Federal Agencies	**Lead/Interface with Government Agency**
None Identified	MWH to support CAW
State Agencies	**Lead/Interface with Government Agency**
Regional Water Quality Control Board	Jim Borchardt
California Department of Public Health (CDPH)	Mike Price
Local/Regional Agencies	**Lead/Interface with Government Agency**
Monterey County	Denise Duffy

Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Denise Duffy

g. MWH's geographic location of key staff during each phase of the Project will facilitate efficient communication

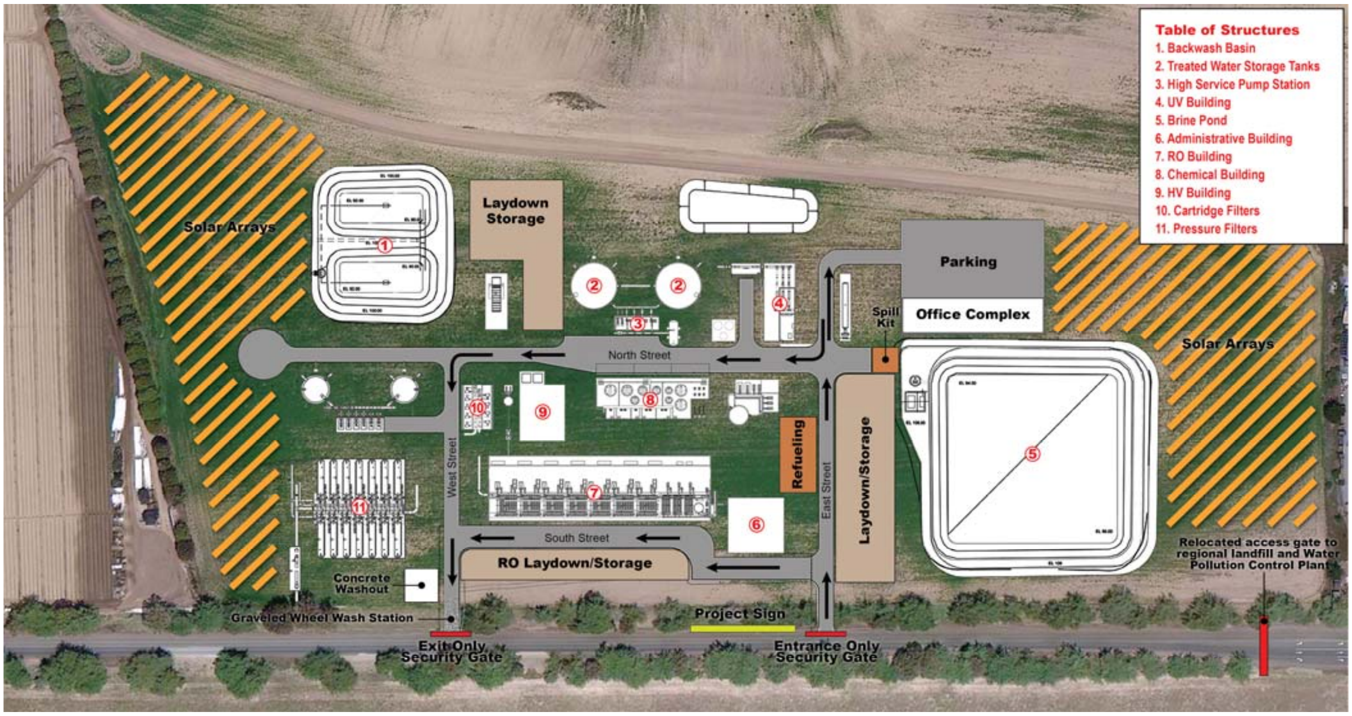
As mentioned above, MWH will co-locate our key individuals in our Walnut Creek office during design and then to the project site from start of construction through closeout. Key individuals' geographic location during each phase of the project is listed in the table below:

Name	Position	Design	Construction	Transition and Acceptance
John Cevaal	Project Executive	Walnut Creek (as needed)	Project Site (as needed)	Project Site (as needed)
Michael Price	Project Manager	Walnut Creek	Project Site (as needed)	Project Site
Michael Haarmann	Design-Build Manager	Walnut Creek	Project Site (as needed)	Project Site (as needed)
Jim Borchardt	Design Principal Engineer of Record	Walnut Creek	Project Site (as needed)	Project Site
Mike Nelson	Technical Advisor	Monterey and Walnut Creek	Project Site (as needed)	Project Site
Ron Cass	Water Treatment Process Design	Walnut Creek	Project Site (as needed)	Project Site
Martin Hind	Reverse Osmosis Design	Walnut Creek	Project Site (as needed)	Project Site
Terry Tobel	Commissioning Manager	Walnut Creek (as needed)	Project Site (as needed)	Project Site
Shon Fandrich	Construction Principal	Walnut Creek (as needed)	Project Site	Project Site
Charlie Randolph	Construction Superintendent	Walnut Creek (as needed)	Project Site	Project Site
Owais Andrabi	QA/QC Manager	Walnut Creek (as needed)	Project Site	Project Site
Laura Casey	Safety Manager	Walnut Creek (as needed)	Project Site	Project Site
Denise Duffy	Permitting	Walnut Creek (as needed)	Project Site (as needed)	Project Site (as needed)
Pauline Souza	Architect	Walnut Creek (as needed)	Project Site (as needed)	N/A

h. MWH's approach to site development, including construction staging and laydown areas, earth movement and all other site work is based on expediency and efficiency

In our approach to site development, MWH has evaluated a number of considerations that affect the site layout and development during construction activities. Of primary focus is the health and welfare of every individual directly and indirectly involved with the project as well as adjacent owners and the public. We have also considered security measures not only for CAW, MWH, and our subcontractors but for protection of native habitat, nearby wetlands and the Salinas River.

Our approach to earthwork is based on the Geotechnical Baseline Report and with OSHA and Cal-OSHA requirements. The site layout for construction activities has been developed based on expediency and efficiency in an effort to minimize travel of manpower, materials and equipment.



Our approach to site development is as follows:

Pre-Mobilization

Safety – As the design-builder, MWH will be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Project. This includes taking all necessary precautions for the safety of, and providing the necessary protection to prevent damage, injury, or loss to all persons on and off the project site, including visitors, subcontractors, suppliers, and inspectors. For example, MWH has engineered a balanced site eliminating the need to export residual or import fill material. This approach significantly reduces truck traffic entering and leaving the site as well as the hazards it creates.

Project Signage – Prior to mobilization, MWH will erect a sign at the project site identifying the Project in accordance with the specifications as detailed in Appendix 4. Additional signage will be installed throughout the project site to highlight safety statistics, direct traffic, identify designated areas for queuing, concrete washout, first aid stations, respective field offices, etc.

Security - MWH will be responsible for protection of the project site, and all improvements, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons. Security measures to be put in place consist of:

- **Fencing** - All temporary and existing fencing affected by the improvements will be maintained by MWH until the completion of the project. Upon completion of the project MWH will restore all fences to their original or to a better condition and to their original locations. Types of fencing to be utilized on this project include:
- **Security** – Upon issuance of Notice –to-Proceed, temporary fencing will be installed around the property boundaries to protect against vandals and unauthorized persons. Upon completion, the permanent fence will be 6 ft. high; PVC coated galvanized steel for salt air corrosion protection. Architectural grade fencing is to be provided within 50 feet, either side, of the main entrance.
- **Orange Fencing** – Prior to any construction activities, the boundaries of construction areas will be clearly delineated with orange plastic construction fencing to prevent workers from inadvertently straying from the construction area
- **Exclusion Fencing** – Prior to the onset of any ground-disturbing activities, exclusion fencing will be established around areas of potentially occupied habitat and to provide protection of plant life designated to remain.

Gates – All access and egress points on the project site will be provided with a gate to control entry to the project. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates across the construction easement will be kept closed and locked at all times when not in use. Gates at access and egress points will be monitored and managed by MWH, open during construction hours and locked during off hours. The permanent gate at the main entrance is to be equipped with closed circuit camera, intercom, lighting, and card access.

Earthwork

MWH has provided CAW with a facility design conscious of safety, efficiencies, traffic flows, site congestion, and adjacent property owners. Upon evaluating the project site we determined the elevation and natural contours of the property facilitate a balanced site requiring no export or import of materials. Additionally, our approach to the earthwork focuses on minimizing the impact to non-construction related areas and leaving natural habitat and vegetation undisturbed. Both of these approaches contribute to the overall site safety, dust control and minimizing construction traffic on public right-of-ways.

Our approach to earthwork is based on the recommendations found in the Baseline Geotechnical Baseline Report as follows:

Site Preparation

- All construction areas will be stripped and cleared of all debris and any vegetation with depths not exceeding 6”
- All organic laden topsoil will be stockpiled for re-use in landscape areas
- All deleterious materials will not be used as engineered fill or blended into engineered fill but will be removed from the site
- In building areas, a minimum over-excavation depth will be at least 3 feet below the existing grade or 3 feet below finish pad grade, whichever is deeper
- Building pads will be over-excavated at least 5 feet beyond the outside edge of the new perimeter footings
- Prior to placement of engineered fill, the exposed soil surface will be scarified to a depth of 8 inches, water conditioned and compacted to at least 90 percent

Engineered Fill

- Material used for engineered fill will be generated from on-site sources
- Engineered fill will be non-expansive, free of organics or other deleterious material, free of rock fragments larger than 3 inches
- Engineered fill will be placed in layers no greater than 8 inches with optimal moisture content and compacted to at least 90 percent for non-structural elements and compacted to 95 percent beneath buildings
- The top 12 inches of finished subgrade beneath concrete walkway and pavements will be compacted to 95 percent

Excavations

- Due to the granular soils at the site shoring may be required to stabilize excavations in accordance with OSHA and Cal-OSHA Safety Standards
- Excavations may be laid back or benched in lieu of shoring in accordance with OSHA and Cal-OSHA Safety Standards
- Where the vertical height of permanent cut and fill slopes exceeds 15 feet, intermediate benches will be provided
- Any water seepage into excavations will be relieved by adequate drainage and or pumping

Surface Drainage

- All graded slopes and exposed soil surfaces will be planted with erosion resistant vegetation and/or erosion control matting
- The ground surface above the tops of slopes will be graded to drain away from the crest
- Lined V-ditches or drainage berms will be constructed along the tops of slopes to prevent surface water from flowing onto the slope face
- Final grading will eliminate ponding of water adjacent to structures, or along edges of concrete slabs or pavements.
- Grades will be sloped away from structures a minimum of 4 percent in landscaped areas and 2 percent in paved areas for a distance of at least 5 feet

Mobilization

- **Construction Staging** – Staging areas will be designated in strategic locations on the project site that facilitate installations by the responsible subcontractor. These areas provide the real estate for the subcontractor to stage its material and equipment for immediate installation such as cranes, RO skids, piping, trusses, etc. For example, the RO building contractor's staging area will be located across South Street. Proximity to the RO building contractor's designated work area minimizes movement of materials and equipment thereby improving dust control while reducing traffic resulting in a safer construction site.
- **Laydown and Storage** – Unlike staging, these areas will be designated in strategic locations on the project site outside of the construction areas providing subcontractors with the real estate to store materials and equipment when not ready for immediate installations. Additionally, fabrication yards can be erected in these areas. Prefabricated components reduce installation times resulting in increased productivity while minimizing waste and improving quality control.
- **Field Offices** – MWH will provide, at a location approved by CAW, field offices for our staff and the Resident Project Representative. The field offices will be large enough to conduct all meetings, be an official place of

business for MWH and house the record documents. Additionally, MWH will provide a separate field office at least 256 square feet (8' x 32') for the RPR and visiting CAW personnel.

- **Parking** - Temporary gravel parking areas to accommodate both project staff and construction personnel will be constructed. Additionally, two parking spaces each for the owner and resident project representative will be designated.
- **Roadways** – Permanent roadways will serve as access to all construction areas within the project during construction. These roadways will be cut to grade and covered with gravel to control dust and minimize mud leaving the project site on construction vehicles. Once construction is complete, the gravel will be moved, the roadways cut to subgrade, approved fill and paved. Roadways have been named to further assist site logistics, orientation and familiarization with the project site.
- **Lighting** – During construction, MWH will strategically install and maintain incandescent lighting for construction operations and lighting to all site access and egress points, easements accesses, parking, office complex, laydown and storage areas. Permanent site lighting will allow for proper functioning of security cameras while not creating light pollution in the form of point sources of direct glare visible from a distance.

i. MWH's measures to minimize noise, odors, dust, traffic and other construction-related impacts during the Design-Build Period will mitigate their impact to the adjacent property owners

Although the project is located outside of residential and commercial areas, we still need to be cognizant of adjacent property owners such as the Monterey Regional Waste Management District, Monterey Regional Water Pollution Control Agency, and farmers. MWH will reach out to the affected stakeholders to develop plans to mitigate the impact of their respective operations during the design-build period. These plans will address at a minimum the following:

Noise Abatement

As a precursor to implementing a noise abatement plan, MWH will conduct a baseline noise survey to establish benchmarks at the plant site and at potential noise receptors and establish threshold noise levels where negative impacts could potentially occur to the wildlife, native habitat and the surrounding areas. To minimize noise levels during construction, MWH will:

- Require the use of noise-attenuated generators for powering lights
- Require engines to be equipped with suitable mufflers to reduce noise levels
- Design traffic flow patterns to reduce backing-up operations for all trucks and operations vehicle
- Use sound blankets and sound walls when and where applicable
- Limiting working hours and working days so that noise-producing activities are normally conducted during the weekday, daylight hours.

Odor Control

Although the construction activities themselves will emit very little odors, there are elements of the project that could emit unpleasant odors that will need to be planned for accordingly such as:

- Dumpsters will be located on the project site away from populated construction activities and the office trailer complex. The location will take into account prevailing winds that could carry odors. Dumpsters will be emptied on a regular schedule; more if needed due to excessive trash generation or odors

- Trash containers will be lined with impervious bags, covered and emptied on a daily basis and washed periodically
- Portable toilets will be located around the project site and maintained on a daily basis
- Debris from clearing the site, such as trees and vegetation, will be removed from the project site and sent to the landfill to prevent odors from decomposition

Dust Control

Construction activities and traffic have the potential to generate significant dust for which innovative control techniques will be developed. MWH will implement a dust control plan that will include:

- Water all active construction areas at least twice daily
- Cover all trucks hauling soil, sand and other loose materials and require trucks to maintain at least two feet of freeboard
- Apply water three times daily on Charles Benson Road, or apply (non-toxic) soil stabilizers on unpaved access roads, parking areas and staging areas at construction site
- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded inactive areas for ten days or more)
- Enclose, cover, or water twice daily exposed stockpiles (dirt, sand, etc.)
- Limit traffic speeds on construction site to 5 mph
- Replant vegetation in disturbed areas as quickly as possible

Minimizing Project Related Traffic

With numerous subcontractors simultaneously working on the project in addition to traffic associated with the regional landfill and wastewater treatment plant and local farmers, MWH will minimize project related traffic in the following ways:

- A balanced site requiring no import or export of material
- Locating staging areas adjacent to work areas
- Designated parking for office and craft personnel
- No personal vehicles allowed in the construction areas
- Encourage carpooling
- One way directional traffic flows
- Schedule earlier start times for large concrete pours

Stormwater Pollution Prevention Plan (SW3P)

An SW3P will be prepared for the site in accordance with State and Federal regulations. The plan will contain specific provisions for spill control and prevention including requirements for vehicle refueling (see site logistics plan), checking of vehicles for leakage, cleanup of spilled materials and storage of chemicals, fuels, and lubricants during construction. The plan will also contain provisions for maintenance and inspection of control facilities and provisions requiring documentation of maintenance and inspection activities. MWH will utilize the following measures at a minimum to manage stormwater events:

- Implement erosion control measures such as slope stabilization, hydroseeding, mulch logs, gravel berms, sandbags, etc.
- Inspection of the project site prior to anticipated storm events and after the actual storm event
- During extended storm events, the inspections will be conducted after every 24-hour period
- Installation of silt-fencing at least 36 inches high that is buried at least 6 inches in the ground to prevent incursion
- Capturing stormwater runoff

Light Control

MWH will follow acceptable means and methods for lighting systems during execution of the work that minimize impacts to native habitat, wildlife and surrounding areas. Once identified, we will submit product literature to CAW for approval and follow restrictions and guidelines on lighting to ensure it is properly installed and oriented. Additionally, nighttime work will only occur as a last resort upon approval by CAW and the appropriate agencies.

Education and Training

Education, training and efficient and effective means of communication are vital to the overall success of this project regarding environmental issues. To help ensure the success of this project all personnel will be required to attend initial and follow up training sessions to review environmental protection goals, requirements, and enforcement. Strict enforcement measures will be implemented that could include dismissal of personnel that fail to conform to the environmental requirements. To further ensure this project meets all the environmental goals, MWH will conduct periodic safety and environmental meetings that will include CAW and all subcontractors. Finally, MWH will continuously evaluate and recommend changes to improve the effectiveness of the education and training of our staff and subcontractors.

j. MWH's Preliminary construction traffic management plan will be coordinated and scheduled to avoid impact to any sensitive nearby wetland habitats

MWH has developed a Preliminary Construction Traffic Management Plan (see Appendix following this section). This preliminary construction Traffic Management Plan (TMP) provides information regarding the associated hazards and issues to be addressed during the construction of the Desalination Infrastructure Project (Project) involving exposure to vehicle traffic and traffic control on Charles Benson Road and on the project site.

Our traffic plan will include demarcation and the installation of exclusion fencing to protect the listed species and its habitat as discovered. As noted on the site logistics plan on page 19, there is one gated entrance to and one gated exit from the project site off Charles Benson Road. Signs, such as Entrance, Exit Only, One Way, Do Not Enter, Speed Limit, etc. will be posted throughout the project site for traffic management.

Orange fencing and barriers will be placed around the construction areas to prevent vehicles from straying from the construction areas. Roads are named to facilitate site logistics, orientation and familiarization with the project site. All traffic flows will be one way with a turn-around located at the east end of the site. A concrete washout is located at the exit for expediency to provide concrete trucks a quick and efficient location to washout upon exiting the site. A gravel pad is located at the exit along with a wheel wash station to remove all mud and debris before entering Charles Benson Road.

We do not anticipate encountering any federally listed species during construction. However, if any are encountered MWH will follow the mitigation measures as outlined in the Mitigation, Monitoring and Reporting Plan as identified in the Draft EIR.

k. MWH's Preliminary spill prevention and control plan for construction address the safe handling, storage, treatment and/or disposal of hazardous materials.

MWH has developed a preliminary Spill Prevention Control and Countermeasure Plan (SPCC) to address the safe handling, storage, treatment and/or disposal of hazardous materials (see Appendix following this section).

l. MWH's approach to obtaining Governmental Approvals needed to construct and operate the Design-Build Improvements is successful and systematic

There were a total of 227 permits applied for and obtained on the $887M combined Facilities and Utilities Expansion Program for Cape Coral, FL. MWH was responsible to design, permit and build three new treatment plants and upgrade another in addition to design, permit and install over 720 miles of utility piping. These permits included General Contractor Building Permits, site plan approvals and Environmental Resource Permits for surface water management systems and Planned Development Project (PDP) rezoning efforts. MWH also prepared and submitted 30 Alternative Water Supply grant applications on behalf of the City. There were no permit-related delays to project schedules during the program and our client received over $17M as a result of MWH's efforts supporting their pursuit of grant funding.

Successful permitting requires a systematic approach to acquisition, design integration, and compliance assurance occurring against a backdrop of environmental commitments for the project. Our permitting approach recognizes that there are key decision makers within the California Coastal Commission, State Lands Commission, State Water Resources Control Board and Regional Boards, U.S. Fish and Wildlife Service, NOAA and other regulatory agencies who must be relied upon to make critical permitting decisions. MWH understands that the responsibility for securing and complying with certain permits will be CAW's responsibility with MWH providing support, some shared with CAW, while others will be MWH's sole responsibility. Required permits, licenses, and approvals all represent critical milestones in completing the Desalination Infrastructure Project on schedule. For example, the Subsequent EIR (EIR) being prepared by the CPUC will provide California Environmental Quality Act (CEQA) compliance for all MPWS Project-related infrastructure, including the desalination plant infrastructure. MWH will work with CAW and the CPUC to ensure the EIR includes Monterey County planning and building requirements. The Monterey County Planning Commission will not be able to approve the desalination Use Permit without certification of the EIR. **Our team has specific, local, relevant experience in obtaining the requisite approvals needed and a proven track record in meeting regulatory compliance requirements.** This experience includes the following:

- Obtaining federal, state, and local permits and approvals for design-bid, design-build, and design-build-operate projects throughout California
- Specialized permitting experience with Clean Water Act Sections 404, 402, and 401
- Preparing complete application packages to satisfy the full range of project permit requirements Working closely with the client and federal, state, and local regulatory agencies
- Monitoring, compliance, and enforcement of regulatory and environmental requirements

- Preparing and implementing National Pollutant Discharge Elimination System (NPDES) permits, encroachment permits, Stormwater Pollution Prevention Plans (SWPPP), and Best Management Practices (BMPs) for all construction activities

MWH recognizes the importance of the permitting phase of this project and how the accuracy and completeness of submitted permit applications can potentially affect project delivery. As such, our Design-Build Quality Management Program will include a separate Permitting Quality Management Plan. This plan will establish quality criteria and measurements for the Design-Build Team members responsible for coordinating with governing permitting agencies to ensure that the level of design detail is sufficient for review by the permitting agencies. The permitting procedures to be detailed in the Permitting Quality Management Plan will ensure the timely review and approval of the design. For permits that are expected to be more difficult to obtain, we will adopt a preemptive approach that would involve upfront meetings with key decision makers to learn as much as we can about what to expect before the process actually begins and to engage regulators early into the project communication loop such that issues can be addressed as they arise. This preemptive approach has proven to increase likelihood of permit approval and has also streamlined the permitting process.

Two factors will drive our approach and schedule to securing all the necessary permits for the Desalination Infrastructure Project:

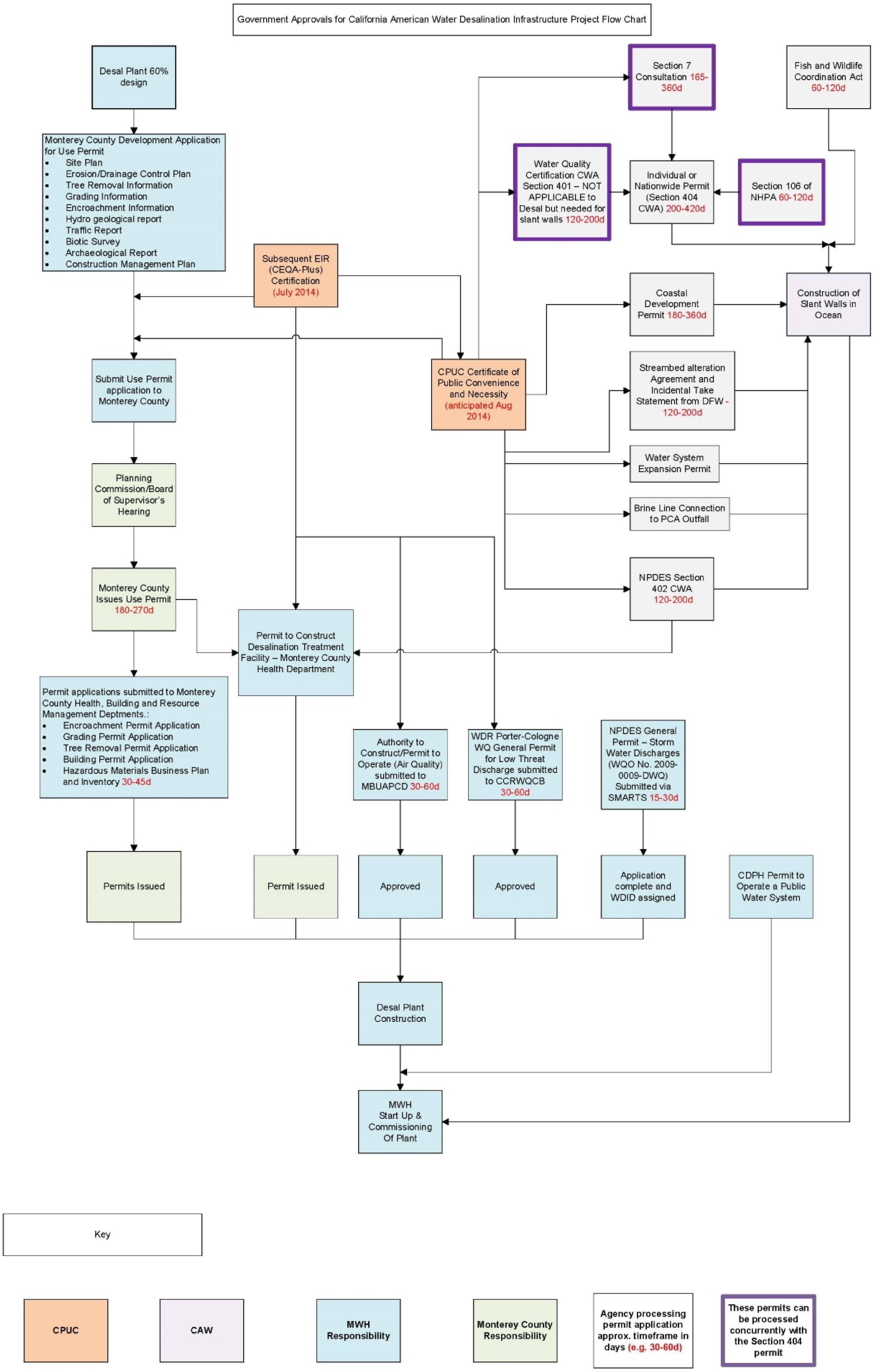
- Permit applications must be completed in a timely manner
- Permit applications must address all the subtleties and nuances of the permitting process

For each of the permits required, we will:

- Determine if any additional studies/analyses are needed to support permit approval
- Identify the need for and nature of upfront agency coordination
- Hold pre-meetings with all applicable permitting agencies to solidify application requirements and any unique issues to the Desalination Infrastructure Project
- Develop a permitting process schedule that prioritizes the permits that are expected to be more difficult to obtain
- Identify major milestones leading up to securing the final permits
- Conduct a schedule risk assessment
- Hold progress meetings with the permitting team to track status

CAW staff and construction experts will be consulted to make sure that actions described in permit applications is reasonable and will not unduly complicate construction efforts.

The **following chart shows the relationship between the required permits** and the following is a brief synopsis of the status each permit and how MWH intends to obtain them.


Government Approvals for California American Water Desalination Infrastructure Project Flow Chart
Desal Plant 60% design
Monterey County Development Application for Use Permit
Site Plan
Erosion/Drainage Control Plan
Tree Removal Information
Grading Information
Encroachment Information
Hydro geological report
Traffic Report
Biotic Survey
Archaeological Report
Construction Management Plan
Subsequent EIR (CEQA-Plus) Certification (July 2014)
Section 7 Consultation 165-360d
Fish and Wildlife Coordination Act 60-120d
Water Quality Certification CWA Section 401 – NOT APPLICABLE to Desal but needed for slant walls 120-200d
Individual or Nationwide Permit (Section 404 CWA) 200-420d
Section 106 of NHPA 60-120d
Coastal Development Permit 180-360d
Construction of Slant Walls in Ocean
CPUC Certificate of Public Convenience and Necessity (anticipated Aug 2014)
Streambed alteration Agreement and Incidental Take Statement from DFW - 120-200d
Water System Expansion Permit
Brine Line Connection to PCA Outfall
NPDES Section 402 CWA 120-200d
Submit Use Permit application to Monterey County
Planning Commission/Board of Supervisor's Hearing
Monterey County Issues Use Permit 180-270d
Permit to Construct Desalination Treatment Facility – Monterey County Health Department
Permit applications submitted to Monterey County Health, Building and Resource Management Deptments.:
Encroachment Permit Application
Grading Permit Application
Tree Removal Permit Application
Building Permit Application
Hazardous Materials Business Plan and Inventory 30-45d
Authority to Construct/Permit to Operate (Air Quality) submitted to MBUAPCD 30-60d
WDR Porter-Cologne WQ General Permit for Low Threat Discharge submitted to CCRWQCB 30-60d
NPDES General Permit – Storm Water Discharges (WQO No. 2009-0009-DWQ) Submitted via SMARTS 15-30d
Permits Issued
Permit Issued
Approved
Approved
Application complete and WDID assigned
CDPH Permit to Operate a Public Water System
Desal Plant Construction
MWH Start Up & Commissioning Of Plant
Key
CPUC
CAW
MWH Responsibility
Monterey County Responsibility
Agency processing permit application approx. timeframe in days (e.g. 30-60d)
These permits can be processed concurrently with the Section 404 permit

Monterey County Permits

The permits required from Monterey County are numerous and require coordination with various departments including Planning, Building, Resource Management, and Health and Safety. The permits required for construction of the desalination plant infrastructure include the following: Use Permit (Monterey County Code Chapter 21.74), Combined Development Permit Process (Monterey County Code Chapter 21.76), Grading Permit (Monterey County Code Chapter 16.08), Erosion Control Plan (Monterey County Code Chapter 16.12), Permit to Construct Desalination Treatment Facilities (Monterey County Code Chapter 10.72), Protected Tree Removal Permit (Monterey County Code Chapter 16.60), and Building Permit (Monterey County Code 18.02).

In the sections below, the overarching approach to obtaining the Monterey County permits are first discussed and followed by specific detail on how the most complex permit, the use permit, will be obtained.

For SRCSD's $600M Lower Northwest Interceptor Program in West Sacramento, MWH obtained many of the same permits, licenses, and approvals for construction as those that will be needed for the Project as identified in Appendix 3. More than 120 permits and/or approvals were obtained from agencies including the State Water Resources Control Board/Central Valley Regional Water Quality Control Board (CVRWQCB), Yolo-Solano Air Quality Management District, Cal OSHA, Central Valley Flood Protection Board, United States Army Corps of Engineers, local farmers, reclamation districts, California Department of Industrial Relations, Yolo County, PG&E, California Department of Fish and Wildlife, Department of Transportation, State Lands Commission, Union Pacific Railroad, and Sierra Northern Railroad. These permits were obtained without any delays to the project schedule.

General Approach to Obtaining Permits in Monterey County

Luke Connelly, Management Specialist for Monterey County, is the planner assigned to the MPWS Project. MWH met with Mr. Connelly to discuss this project in September 2013. Monterey County will require submittal of a Development Project Application for a Use Permit for construction of the desalination plant infrastructure. The Use Permit application is considered an "Extraordinary Development Application" due to the complex nature of the project. A Combined Development Permit application (as listed in table 3-2 of Appendix 3) is normally issued when a coastal permit is required. The parcel on which the desalination plant infrastructure will be constructed is located outside the coastal zone and will not require a Coastal Development Permit. Therefore, a Combined Development Permit is not anticipated for construction of the desalination plant.

The Use Permit is a "catch all" permit and will include information on the operation of the desalination plant, encroachments needed, grading and erosion control, hazardous waste, and tree removal. Dennis Duffy with Denise Duffy & Associates (DD&A) and Meredith Parkin with MWH have obtained numerous Use Permits in Monterey County and understand the need to submit a complete application the first time. The California Permit Streamlining Act allows up to 30 days for the planning and building department to complete their initial review. At that time they can deem the application "complete" or "incomplete". Denise and Meredith have a proven record of submitting applications that are deemed "complete" because they coordinate early with the appropriate departments to clearly understand what is needed for a complete application.

A public hearing will be held with the planning commission and, if appealed, the Monterey County Board of Supervisors would approve the Use Permit for the desalination plant infrastructure. It is very important that the Use Permit application include information in anticipation of questions and comments that the Commission, Supervisors, or general public might have. This will help reduce the potential of a hearing being continued to gather more information to answer these questions.

The Use Permit will be on the critical path because it is needed to obtain other Monterey County permits. The Encroachment Permit, Grading Permit, Erosion Control Permit, Building Permit, Protected Tree Removal Permit, and Permit to Construct Desalination Treatment Facilities will not be granted by the Monterey County Building, Resource Management, or Health and Safety Departments until the Use Permit has been approved. In addition, as mentioned above, the Use Permit can't be issued until the EIR is certified. To expedite the issuance of the Encroachment, Grading, and Building permits, MWH has included in our bid the extra fee to have outside consultants assist the building department in their review of the Desalination plant infrastructure applications.

MWH will initially arrange a biweekly meeting with representatives from the Monterey planning/building departments to discuss information contained in the applications, so the application submitted meets all the requirements of Monterey County. These meetings will help reduce any guess-work and potentially eliminate the iterative process common during most permit approval processes.

Specific Approach to Obtain the Monterey County Use Permit

The MWH design-build team will develop an Initial Permitting Memo which will include the land use designations, applicable county regulations, and entitlement constraints for construction of the desalination plant infrastructure. In addition, MWH will review existing technical reports and, utilizing information from the Subsequent EIR, develop a comprehensive project description for inclusion in the "Pre-Application" form to be submitted to Monterey County. In addition to the project description, the "Pre-Application Package will include the concept site plan, vicinity map, assessor's parcel map, aerial photography, GIS exhibits, maps, and information on public/private roadways and easements. MWH will submit the Initial Permitting Memo and Pre-Application form to CAW for review and comment prior to submitting the Pre-Application form to Monterey County.

Various Monterey County departments will be invited to a pre-application meeting and, based on the information obtained at the meeting, MWH will prepare the Development Project Application for a Use Permit. The application will include, at a minimum, the following elements:

- Project Description
- General Plan Consistency Analysis
- Environmental Information (utilizing information from the Subsequent EIR)
- Site Plan(s)
- Floor Plan(s)
- Elevations
- Landscape Plan
- Fuel Management Plan

- Grading/Slope Map(s)
- Drainage Plan
- Agricultural Buffer Plan
- Construction Management Plan(s)
- Technical Reports
- Project Mapping
- Improvements Plan(s)

Once the application is submitted to Monterey County for review, the California Permit Streamlining Act allows up to 30 days for the Monterey County to complete their initial review. At that time they can deem the application "complete" or "incomplete". As stated above, Denise and Meredith have a proven record of submitting applications that are deemed "complete" because they coordinate early with the appropriate departments to clearly understand what is needed for a complete application. MWH will continue to meet with County staff on a regular basis to ensure timely process of the application.

California Department of Public Health (CDPH)

Permit to Operate a Public Water System (Health & Safety Code Section 116525)

Our team has assisted many water utilities in California obtain original and amended water supply permits from CDPH, including CAW for the Carmel Valley Filter Plant, Peralta Well Treatment Facility and Begonia Iron Removal Plant. The process to obtain the CDPH Permit to Operate a Public Water System is relatively straight forward but requires attention to detail and open communication with CDPH staff. A permit from CDPH to construct the desalination infrastructure is not required. CAW needs only a permit to operate the plant after it's built; however, this is a strategy MWH would not endorse. MWH will consult CDPH soon after NTP and maintain dialogue through design and construction of the facility. The application process will begin at the 30% design stage with the updated BODR serving as the Engineering Report. Once the permit application is submitted, CDPH has three months to respond; however, the clock starts once the application is determined to be "complete."

MWH's permit strategy is to meet early and often with CDPH to avoid notification as late as day 89 that the application is not deemed complete. We have discussed this permit with Jan Sweigert, the CDPH District Engineer in Monterey, and she agreed with MWH's strategy and expects to have an ongoing dialogue with CAW and MWH throughout the design process. **She indicated that she was not contacted about the Sand City desalination plant until construction was complete and she was requested to approve operation of the plant. This led to delays and unfavorable operating conditions such as the inability to operate both trains at the same time.**

By submitting the amended permit application and Engineering Report to her early, she will provide us written comments as we work through the permit process. Some of the important issues to resolve early will be pathogen removal credits, ability to operate all trains/equipment at the same time, safety measures (e.g., automatic plant shutdown, switchover to standby trains/equipment), reporting requirements, and minimum staffing levels (including remote operation). MWH has a successful track record working with CDPH on all these issues. For example, we know that pathogen removal via the RO process will be determined on a case by case basis. Although other projects received pathogen removal credit when salt removal was 99%, there is no guarantee that this project will be treated similarly.

The Fairfax County Water Authority retained MWH to provide planning, preliminary design, final design and construction management services for the 300-mgd Potomac Off-Shore Intake and Corbalis Water Treatment Plant. MWH assisted the Authority in permitting the project by preparing permit applications for Maryland and Virginia, as well as federal and local agencies. Rather than common centerline in the Potomac River, the jurisdictional state boundary of Maryland ends on the shore of Virginia. MWH recognized the potential impact to the permitting process in the conceptual stage and realigned the project to allow for the necessary permitting approvals to follow. MWH assisted the State of Virginia in the lengthy Maryland permitting process, which ultimately ended up in the Supreme Court with a ruling in favor of Virginia, giving the state access to the Potomac for its new intake structure.

MWH currently has a WRF project underway to define methods of assessing pathogen removal through RO systems. We also assisted Sonoma County Water Agency and Rancho California to receive groundwater designations (i.e., not under the direct influence of surface water) for shallow groundwater sources being recharged by surface water directly above the extraction locations. Those designations had immeasurable benefits to those agencies by not having to meet the requirements of the Surface Water Treatment Rule. We can bring that experience to the Desalination Infrastructure Project to try to convince CDPH that the slant well supply is a groundwater and not under the direct influence of surface water. MWH also was instrumental in obtaining approval for Sacramento County Water Agency's Vineyard Surface Water Treatment Plant to be operated remotely. It's the largest surface water plant in California to receive such approval.

Once the plant is constructed, it will be critical to the overall project schedule to receive approval to produce water that can be pumped to the CAW distribution system. Our schedule includes the necessary demonstrations with CDPH staff present to receive this approval prior to the RIPPT. CDPH often takes months to formally sign the amended permit, but since CAW already has a water supply permit, conditional approval to use the facilities for domestic consumption is likely as long as all drinking water standards are met.

Regional Water Quality Control Board (RWQCB)

National Pollutant Discharge Elimination System (NPDES) General Permit For Storm Water Discharges Associated With Construction Activity (WQO No. 2009-0009-DWQ) and Waste Discharge Requirements (WDR) per Porter-Cologne Water Quality Control Act. (Water Code Section 13000 et seq.).

A General Permit for Storm Water Discharges will be required from the CCRWQCB as the desalination plant infrastructure construction activity on the 46-acre parcel involves clearing, grading, and excavation. To obtain coverage under this permit, MWH will electronically file the Permit Registration Documents (PRD) through the State Water Resources Control Board (SWRCB) Stormwater Multiple Application and Report Tracking System (SMARTS).

The PRD's will include the Notice of Intent, Risk Determination Worksheet, Site Maps, Storm Water Pollution Prevention Plan (SWPPP), Annual Fees and Owner Certification. The Risk Determination Worksheet will be calculated by QSD during SWPPP preparation and based on rain, soil type, etc. It is anticipated that this project will fall within Risk Level II.

The SWPPP will be developed by MWH. MWH realizes some of the most important aspects of a compliant SWPPP are the mandatory documented SWPPP inspections, monitoring, sampling, authorized/unauthorized non-stormwater reports, weekly BMP inspections, Rain Event Action Plans, documentation of weather tracking, and, most importantly, training. MWH will take into account these aspects when developing the SWPPP and other PRD documents, so that the Waste Discharge Identification Number (WDID) can be obtained expeditiously.

It is anticipated that a low-threat discharge permit (R3-2011-0223) will also be needed for discharges that contain minimal amounts of pollutants and pose little or no threat to water quality and the environment, such as for pipeline testing.

MWH has developed, submitted and/or monitored hundreds of NPDES permits, including permits for the Lower Northwest Interceptor Program, Vineyard Surface Water Treatment Plant, and Borel Relicensing Project.

Monterey Bay Unified Air Pollution Control District (MBUAPCD)

Authority to Construct in accordance with Local Rule 3.1 Permit to Operate in accordance with Local Rule 3.2

Permit application and approval is typically straightforward. MWH has met with MBUAPCD, and will continue to do so, throughout the process to ensure approval. There are two types of permits that are issued by MBUAPCD: Authority to Construct (A/C) and the Permit to Operate (P/O). The A/C is a certification that the emissions from the proposed project will meet all applicable District requirements and not interfere with air quality standards when constructed. The P/O is issued after construction is completed and operation of equipment has begun. It certifies that the construction and actual operation meets the terms and conditions of the A/C and that there are no apparent emission problems. Only one permit application is required for both the A/C and P/O. MWH will utilize air quality information contained in the Subsequent EIR when submitting this application.

Water Quality Certification in accordance with Section 401 Clean Water Act (33 U.S.C. Section 1341).

The desalination infrastructure is part of a larger project that could result in discharge into navigable waters. Part of the MPWS Project could require 401 Certification. However, because no impact to navigable waters is associated with the desalination infrastructure component, a permit is not required.

Meeting Permit Requirements and Conditions

The MPWS Project Subsequent EIR will establish environmental compliance conditions during construction of the desalination plant. These environmental compliance conditions range from traffic and erosion control to biological monitoring. Furthermore, permits issued by Monterey County will establish additional requirements that must be implemented. MWH's approach to ensuring that environmental compliance conditions and permitting requirements will be met during construction includes identifying responsibilities for meeting these conditions and requirements early, and communicating these to the responsible party to ensure that permit conditions will be met.

Implementation of environmental compliance conditions and permit requirements can sometimes be inadvertently overlooked, but taking into consideration these requirements into the design of the desalination plant ensures they will be implemented correctly. In addition to the traditional plan and profile drawings, MWH will provide information in the drawings that present the construction and permit requirements. This approach puts both design information and all associated permit and environmental requirements in one place.

MWH uses a database approach to monitor compliance with permit and environmental conditions. The Design QA/QC Manager will start the permit compliance log after the first meeting with the permitting agency. We expand it and maintain it throughout design and construction. During design, it is used to make sure that all permitting agency requirements are addressed in the design. During construction, it becomes a way to track permit compliance. After construction, the database is an effective tool to demonstrate to regulators that all conditions have been met.

Like any inspection, permit compliance inspection is more effective when it is proactive. MWH will look ahead, try to predict potential problems before they occur, and then work to prevent them from occurring.

m. MWH's Design-Build Quality Management Plan successfully implements quality assurance and quality control

MWH has developed a preliminary Design-Build Quality Management Plan (see Appendix following this section).

n. MWH's approach to procurement and delivery of materials secures the best prices

As a leader in the water/wastewater industry, MWH has procured millions of dollars in water treatment equipment on projects across the U.S. utilizing our global expertise in wet infrastructure and international buying agreements to secure the best prices for our clients. In the last 5 years, MWH procured, handled and installed more than $138M of water treatment equipment for eight large wet infrastructure projects in addition to equipment procured for numerous smaller jobs.

Project Name and Location	Project Amount	Equipment Procured
Central Weber WWTP Expansion & Upgrade, Layton, UT	$135M	$20M
Ina Road WRF, Pima County, Tucson, AZ	$225M	$48M
Thomas P. Smith WRF, Tallahassee, FL	$165M	$32M
Water Treatment Plant No. 4, Austin, TX	$359M	$7M
Piedmont Regional WWTP, ReWa, Greenville, SC	$46M	$10M
Southwest WRF, Cape Coral, FL	$122M	$21M
TOTAL	**$1.05B**	**$138M**

MWH Constructors' procurement staff is highly experienced at procuring equipment for treatment facilities and will use that expertise to deliver the best prices and highest quality equipment for CAW's Project.

Identifying Qualified Vendors

First, our process engineers identify need and establish design criteria specific to each process component. Once needs have been established, size determined and performance requirements verified, our engineers research and collaborate with equipment manufacturers to establish a basis of design. As the design progresses, equipment specifications are developed and manufacturers are pre-approved. During the approval process MWH runs a Dun & Bradstreet report to confirm the financial capability of the potential manufacturer and vendor. For critical equipment we may require a material delivery bond to confirm the proposer has been vetted by a surety, which is typically a rigorous process. All things being equal, it is our preference to deal directly with the manufacturer so that if a problem arises we can deal directly with the firm in charge. We maintain information in-house regarding equipment offered by many manufacturers. Where we are unable to deal directly, often because of client requirements, such as small business enterprise goals or a requirement to buy locally, we identify local manufacturers' representatives prior to issuing an RFP. During the bidding process, we call potential bidders to confirm receipt of the bid and to confirm they are going to submit a bid.

Confirming Equipment Meets Specifications

Manufacturers/vendors are required to provide submittals with respect to their scope of supply. The submittals are reviewed by MWH procurement staff as well as the lead engineer to verify compliance with the specifications. If the submittals are rejected, the manufacturer is required to correct and re-submit them for engineer review and approval.

Typical Purchase Order Process

Following is the typical process for procuring equipment following selection of the selected bidder on an MWH project:

1. MWH will **negotiate and finalize purchase order agreements** with vendors, suppliers and manufacturers. Vendors will be given direction to proceed with preparation of shop drawings. MWH issues common standards terms and conditions and ensures that all required provisions, including critical Client requirements, flow down to all vendors to ensure efficiency and consistency.
2. MWH's procurement specialist will take the lead in **coordinating and expediting technical information** between the lead engineer and the vendors.
3. To coordinate complex, specialized or long-lead equipment, such as motor control centers and large pumps, MWH's procurement specialist will facilitate **specific meetings with manufacturer representatives** and design and construction personnel to discuss and resolve issues before they are submitted for review and approval.
4. Once the equipment shop drawings have been approved for fabrication, MWH's procurement group, lead engineer and construction staff **maintain close contact with the vendors to ensure timely delivery of equipment and materials**. MHW staff will perform in-factory quality assurance inspection and documentation wherever the equipment is being manufactured or assembled.
5. If so desired, a CAW representative can accompany MWH to **visit the manufacturer's facility** to witness a factory test or conduct a vendor inspection.
6. **Strict shipping and transport clauses** are included in purchase orders with the vendors.
7. When equipment is received on-site it is **inspected before it is removed from the truck** to check for any damage it may have received in transit from the factory before placing it in appropriate staging and storage areas on-site.
8. Care and appropriate measures will be taken to make sure the equipment and materials sensitive to the surrounding environment (i.e., moisture, temperature and sun light) are **properly handled and stored**.
9. Any **maintenance necessary prior to installation is identified and highlighted** during the shop drawing review process, so that the equipment will be properly serviced beginning the day it arrives.

10. Installation of the equipment is in strict conformance with the manufacturer's requirements, which are also identified and highlighted during the shop drawing review process.

o. MWH's scheduling process identifies and manages these resources to prevent them from impacting construction progress including such items as availability of skilled workers, materials, machinery, equipment, and working capital

As the selected DB Contractor, MWH will provide and manage a fully cost and resource loaded detailed construction schedule which will minimize schedule risks such as availability of skilled workers, materials, machinery, equipment, and working capital. Utilizing the schedule to this capacity assists the project team in analyzing the planned work should it begin to fall behind or cost are not being expended as scheduled. MWH also utilizes a risk assessment program which contributes in accessing specific examples of risks which may arise, and provides MWH with the keen ability to begin correcting such risks in advance of becoming project delays. This allows the project team to begin supplementing additional resources, cost or equipment necessary to maintain the project schedule for successful on time completion.

Our schedule controls proved valuable on the $40M South County WRF Expansion in Collier County, FL. At the project's onset, the County was unable to obtain the requisite FDEP permits, causing a three and a half-month delay in construction activities. Despite the delay, MWH tightened the aggressive schedule and delivered the plant four months ahead of schedule and $1.4M under budget.

p. MWH's craft labor hiring practices provides incentives to attract and retain the skilled laborers necessary to meet CAW's labor requirements

MWH understands the difficulties and challenges related with attracting and retaining skilled laborers necessary to meet the labor requirements associated with the Project. While MWH has WMDVBE and local participation goals to meet for the project as a whole, we will also require our subcontractors to meet similar goals. MWH will work with each of these subcontractors to ensure it is attracting and retaining skilled laborers to meet labor requirements and, if necessary, can supplement the subcontractor with our own forces.

As a national leader in design and construction of water related utility projects, we are able to draw on a larger regional and national subcontractor resource base when necessary to supplement the local market, both in terms of resources and of specialized supplier/contractor requirements.

By preparing an initial cost model in support of our schedule development, we have also been able to estimate that over 125 craft labor and associated field management will be necessary to construct the project on schedule. MWH has developed an initial subcontracting and equipment plan with the goal of attracting the right type and amount of resources to complete the project on schedule. **Our plan focuses on the following areas:**

Strategy No. 1: National and Regional Electrical Contractors. We have identified several large electrical contractors that are financially sound and experienced with water treatment plant projects. The project will not only benefit from their early involvement during the design phase, but will also benefit from their ability to bring treatment plant experienced electricians to the construction.

Strategy No. 2: Building Contractors. We have prequalified and selected Overaa to provide design-build proposals for the administrative, RO, and process support buildings. MWH selected this building contractor due to its experience, financial strength and ability to staff this project with local resources or via relocation.

"I have been especially impressed with the ***high level of coordination*** *with our local contractors as you worked with us to* ***reorganize*** *the project into smaller bid packages and pre-purchase major equipment in an effort to attract qualified bidders,* ***obtain more bids*** *and* ***reduce the cost*** *of the project."*

—Mike Flood
Agency Engineer
Antelope Valley-East Kern Water Agency

Strategy No. 3: WMDVBE and Local Contractors. We understand the challenges associated with this project meeting 21.5% WMDVBE and 50% local participation goals. We have already identified a number of packages for WMDVBE and other local firms – such as the civil, paving, fencing, signage, landscaping, miscellaneous steel as well as smaller structural concrete packages. Additionally, we have required major subcontractors, i.e., buildings and electrical, to meet these goals as well.

Strategy No. 4: Self Performance. We intend to supplement local craft labor with existing foreman and crews from other MWH projects by providing incentives to attract and retain local labor. MWH provides a first-rate training program with access to over 500 online educational courses spending on average $450 per employee. Employees also receive full medical, dental and wellness benefits as well as profit sharing and financial assistance with higher education.

q. MWH's approach to management of subcontractors focuses on their and the project's success

Each of MWH's subcontractors is a key team member whose individual success and the ultimate success of the project are the same. MWH works diligently to ensure clear, concise communication is adhered to as the cornerstone of the relationship between the subcontractor and MWH at all times. Frequent meetings and daily discussion of potential issues resolve most problems before they occur. The on-boarding activities during preconstruction and described below help the subcontractor take responsibility for its portion of the project and assimilate into the project team. And, the activities that take place throughout construction and into close-out and warranty implementation provide proactive management of each subcontractor — from completion of its work to the way in which it's done — with an eye to safety, quality, and staying on budget and on schedule. Ultimately, all of this contributes to the way MWH manages subcontract cost.

Key Features and Activities

Preconstruction Phase

1. Conduct a page-by-page review of the subcontractors' proposals prior to award of a contact to ensure any potential scope gaps are identified and rectified, and that scope is clearly defined and expectations clearly expressed prior to subcontract formation.

2. Hold preconstruction kick-off meeting with all stakeholders

3. On-board each subcontractor through a series of preconstruction meetings to ensure communication lines are clearly established and requirements are understood and implemented.

4. Incorporate the subcontractors' CPM schedules for their scope of work, using a simple list of anticipated work activities, including sequence and duration, into the master schedule — this encourages each subcontractor to take responsibility for the schedule.

- MWH field management integrates this schedule into the overall project CPM.
- Subcontractors are required to "meet or better" the work activity durations they have committed to.

Safety

1. Conduct a separate, mandatory safety meeting with each subcontractor (principal-in-charge, project manager, safety manager and all superintendents) to ensure that project safety requirements, procedures and expectations are clearly understood.
2. Provide training in hazard recognition and mitigation documentation requirements, as well as MWH's STAR (Safety Task Analysis & Review) card program.
3. Train each subcontractor in the specific requirements and procedures to follow in emergency situations.

Quality

1. Conduct a separate, mandatory preconstruction quality meeting with every subcontractor (project manager, field supervision and project engineering staff) in order to reiterate the requirements of MWH's quality control program.
2. Provide training on the MWH quality control program, including SPQS (safety, production, quality, startup) planning and the Inspection and Test Plan (ITP) process.
3. MWH and subcontractor jointly develop the ITP for the subcontractor's respective scope of work, which serves as the basis of the pre-task planning process (SPQS) used to plan each element of the work.

General and Administrative

1. Train the subcontractor's administrative staff in the day-to-day operational requirements of the project, including:

- Access and use of the project electronic document control system
- Daily reporting requirements
- Requests for information and clarification
- As-builts
- Invoicing
- Correspondence
- Schedule updating
- Change orders
- Open-door policy and escalation matrix

Construction Phase

1. Assign each subcontractor an MWH field superintendent as a sponsor that serves as an advocate and someone who can help solve conflicts involving competing interests. This process ensures that even the smallest subcontractor has a voice in the overall success of the project.
2. Host daily, mandatory subcontractor coordination meetings to ensure issues are identified and solutions found prior to problems that might impact cost, time, quality or safety.
3. Conduct weekly project progress and coordination meetings that include all stakeholders to review overall project status and review a three week look-ahead to review and coordinate construction activities.

Closeout and Warranty

All of the activities discussed above are continued throughout closeout and warranty implementation. MWH processes and procedures discussed throughout this proposal, combined with each subcontractor's contract specification requirements, serve as the basis for development of the project closeout ITP. Warranty implementation is managed in the same proactive way – with clear consistent communication between the subcontractor, MWH and CAW.

1. Develop closeout ITP that includes each of the required elements of project closeout (such as as-builts, record documents, open submittal comments, etc.)
2. Subcontractors must maintain and update these items on a weekly basis, which serves as a condition precedent to payment on a monthly basis.
3. Develop ITP for warranty management, working with the subcontractor to develop and document all issues relating to warranty.
4. Provide documentation to CAW that provides all key elements of the warranty, including:
    a. Start and completion dates
    b. Contact information
    c. Assigned MWH representative – MWH ensures its clients are always able to reach MWH for assistance
    d. Electronic format and transmission to CAW staff

Management and Elimination of Subcontractor Liens

Elimination of subcontractor liens is accomplished by strict adherence to the procedures and processes discussed above. In general, if clear and consistent communication is maintained with each subcontractor, problems such as liens are virtually eliminated. ***MWH considers a subcontractor lien to be a complete failure of its processes.*** Considered a serious issue, a subcontractor lien would be elevated to senior MWH management for resolution. It is then incumbent on senior MWH leadership to resolve the issue as expeditiously as possible to ensure there is no impact to CAW or the project.

r. MWH's approach to integrating the Desalination Infrastructure project improvements with CAW's other MPWS Project improvements ensures all improvements are coordinated efficiently

The Desalination Infrastructure Project includes several other projects that will be occurring concurrently which abut the Project such as the raw water and finished water supply pipelines, the brine disposal connection, and drilling and installation of the production wells and header. In addition to coordinated efforts to tie-in the pipelines to the facility, coordinated efforts for the SCADA installations and programming for these systems will be paramount. CAW has the challenge of coordinating and completing several critical projects in a fairly small geographical footprint and in a narrow timeframe. MWH will facilitate monthly Program Alignment Meetings to include CAW, the I&C contractor and the pipeline, production wells and header designers and contractors. These monthly meetings will provide a venue for the key entities to review the overall program requirements and schedule as well as coordinate their respective efforts to ensure the program is completed on time. These meetings will review:

- Safety
- Schedule updates
- Coordinate activities between contractors
- Develop/review tie-in plans
- Quality
- Operational issues

As a tie-in date approaches, additional meetings will be scheduled with the responsible contractor to finalize and refine each tie-in plan. These plans will address:

- Task to be completed
- Location of the tie-in
- Start date, time and duration
- Names of contractors and subcontractors and each individual and their respective roles and responsibilities
- Safety and environmental hazards and mitigation measures
- Equipment and tools to be used
- Detailed description of events
- Contingency plan

Once completed, we will hold a lessons learned session to review the overall success of the tie-in and use these lessons learned on future tie-ins. MWH will work with each of these entities to safely plan and execute these activities regardless if MWH is the responsible party or another contractor.

s. MWH's internal dispute resolution process for on-site disputes between the MWH and its employees and/or subcontractors is proved and effective

As an integrated design-builder, MWH is void of the complexities and complications associated with joint ventures. As a result, internal disputes are minimized and easily resolved with no impact to the project. If an issue does evolve, John Cevaal, Project Executive, has complete authority to make any and all decisions associated with all aspects of the project. His ability to facilitate negotiations and agreements within MWH will facilitate rapid resolution of any potential issues.

Dispute resolution with subcontractors - Procedures will be developed to ensure efficient and timely resolution, to set time constraints, establish levels of authority, clearly define procedures for elevation to next tier and provide parameters for appeals. We will use a four-level tiered approach consistent with the dispute complexity starting with the foreman and working its way up through the construction manager, project manager and then senior management. MWH uses multiple tools and structures to proactively reduce the potential for conflicts and summarized below. These include:

- Roles and Responsibilities Workshop
- Periodic Partnering Workshops
- Project Management Plan
- Constructability Reviews
- Quality Workshops
- Project Kickoff Workshops
- Cost Model Agreement to Facilitate "Apples to Apples" Comparisons of Estimates

The conflict resolution communication process must be defined during preconstruction. MWH uses and advocates a system of dispute resolution based on the principles of collaboration, accountability and consistency that expeditiously resolves disagreements at the lowest possible level in an equitable, traceable, predictable and productive manner. Disagreements that cannot be resolved at a particular level are elevated to the next level. The representatives have clear responsibility for some specific part or the entire project, as well as their obvious counterparts in the other organizations that appear in the table below.

Organization	Level 1	Level 2	Level 3	Level 4
MWH (Construction)	Superintendent	Construction Manager	Project Manager	Project Principal
MWH (Design)	Project Engineer	Design Lead	Design Manager	Principal
Subcontractor	Foreman	Superintendent	Project Manager	Principal

This structure avoids issues being hoarded, blocked or owned by one individual in any organization. Likewise, it prevents higher level managers from reaching down in the organization to solve problems at an inequitable level to his or her counterpart.

Issue Escalation Process - Only issues that threaten project budget, quality, safety or schedule should come through the dispute resolution system. For example, environmental issues that are obviously a critical element of the project could fall under the "quality," "schedule" or "budget" category, depending on the issue. An escalatable issue is one that immediately or imminently affects the project or team goals and cannot be resolved at the current level of management. The involved parties are clearly at an impasse or the issue is beyond the level of authority of the involved parties, and the agreed upon budget, quality, safety or schedule faces imminent impact.

Required Information for Escalation

- Basic description of the issue – a description of both sides' version of the issue. This allows the next level of management to compare the lower levels' understanding of the problem.
- Supporting facts – forcing the disagreeing parties to focus on facts rather than opinions can make many disputes disappear.
- Potential impacts – documentation of project dimension(s) (schedule, budget, quality, safety, etc.) potentially affected and quantification, if possible.
- Relevant contract provisions – both sides need to consult and understand the contract provisions that govern the matter under dispute and provide those provisions in the write-up.
- Actions taken to date – short description of what the parties have done to try to solve the problem.
- Proposed resolutions – the parties may not have the authority to implement the solution, but should at least come up with a way of solving the impasse.
- Why impasse still exists – if the parties have gone through all the steps above and collected all the relevant information, why is there still a problem?

"MWH's excellence in effective safety and health management has resulted in OSHA's VPP Star award at seven separate locations…Their outstanding efforts include maintaining an injury and illness rate 68% below the national average for their industry."

—John Miles
OSHA Regional Administrator
Dallas, TX

t. MWH's Approach to construction safety is to deliver the highest standard of health and safety performance

SafeStart – MWH's Global Safety Program

Zero Incidents on Every Project – MWH's approach to all projects begins with safety and safety remains a top priority throughout the entire project duration. MWH is committed to developing a positive safety culture and delivering the highest standard of health and safety performance. Our goal is "Zero Incidents" on every project. MWH will make conscientious and diligent efforts to eliminate any conditions that would be hazardous to the workers, program personnel or the public. We provide a well-established global occupational health and safety program known as SafeStart.

Safety as a Core Value – SafeStart is a program designed to create a visible minimum standard of Health and Safety that is diligently communicated and enforced at every level. All onsite employees are required to complete the SafeStart program. Our vision is to encourage employee engagement and involvement in every aspect of health and safety across all areas, activities and disciplines. Each level of management is responsible for demonstrating safety leadership, providing a safe work environment and promoting safety as a value.

Proactive Approach – SafeStart encourages a proactive approach to Health and Safety. These policies and procedures include a code of safe work practices for construction; a substance abuse program; confined space program; as well as a host of practices compliant with global, regional, state, county or city-specific standards. By implementing the fundamental concepts of a systematic approach to safety, MWH employees and project team members enjoy safe and healthful working conditions.

Safety Education and Training – As part of our initial planning process and development of the Project Administration Manual, we will develop the Project Health & Safety Plan, which includes an Emergency Response Plan, a Site Security Plan and a Crisis Communications Plan. This overall plan describes the scope of work, specifies roles and responsibilities, identifies safety and health risks and controls, includes a Code of Safe Work Practices and establishes an emergency assistance network. A site-specific safety orientation, where project specific and general safety procedures are reviewed, will be required for all personnel on the site project site.

Our proposed safety manager, Laura Casey, will ensure compliance with all provisions of the contract documents, OSHA, other governmental agencies, industry safety requirements and standards; and provide safety oversight of the entire project. Additionally, Ms. Casey will conduct weekly "toolbox or tailgate" safety meetings on-site with all crews and conduct daily visual safety inspections of all ongoing work. Periodic safety audits and site visits are made by MWH's Global Director of Health & Safety to ensure adherence to the SafeStart Program.

- Low EMR of 0.57
- Zero OSHA citations in the past five years
- 1st Place in 2010 AGC Construction Safety Excellence Award

Key Features and Activities

Safety Audits: Subcontractor walk-around safety inspections will be conducted at the beginning of their work activities and at least weekly thereafter.

Safety Bulletin Board: The safety manager will establish a safety bulletin board on the Project to increase employee's safety awareness and convey the company's safety message. The following items are required to be posted:

- OSHA poster
- Industrial insurance poster
- Wage and hour laws
- Regulator citation(s) and notice(s). If a citation or notice is received, it must be posted until all violations are abated (as appropriate)
- Emergency telephone numbers and contacts posted (as appropriate)
- OSHA 300A Summary (required February 1 thru April 30 of each year)

Safety Committee: The safety manager is required to set up an Project Safety Committee and conduct monthly meetings.

Safety Disciplinary Policy: MWH believes a safety plan is unenforceable without some type of disciplinary policy. In order to maintain a safe and healthy workplace, employees must be cognizant of project rules, state and federal safety and health regulations as they apply to specific job duties.

Safety First: Safety is a top-down and bottom-up driven value of our organization. Our Monday morning project coordination call always begins with a "Safety Moment." And, any visitor to the job site must complete MWH's and the owner's safety orientations prior to accessing any project work area. The Project safety manager will conduct project orientation for all field personnel prior to the first work shift or visit (in English and Spanish).

Safety Incentives: Approximately quarterly, MWH will sponsor a safety awareness luncheon or other project safety incentives to raise the safety awareness level of project personnel and promote and publicize safety. MWH also holds safety barbecues periodically to emphasize and celebrate successful past performance.

Safety Oasis: One of the ways we proactively manage the welfare of our personnel, while reinforcing our commitment to the safety of our employees, is through setting up one or more Safety Oasis locations on every jobsite. The Safety Oasis helps increase overall safety awareness across the project site. A Safety Oasis is an area designated for the project personnel that contains one or more of the following:

- Shade from the sun or a place to warm up
- Eyewash stations
- Hand wash stations
- Drinking water and/or Gatorade
- First aid kits
- Fire extinguishers
- Seating during breaks
- Trash cans
- Extra PPE such as safety glasses, ear protection, gloves, etc.
- Safety signage
- Extra STAR cards

Safety Performance Report: A monthly summary of hours worked and number and types incidents (e.g., first aid, near hits, OSHA recordable injuries) shall be provided to the MWH safety manager no later than the second workday of each new month.

Safety Training: Our project staff is required to attend OSHA 10- and 30-hour construction safety awareness training. In addition, MWH initiated an ongoing web-based safety training program designed to augment lectures and hands-on training. Each year, employees are required to complete eight hours of web-based training. Project staff also must maintain first aid and CPR certification. Training is also provided on topics unique to a given project, such as confined space entry; fall protection; lead, asbestos, and silica awareness; and excavation and trenching.

Safety Task Analysis and Review (STAR) Plan: The STAR plan provides a method to perform a safety analysis on a specified job task or work operation. The STAR card assigns go/no-go responsibility for a task and must be completed daily by the supervisor and the crew assigned. Each crew member involved must review, participate in and sign the plan. Upon completion, the card is signed and returned to the safety manager or project manager. The cards are located in a Safety Awareness Box, where the cards, corrective action reports, ITPs, etc., are posted for all to see for the duration of the task.

Periodic Safety Activities: Site management conducts periodic meetings with supervisory employees to discuss safety problems and review any site incidents that have occurred. MWH's safety director and members of the executive team also visit sites periodically to perform safety audits. As with the daily inspections, any deficiencies are identified and communicated to personnel involved.

Weekly Safety Activities: Site safety supervisors conduct weekly "toolbox" or "tailgate" safety meetings with crews to reorient them with the specific hazards that may be encountered on current work. Safety will be discussed at all weekly staff and subcontractor meetings and will be the first item on the agenda. Project tours are taken with each individual contractor to provide feedback and guidance and to assist in resolving any safety issues the contractor may have.

Incident Investigations and Root Cause Analysis: After occurrence of any incident and/or a near miss, MWH will perform an incident investigation to discover the root causes that led to the incident. The objective is to discover the timeline, root causes, contributing factors and develop resolutions to ensure the incident doesn't occur again. The incident and summary of the investigation will be shared with CAW, MWH project staff as well as all subcontractors and vendors working on site.

Subcontractor Responsibilities: The subcontractor shall ensure compliance with all applicable federal, state, and local laws, rules, regulations and guidelines governing safety, health and sanitation, including but not limited to the Subcontractor Safety and Health Plan described in the MWH Health & Safety Plan, the Occupational Safety and Health Act and the Drug-Free Workplace Act.

Substance-Free Workplace: MWH will not tolerate unsafe workplace conditions created with substance (alcohol or drug) use. Subcontractors, lower tiered contractors, vendors and their employees are obligated as a condition of doing business with MWH.

J. Plan for the Transition and Acceptance Testing

J. Plan for the Transition and
Acceptance Testing

J. PLAN FOR TRANSITION AND ACCEPTANCE TESTING

Commissioning and start-up of new treatment plants is a challenging task. All aspects of the project – design, construction, permitting, training - must seamlessly come together in a coordinated manner to ensure that each individual process, and the process as a whole, is commissioned, started up and tested in the most efficient manner possible. In addition, for the Desalination Infrastructure project, we understand how critical it is for the new facility to be able to meet its production capacity immediately upon completion. This requirement adds even more importance to the transition phase.

MWH understands that many issues can impact coordination of construction, startup, testing, and transition of the treatment facilities to CAW for operation. Significant issues for this project include:

- Delays in completion of activities upon which subsequent equipment testing is dependent, whether by receipt of incomplete or delayed equipment, permitting issues, etc., have a significant impact as the time required for startup and commissioning is dependent upon proper sequencing and availability of various units.
- Timely training of operators is important so they do not become critical path for startup acceptance testing and transition, and availability of operators both during scheduled training periods, and during testing periods is critical to the schedule.
- Coordinating the commissioning and startup (C&SU) needs with other CAW projects including the availability of seawater to the site, ability of outfall to accept the concentrate, completion of the product piping from the site to point of use, and various permitting issues all can affect the commissioning and delivery of water.

We have developed an approach that anticipates and eliminates these issues and ensures that the project is able to meet its production capacity immediately upon completion. Our approach is based on three areas:

1. Seasoned C&SU team
2. Well Planned Approach
3. Flexibility

Seasoned C&SU team

There is no substitute for experience. Anticipating issues before they happen, planning for the "what-ifs" that have happened before and could happen again, and building a plan that accounts for these issues has proven time and time again to be the most important factor in MWH's successful treatment facility startups. MWH has a team of experts with this kind of experience who are specifically dedicated to commissioning and startup of new water treatment facilities. **Since 2006, this specialized team has commissioned 14 water or wastewater treatment plants totaling 385 mgd and is currently developing plans for two others totaling 100 mgd.** We will bring this expertise to the new Desalination Infrastructure Project to help make the critical commissioning and startup phase run as smoothly as possible and see that CAW's operations personnel are properly trained and can effectively transition into running the plant.

For this project MWH has built one of the premiere commissioning teams in the country lead by Mike Price and Terry Tobel. Mr. Price is a Grade 5 Water Treatment Operator and has served as the project manager or has provided technical and commissioning support on numerous water treatment projects. Mr. Tobel is a Grade V wastewater operator and California licensed PE who has 37 years' experience commissioning and operating both water and wastewater treatment facilities. Mr. Tobel managed the commissioning of the North Cape RO plant and the City of Greenville, NC's membrane plant and is currently planning the commissioning schedule and activities for Austin's 50 MGD Water Treatment Plant No. 4. Supporting this team is Dr. Michael Nelson who has provided professional services on more than 50 seawater desalination facilities around the world. Additionally, Dr. Nelson has owned, commissioned and operated numerous seawater desalination facilities throughout the Caribbean. His vast experience and close proximity to the project make him a valuable asset to the MWH team.

Well Planned approach

The foundation of MWH's approach to C&SU is that the transition of the new facilities from construction to full operation is built into the MWH program from the beginning. MWH's program consists of three distinct phases:

1. Planning
2. Commissioning and Training
3. Startup and Performance Testing

Planning

The major components of the planning phase effort include:

- Operability Reviews during Design
- Commissioning Schedule
- Comprehensive Commissioning and Start Up Plan Development
- O&M Manuals
  - Facility
  - Vendor Technical Manuals
  - SOP Development

Operability Reviews during Design – The commissioning team will participate in the operability reviews of the design at key milestones. The design team will present its concepts for operation, including monitoring and control functions, at every design review meeting. The Basis of Design Report contains sections on operation of every process, and they will be updated at every design submittal. Comments by CAW operations staff and the MWH C&SU team will be incorporated into the design and control logic.

Commissioning Schedule – The C&SU team will participate in the development of the critical path schedule to ensure that the Desalination Infrastructure Project is not only constructed by May, 2017, but is fully operational as well. In the simplest analysis, MWH schedules each unit operation to be completed and commissioned in the order they occur in the treatment sequence, because each downstream process is dependent upon the upstream process supplying it. Therefore, the project schedule in Section 3 H of our proposal is developed to complete the upstream processes first, and the downstream processes in the order of flow. This ensures that all commissioning tasks and activities are properly prioritized and sequenced so that each plant component is available when required for commissioning other components. This also allows commissioning and training to proceed in a systematic and efficient manner, further contributing to a more efficient and complete commissioning process. This is especially important on a project with tight schedule constraints such as the Desalination Infrastructure Project.

One scheduling issue of importance on the Desalination Infrastructure Project is the availability of the intake to supply water and outfall to remove water from the site. The completion of the piping from the slant wells to the plant site and from the plant site to the outfall is shown early in the construction schedule, as many of the subsequent unit operations are dependent upon their availability. There may be benefit to both CAW and MWH for MWH to take over the commissioning and control of the wells, both from a schedule perspective, and to address the issue of dealing with the large volume of seawater produced during testing of the wells. Early in the startup and commissioning process, the well pump operation will be incorporated into the overall control logic, and the well pump operation can be started and tested as soon as the piping is complete.

While final commissioning may be dependent upon the processes upstream, there are opportunities to optimize the commissioning schedule, which MWH has incorporated into our schedule. For example, the RO CIP and Flush systems are not considered to be directly on the critical path. They are quite useful in facilitating hydrostatic testing of the SWRO and the second pass RO, functional testing of the ERD, and other pre-membrane loading testing, which cuts time off of the overall schedule. In addition, the SWRO equipment is typically longer lead than the second pass RO due to larger pump, motor and VFD, etc. A significant amount of the startup and testing of some of the latter processes such as the second pass RO and post treatment can be accomplished with alternate water supplies, such that the equipment is essentially ready for the final testing steps when water becomes available from the SWRO. This will help reduce the overall schedule.

Other normal sequences for an RO plant are already incorporated into the schedule. The pneumatic system must be functional before the pretreatment filter system can be commissioned. The filtered water tank and backwash pumps are necessary for commissioning of the pretreatment system, as are the wastewater basins and backwash recycling pumps. The completion of the commissioning of the second pass RO and the post treatment operations (U.V, carbon dioxide injection, lime system) are dependent upon a flow of water from the SWRO. The high service pumps are last in the process sequence and dependent upon water from the RO and post treatment processes.

Comprehensive Commissioning and Startup Plan – MWH will commission the Desalination Infrastructure Project with CAW's operations and maintenance staff in mind. This approach will be detailed in a comprehensive C&SU plan that is developed in collaboration with CAW. The contents of the startup plan cover safety, quality, organizational approach during all start up stages, schedule, dry, wet and performance testing procedures, communication protocol and demonstration testing details. CAW operator training will be planned and incorporated into the overall schedule. Test procedures follow the same generic outline with test objectives, conditions, sequence, duration and acceptance criteria. Additional check / sign off sheets are also provided and vendors / subcontractors are encouraged to use these documents as part of their testing procedures. An example of the C&SU Plan is attached.

O&M manuals – The O&M manuals will be required to be completed before staff training takes place and will be scheduled early in the project. Standard Operating Procedure development will be scheduled later in the project to assure accurate procedures based on the as-built facility. Commissioning documents will be developed based on the P&IDs and the control narratives. Additionally, to ensure that required final reports can be generated, MWH will prepare pro forma procedures for test data collection, analysis and presentation well before Run-In Place Performance Test (RIPPT) starts.

The C&SU team will be completing the overview training, the SOP development and training; managing the approvals of the vendor technical manuals; and developing the facility O&M manual. All of these activities will need to be completed before staff training and commissioning is completed.

Prior To Commissioning - At least 30 days prior to the proposed testing, MWH will conduct a meeting with CAW to discuss the Commissioning Plan and to finalize roles, responsibilities, proposed schedules and required documentation of the tests. Commissioning will not begin until the final Plan is issued to all parties.

Commissioning and Training

Commissioning – Commissioning activities and Mechanical Performance Demonstration (MPD) will be accomplished beginning with the first unit process ready for testing and finishing with the last unit process ready for testing. During MWH's commissioning activities, each control narrative is thoroughly tested and signed off through the loop validation process, including: Local/Manual, Local/Automatic, Remote/Manual, and Remote/Automatic modes. Performance over the full operative range and efficiency of each mechanical and electrical item of equipment will be tested. All alarm conditions and interlocks are also tested. During the vendor startup, MWH requires the vendor to certify the equipment is installed correctly and ready to operate. A certificate of proper installation (COPI) signed by the vendor will be obtained before MWH commissioning staff begins equipment testing. The program envisioned by MWH will meet the MDP requirement. After completion of MPD, MWH will submit its completed test forms to the CAW for their review.

During commissioning phase MWH holds daily meetings to discuss the day's activities. Additional attendees will include appropriate vendors and subcontractors. A six-week look ahead is developed for overview training, vendor startup, vendor training and commissioning. CAW's staff will be invited to attend the daily commissioning phase meetings to understand what is being commissioned, the commissioning process and, if any issues arise during the commissioning, the corrective actions taken.

CAW Training – MWH will request that CAW identify their proposed operators before the project reaches mechanical and electrical completion phase. It is important to confirm they have the requisite licenses, background and experience for this type of plant. If any of these are lacking, MWH can tailor their training accordingly.

Operator training will be provided for each unit operation, subsystem and major piece of equipment. MWH plans for unit process overview training to occur before staff receives training on specific equipment. This method allows for better understanding how the specific equipment fits into the unit process and overall process of the facility. The training classes will be broken into a series of classes correlating to the commissioning schedule. Training is broadly broken into classroom training and hands-on field training. Class room training will focus on the principles of the process, purpose, and practical considerations, with a field walk through when possible to put the equipment into perspective. Safety procedures and consideration specific to the unit process or equipment, trouble shooting, and operator data collection and analysis will also be addressed in the classroom training.

The classroom training will be scheduled for a period fairly close to when the equipment is expected to be available for commissioning team. CAW's operations and maintenance staff will be invited to participate and observe any and all of the commissioning activities to become familiar with the new equipment and processes.

During commissioning, staff will continue to receive training as an extension of the vendor training. For many of the operating modes and faults, the only opportunity the operator may have to observe them, is during the startup and commissioning testing, as they may never occur during normal operation.

Immediately prior to, and during the RIPPT testing, the operators will have the opportunity to bring the equipment through various operating mode transitions, startups and shutdowns. The operators will be introduced to the actual data collection and analysis procedures available in the HMI/PLC system during this period. Training during the RIPPT will be under the direct supervision of MWH, as this is part of the formal testing and equipment acceptance process.

Following the RIPPT, the system will go through the acceptance testing. During this period, the system will largely operate at steady state conditions, so this will primarily be a period during which the operators continue to become familiar with the equipment. The training focus during this period will be on data collection, analysis, and interpretation of trends.

System Commissioning and Water Management – MWH's commissioning plan is shown in the figure below and generally is in the order the unit operations appear in the process. In practice, the startup sequence may be driven by the long lead times of various equipment and when the various unit operations will be completed and ready to test, and we will work around them with some of the approaches discussed, to keep making progress despite these issues.

Startup and commissioning will involve large volumes of seawater, potable water and waste washwater, and a number of temporary piping bypass and recirculation lines will be required. MWH has incorporated these into our proposal which has materially improved the schedule and flexibility of the startup process.

The completion of the GMF system can be largely completed prior to availability of water from the slant wells, using potable water added to the filtered water tanks. During normal operation, the filtered water tank will provide water for GMF backwashing. The water from the filtered water tank can be used during the construction phase for leak testing, media loading, soaking, and backwashing. This requires completion of the filtered water tank, backwash pumps, wastewater basins and backwash recycle pumps.

Preliminary testing of the filtered water pumps, cartridge filters, and pretreatment controls will also be done with water from the filtered water tank. In the absence of seawater to the tank, preliminary testing can be done with potable water from the tank. Water would be recycled to the filtered water feed tank after the cartridge filters to minimize consumption of potable water. This testing is generally fairly short and simple.

Seawater will be necessary to complete the commissioning of the pretreatment system. Therefore is the first system that is dependent upon the availability of seawater from the slant wells to the plant site and the availability of its disposal from the plant site to the outfall. MWH has assumed seawater well supply to the site, and piping from the site to the outfall, will be available before the GMF construction schedule reaches the point water is required for leak testing, media loading, backwashing, etc. Assumed dates for completion both of the CAW furnished systems are included in our schedule.

The commissioning program will utilize potable water for a majority of the second pass RO and post treatment testing, and piping disinfection prior to actual membrane loading. This will both allow the commissioning schedule to be accelerated, by allowing testing before the availability of permeate from the seawater RO, and minimize the total volume of wastewater.

USE OF RO CIP SYSTEM DURING COMMISSIONING

During the commissioning of the Desalcott plant at Point Lisas, Trinidad, both the SWRO and the second pass were tested hydrostatically using the CIP system. We have successfully used the RO CIP systems for preliminary testing of the RO equipment in plants in Curacao, Aruba, St. Maartin, and the BVI.

At Point Lisas, there was also a large inter-pass tank from which the second pass RO trains would normally draw SWRO permeate as feed to the second pass. Potable water was used in the tank for second pass testing, prior to commissioning of the SWRO. Specially designed orifice plugs which eliminated the high velocity water jets into the low pressure permeate piping, typically observed with orifice testing, were also useful in allowing the second pass to be largely tested without risk to the RO membranes.

The disinfection of the RO permeate piping, post treatment processes, product water tank, and product pipeline will be done right before the membrane installation. The majority of startup and commissioning testing of the second pass and post treatment processes can be completed using potable water in the product tank, CIP tank and flush tank, before permeate is available from the seawater RO system.

Startup and Performance Testing

Initial Plant Performance Test – After the entire facility is commissioned and the MPD complete, the facility and staff will be ready for Initial Plant Performance Tests. This 24 hour test will be completed jointly by MWH and CAW with MWH managing the facility while CAW receives on-the-job training via observation and participation. The plant will be ready to start as the facilities have been appropriately disinfected.

Run-In Plant Performance Test (RIPPT) – During the 14 day RRIPT, the plant will be run over a range of transition conditions while concurrently collecting performance data. MWH commissioning staff will be on site to provide oversight, direct supervision, assistance and additional training to CAW's operations staff as necessary. This will also ensure all the required data and documentation for the final report is collected. Daily meetings will continue through this period to discuss any issues that may arise during the testing. Any problems will be corrected as soon as possible.

Acceptance Test - During the Acceptance testing, the plant will generally be run at steady state conditions, except for two days at the maximum flow conditions. The post treatment will be run at three different combinations of hardness, alkalinity and pH, each for three days. Although CAW's operations staff should be thoroughly familiar with the facility and its treatment capabilities at this time, our commissioning team will continue to provide direct supervision to assist if needed and to ensure all the required data and documentation for the final report is collected.

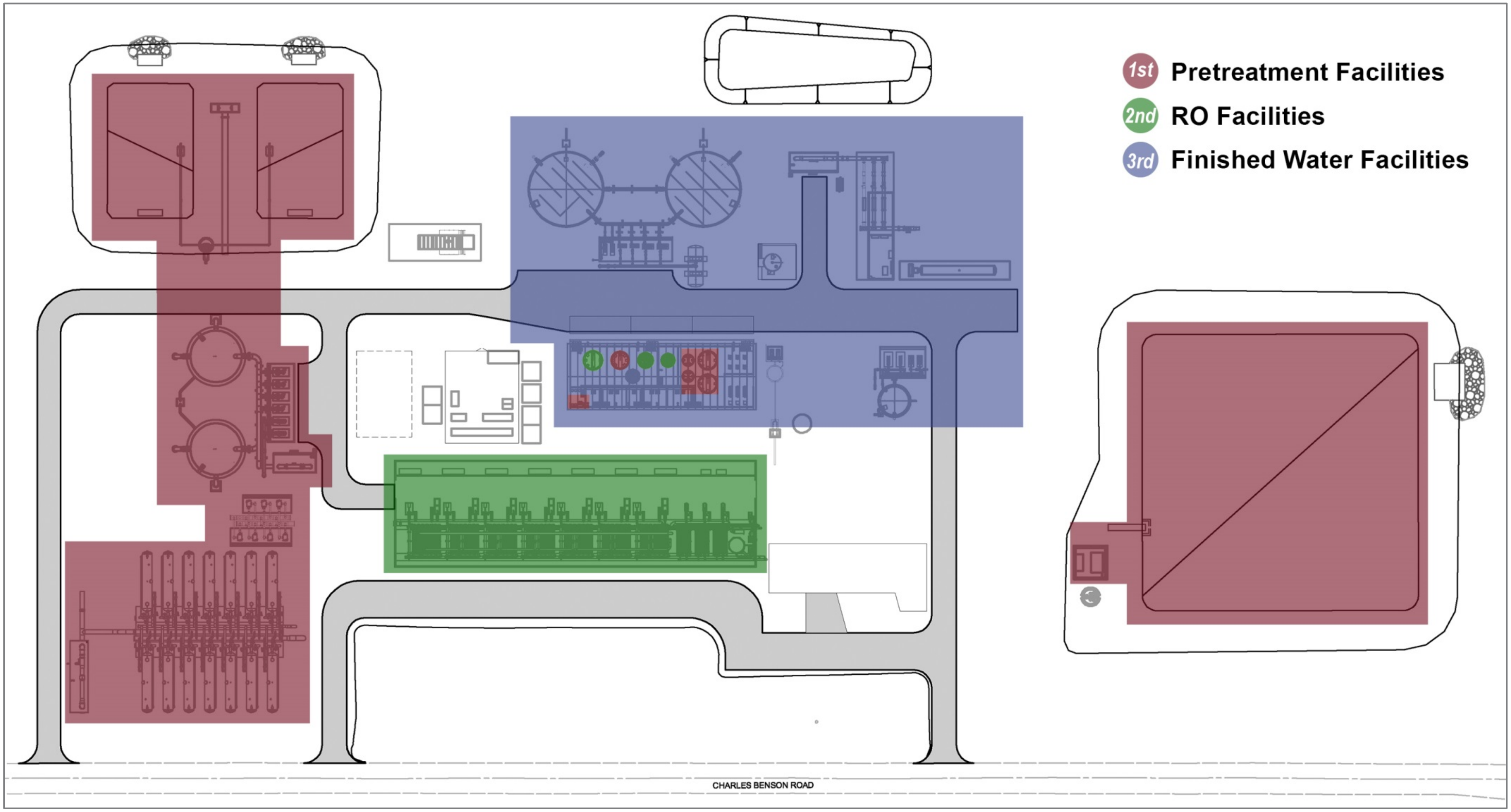


Figure 3.J-1 shows the sequencing of the startup process

Water Management – The disposition of the product water is a critical issue both during the RIPPT and Acceptance testing, as well as in the post acceptance period.

There are two normal delivery points for the potable water, the finished water pumps to the potable water supply, and the Salinas Valley pumps. Presumably the water going to the Salinas Valley does not have to be potable as it is being used for groundwater recharge. The capacity of the Salinas Valley pumping system is limited, and it can only accept a small percentage of the total production.

Water samples will be taken early in the RIPPT and sent out for chemical analysis. Samples for bacterial analysis will be taken periodically throughout the RIPPT, acceptance testing, and post acceptance testing. If the water meets the bacterial standards and the preliminary chemical analysis results indicate there is no problem with the water, there is the possibility of receiving permission from CDPH to supply water to the distribution system. There is precedence for this at other locations using RO, such as Corona, California. In MWH's experience, systems with existing Domestic Water Supply Permits are allowed to send water from new or upgraded facilities to the distribution system prior to receiving amended permits. Other alternatives would be to reduce the overall capacity to the amount which can be delivered to the Salinas Valley, or send the excess permeate to the outfall, if full operation must be maintained.

Flexibility

Flexibility is built into our planning. Flexibility in both the construction sequencing and the commissioning sequencing is important to minimizing the impact on the schedule. Should there be delays in equipment delivery or receipt of a permit, we will identify the impacts on the overall project schedule and develop work-arounds. Use of the RO CIP system and flush system for hydraulic and control testing before normal feed water supplies are available is an example. At a recent project for San Francisco Public Utilities Commission's Sunol Valley WTP, there was insufficient source water to run the plant during startup of the new chemical feed systems. To maintain the schedule, an alternative source, which normally wouldn't require treatment, was diverted to the plant for three weeks, and startup testing was completed on schedule.

K. Reduction in Rated Capacity

K. Reduction in Rated Capacity

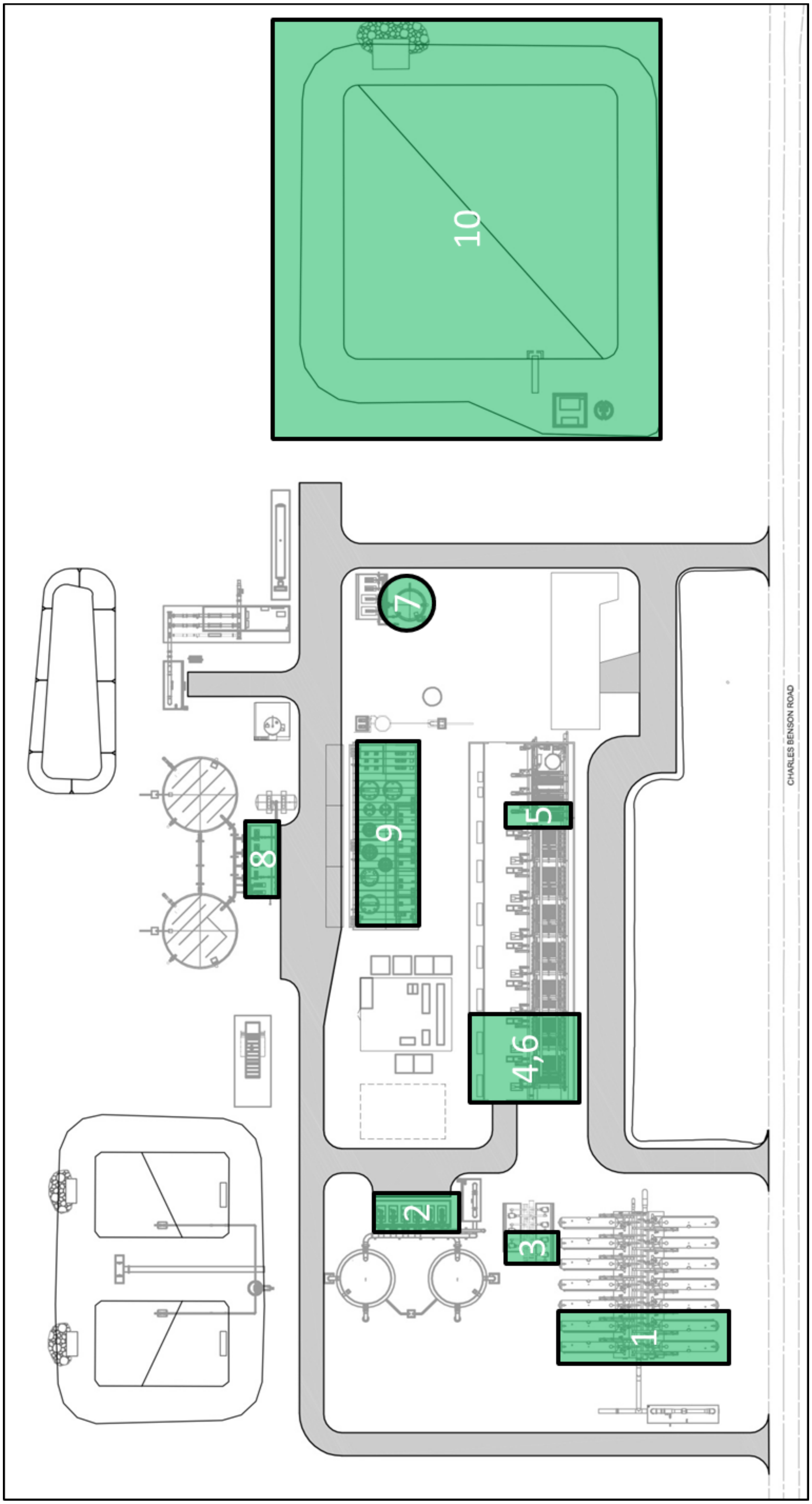
K. REDUCTION IN RATED CAPACITY

MWH's design for the 9.6 mgd base project can be readily reduced to 6.4 mgd. The RFP states that both the 9.6 mgd and 6.4 mgd base projects must be expandable to 12.8 mgd. Therefore, many of the components will not change for the 6.4 mgd base project. For example, the basic plant layout, yard piping, filtered water tanks, finished water tanks, administration building, etc. will not change. The UV reactors will not change because they are already the smallest available for the flow range and disinfection level required.

If the capacity is reduced to 6.4 mgd, the following changes to the 9.6 mgd base project design will be implemented:

No.	Item	Description of Reduction
1	**Pretreatment filters**	The number of pressure filters will be reduced from 14 (12+2) to 10 (8+2). Expansion to 12.8 mgd will be toward the west in both cases.
2	**Filtered water pumps**	The capacities of the pumps will be reduced by one third.
3	**Cartridge filters**	The number of cartridge filters will be reduced from 7 to 5.
4	**First pass RO system**	The number of trains will be reduced from 7 (6+1) to 5 (4+1) with no changes to the individual trains.
5	**Second pass RO system**	The number of trains will be reduced from 3 to 2 with no changes to the individual trains.
6	**RO building**	The building will be reduced in length. The east wall of the building will remain in the same location as for the 9.6 mgd base project, with the west wall moving toward the east. Expansion to 12.8 mgd will be to the west in both cases.
7	**Flush tank**	The size of the flush tank will be reduced by one third.
8	**Finished water pumps**	The capacities of the high service and Salinas Valley pumps will be reduced by one third.
9	**Chemical feed systems:**	The capacities of the systems will generally be reduced by one third with the exception of some of the tanks whose sizes are based on delivery volumes.
10	**Concentrate equalization basin**	The RFP and Appendices do not have a reference to reduction in size for the 6.4 mgd base project. However, the testimony to the CPUC on April 23, 2012 stated that the concentrate equalization basin should be sized to contain 6 hours of concentrate flow. At a production rate of 6.4 mgd, the concentrate flow will be 8.1 mgd. Six hours of flow at that rate is 2 MG. Therefore, the concentrate equalization basin for the 6.4 mgd base project will be reduced from 3 MG to 2 MG.

These modifications are highlighted in the figure of the site plan below, and details of these changes are provided in the Basis of Design Report.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CHARLES BENSON ROAD

L. Required Alternative Proposals

L. Required Alternative Proposals

L. REQUIRED ALTERNATIVE PROPOSALS

UV Disinfection System

MWH's base proposal includes a Low-Pressure High-Output (LPHO) UV system with two Wedeco/Xylem reactors housed in a building in a 1+1 arrangement for both the 9.6 mgd and 6.4 mgd capacities. These UV reactors have significant headloss at the peak flow rates (80 inches at 11.2 mgd [9.6 mgd base project] and 69 inches at 8.0 mgd [6.4 mgd base project]). Our site plan and hydraulic profile set the finished water tanks at an elevation that allows RO permeate to flow by gravity to the tanks, even with the headloss through the UV reactors. These UV reactors are less expensive overall than other LPHO and medium pressure UV systems, even when including the additional finished water pumping costs associated with lower tank elevations.

The cost reduction in our bid form for elimination of the UV disinfection system includes the following credits:

- UV supplier package
- Piping, valves, fittings and flow meters
- UV building
- Associated electrical supply, including the UPS system
- Associated instrumentation and SCADA programming
- Associated reduction is labor and equipment

No changes to the overall project schedule are expected.

Post-Stabilization System

MWH's base project design includes the RDP Tekkem system for both the 9.6 mgd and 6.4 mgd base projects. It is the least expensive of all the alternative post-stabilization systems required to be priced, it is easier to operate than a hydrated lime saturation system, and it has no headloss. A calcite contactor would have 6 to 8 feet of headloss (which would require additional finished water pumping head and additional site work to lower the finished water tanks). Although our drawings show the RDP Tekkem system, our bid forms are filled out as though the hydrated lime system is the type of post-stabilization process included in our proposal. Any of the three systems can be accommodated by our design without impacting the overall project schedule.

M. Voluntary Alternative Proposals

M. Voluntary Alternative Proposals

M. VOLUNTARY ALTERNATIVE PROPOSALS

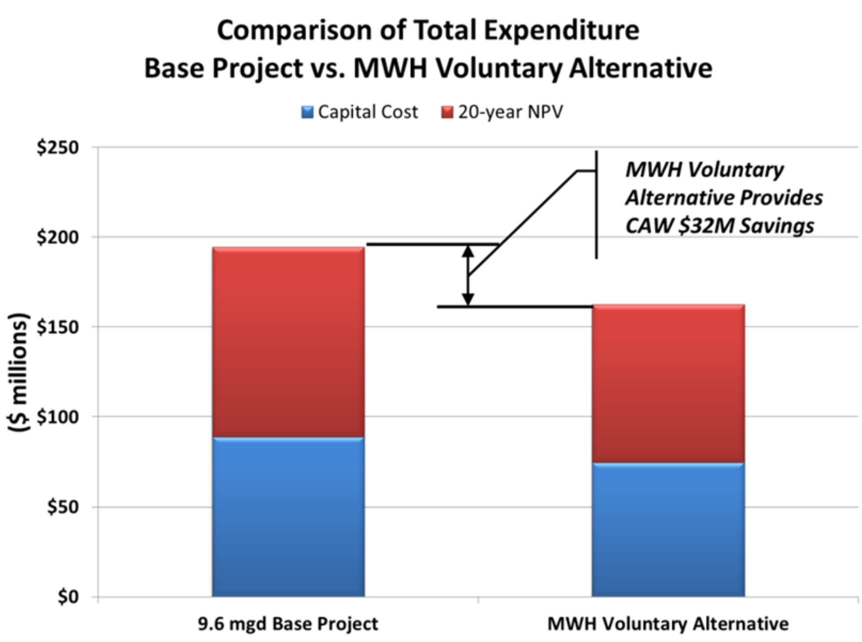
As allowed in the RFP, MWH is providing four voluntary alternative proposals. These alternative proposals are aimed at reducing total cost and increasing cost effectiveness, improving reliability and ease of operation, and creating a more environmentally-friendly and sustainable facility. The voluntary proposals are:

- Voluntary Alternative Proposal No. 1 – Modified Facilities to Achieve 9.6 mgd Capacity
- Voluntary Alternative Proposal No. 2 – Solar Option
- Voluntary Alternative Proposal No. 3 – MWH Furnished Builders Risk Insurance
- Voluntary Alternative Proposal No. 4 – Enhanced Landscaping Features

Voluntary Alternative Proposal No. 1 provides an innovative approach to the treatment process, which results in significant capital and operational savings while improving operability and reducing maintenance over the life of the facility. Voluntary Alternative Proposals No. 2, 3 and 4 can be applied to Voluntary Alternative No. 1 or the Base Project with either the 9.6 or 6.4 mgd capacity configuration.

A description of each of the voluntary alternative proposals is provided below.

Voluntary Alternative Proposal No. 1 – Modified Facilities to Achieve 9.6 mgd Capacity



MWH's Voluntary Proposal No. 1 reduces the capital cost of the 9.6 MGD Base Proposal by $14M and the total project expenditure by $32M over 20 years, while increasing plant worker safety, simplifying operation, and increasing facility reliability.

As MWH's integrated design build team considered modifications to the base project, we established three criteria to screen concepts. First, all modifications must improve worker safety, operation, and facility reliability. Second, we must be able to demonstrate the modifications provide a clear value to CAW, and third, MWH must be willing to stake its reputation on the performance, longevity, and appropriateness of the concept.

The narrative below summarizes the modifications to the base project that make up our Voluntary Alternative Proposal No. 1 for the 9.6 mgd capacity facility. **Additional supporting material for each of the items below may be found in Appendix J of the Voluntary Alternative BoDR.** It should be noted that this voluntary alternative concept for the 9.6 mgd facility can readily be converted to a 6.4 mgd facility with even more capital and operational savings to CAW. The standard warranty for the RO membranes and high-pressure pumps included in the price for this alternative are three years and one year respectively.

Item	***Replacement of the Pretreatment Filters with Hydrocyclone Sand Separators*** This also includes elimination of the waste backwash water treatment and recovery facilities.
Why it will Work	The stated purpose of the pretreatment system is to remove iron, manganese and turbidity that could be in the feedwater from the slant wells. MWH believes these water quality constituents will be low enough to allow the feedwater to go directly to the RO membranes after a pretreatment consisting of hydrocyclones followed by cartridge filters. The 2 mg/L design criterion for iron was based on samples from two wells feeding the Sand City desalination plant. All other fresh water iron data in the region, from both CDPH and USGS as well as the other Sand City wells, show iron concentrations less than 0.15 mg/L, and most are much less than that. Seawater iron concentrations are even lower. If, as expected, the feedwater from the slant wells is at least 96 percent seawater the iron concentration cannot possibly be 2 mg/L and almost certainly will be less than 0.05 mg/L. In addition, the iron coming from the slant wells will be in reduced form (ferrous), which will be dissolved. As long as the iron does not reach a free water surface, it will remain in reduced form and be readily removed by the RO membranes without fouling them. The slant well pump station can be configured with canned pumps to avoid exposing the feedwater to a free air surface. This also reduces the potential for biological fouling, which is much more likely in the filtered water. Water quality data available for manganese suggest that it is even less likely to cause a fouling problem than iron. We do not believe turbidity will be a significant issue from the water coming from the slant wells. Our team's experience in the Marina area has shown turbidity in beach wells during rainfall events, but the turbidity came from rain percolating through the beach sand and not from the ocean. Since the slant wells will be under the ocean and drawing at least 96 percent seawater, turbidity spikes are highly unlikely.
Value to CAW	Replacing the pretreatment filters with hydrocyclones and eliminating the backwash water treatment and recovery facilities provides the following benefits to CAW: 1. Approximately $5,140,000 in capital cost savings 2. Lower annual power consumption 3. Reduced operational requirements by eliminating two systems 4. Reduced maintenance requirements by eliminating two systems

Item	***Elimination of the Filtered Water Storage Tanks*** This modification, combined with elimination of the pretreatment filters and filtered water pumps, allows pumping directly from the slant well pumps, through the cyclones and cartridge filters, to the suction side of the high pressure RO feed pumps.
Why it will Work	The filtered water storage tanks would provide some buffer should a slant well pump fail. However, this benefit would be offset by the potential for biogrowth in the tank as experienced in the Moss Landing pilot plant. An option to maintain a similar level of reliability is to install an extra pump at the slant well pump station and operate all pumps at lower speeds. Should one pump fail, the remaining pumps could be ramped up and continue to meet the feedwater flow requirements. As demonstrated at the Sand City facility, close coordination between the slant well pump station and RO treatment plant designs are critical. **If this alternative is selected, MWH would be willing to do the pump selection, prepare process and instrumentation and control design and review the mechanical design of the slant well pump station at no additional cost to CAW.**
Value to CAW	Elimination of the filtered water storage tanks provides the following benefits to CAW: 1. Significant reduction in the potential maintenance requirements associated with biogrowth in the tanks 2. Approximately $1,670,000 in capital cost savings 3. Reduced operational and tank maintenance requirements 4. Lower annual power consumption through the elimination of the filtered water pumps

Item	***Elimination of the Concentrate Equalization Basin*** MWH proposes to eliminate the concentrate equalization basin.
Why it will Work	MWH reviewed the hydraulic analysis of the outfall and concluded that there were only two instances during the period of record where combined WWTP and Marina Cost WD and CAW concentrate flows exceeded the capacity of the outfall assuming the outfall had a Hazen-Williams C factor of 80. Based on MWH's experience with ocean outfalls, MWH expects the C factor to be a near or at 100 for a 60-inch pipeline. In addition, with all the outfall ports opened, the outfall will always have capacity for the CAW concentrate flows.
Value to CAW	Elimination of the filtered water storage tanks provides the following benefits to CAW: 1. Approximately $579,000 in capital cost savings 2. Annual O&M cost savings 3. Reduced risk of groundwater contamination from a brine pond 4. Reduced operational requirements 5. Reduced maintenance requirements associated with checking liner integrity and repairing when necessary

Item	**Use of Delivered Liquid Lime Instead of a Hydrated Lime System or Calcite Contactors** MWH proposes to replace the lime slurry system with the delivery of liquid lime to the site.
Why it will Work	East Bay Municipal Utility District installed a liquid lime system for their Mokelumne River supply approximately 10 years ago and has been operating issue free since then. MWH is currently designing a liquid lime feed system for San Francisco Public Utilities Commission for RO permeate stabilization. Lime is delivered as a 45% solution, stored in a conventional chemical storage tank, and fed through peristaltic or diaphragm metering pumps.
Value to CAW	Use of liquid lime instead of dry lime or calcite contactors provides the following benefits to CAW: 1. Approximately $140,000 in capital cost savings 2. A liquid lime feed system requires a small fraction of the labor to operate compared to a hydrated lime system 3. Reduced maintenance requirements associated with maintaining dry feed equipment 4. Improved operator safety because of elimination of worker exposure to hydrated lime in powder form (hydrated lime is an irritant to the respiratory system and skin, and can cause serious damage to the eye)

Item	**Use of Delivered Sodium Hypochlorite Solution Instead of Onsite Generation** MWH proposes to replace the onsite hypochlorite generation system with the delivery of 12.5% sodium hypochlorite liquid to the site.
Why it will Work	An onsite hypochlorite generation system requires significantly more operator attention and maintenance than a delivered liquid sodium hypochlorite system due to the much larger number of instruments, field devices, monitors, alarms, pumps and other equipment. To save capital cost and improve operation as well as to simplify overall labor requirements, MWH's alternative design includes two sodium hypochlorite storage tanks and pumps based on receipt of 12.5 percent sodium hypochlorite deliveries. Virtually every water and wastewater utility in California uses delivered 12.5% sodium hypochlorite. MWH has experience designing many of these systems and understands how to design them to minimize the problems associated with decomposition, gas binding, and feed system material degradation. In May 2013, MWH started up a new sodium hypochlorite feed system for San Francisco Public Utilities Commission's 160 mgd Sunol Valley WTP and can provide many other examples.

Value to CAW	Use of delivered sodium hypochlorite instead of onsite generation has the following benefits:
	1. Approximately $836,000 in capital cost savings
	2. Reduced operational requirements
	    a. Simple operation.
	    b. Venting of hydrogen gas from an on-site system is avoided making the delivered sodium hydroxide system safer
	    c. Receiving, storing and pumping of 12.5% hypochlorite is similar to other treatment chemicals such as alum, liquid polymer, fluoride, etc. and does not require specialized attention.
	    d. Significantly less operator training is required
	3. Reduced maintenance requirements
	    a. Electrolysis cells in the hypochlorite generation system require periodic replacement
	    b. Softened water needed for brine makeup and resulting brine or reject water discharges are eliminated.
	    c. Salt deliveries can create corrosive dust and corrosive saline environments are avoided.

Item	***Construction of a More Efficient RO System*** MWH proposes to construct an RO system with a number of modifications to improve efficiency and reduce both capital and O&M costs. MWH's recommended design includes: • 3 + 1 first pass trains • Multiport pressure vessels • RO rack design 10 pressure vessels high
Why it will Work	All of our proposed modifications to the RO system are proven technology and have supporting operational history to support their reliability. These modifications include: • Larger first pass trains allow use of more energy efficient high pressure feed pumps • Larger trains allow more rapid makeup of production after train or plant shutdowns resulting in less plant downtime • Multiport pressure vessels are the industry standard and don't create significant flow variations • With appropriate worker training and equipment a higher RO rack does not create significant maintenance issues
Value to CAW	A more efficient RO system offers the following benefits to CAW: 1. Approximately $100,000 in capital cost Increases offset by at 20-year NPV savings of $14,300,000 in energy cost 2. Smaller building footprint 3. Smaller carbon footprint for the plant

Voluntary Alternative Proposal No. 2 – Installation of Solar Power Equipment

The Desalination Infrastructure Project will consume approximately 50 million kwh of electrical energy every year. This is one of the most objectionable aspects of project by the environmental community, and any measures that can be taken to reduce the amount of power produced by fossil fuels should be seriously considered.

MWH has incorporated PV panels into the plant design at multiple water treatment plants in northern California, including the Vineyard Surface Water Treatment Plant and Sacramento and the Northbay Regional Water Treatment Plant in Fairfield. For this project we discussed installation of PV panels with multiple companies, and we are bringing to this project a proposal from Sunora Energy. They will provide enough PV panels to produce up to 1.6 megawatts of DC power (1.2 megawatts AC) plus inverters to supply usable AC power in the plant. Based on historical weather data, Sunora expects the system to supply approximately 2.5 million kwh annually. The PV panels have a 25 year warranty and are expected to lose only 5% of their production capacity over that time. This Voluntary Alternative No. 2 will increases the capital cost of the project by $4.3M (net capital cost will depend on power purchase agreement and tax incentives), however, it will provide a 20-year NPV savings from reduced power consumption of $4M to any of the project alternatives it is applied to. See the solar site plan following this section.

Item	***Installation of Solar Power Facilities*** MWH proposes to install a system to generate approximately 2.5 million kwh of energy annually.
Why it will Work	Solar power facilities are very common. MWH assisted the Metropolitan Water District of Southern California in completely eliminating its use of utility power. We have also designed many new solar facilities to augment or replace utility power at water and wastewater plants in many parts of the country. That experience will be brought to this project. Although there will be an upfront capital investment, the green power system will pay for itself over time.
Value to CAW	The use of solar power at the Desalination Infrastructure Project will provide the following benefits to CAW: 1. Reduction in energy purchases by 2.5 million kwh annually 2. Reduced carbon footprint 3. Demonstration of CAW's commitment to environmental protection

Voluntary Alternative Proposal No. 3 – MWH Furnished Builders Risk Policy

MWH places comprehensive builders risk coverage through Allianz Global Risk US Insurance Company with an A.M. Best rating of A+ : XV. Their builders' risk coverage form contemplates the variety of projects that MWH Constructors, Inc. undertakes with some of the broadest terms and conditions commercially available. Allianz builders risk coverage highlights are:

- Full Project Value Coverage for Flood
- $25M earth movement coverage with a deductible of 5% of the total project value at time of loss ($100,000 minimum)

- $10M sublimit for extra expense, in transit, off-site storage. $25M sublimit for debris removal and demolition
- $100,000 deductible for Flood, Water Damage and Testing/Commissioning; $25,000 deductible for all other perils
- Automatic damage to owner's existing property coverage at $500,000 per occurrence with ability to increase coverage

If CAW finds this coverage attractive, MWH can immediately implement this coverage for a premium of 0.243 per $100 project value (annual rate).

Voluntary Alternative Proposal No. 4 – Enhanced Landscaping Features

MWH is proposing an enhanced entrance to the administration building as shown in the figure below.

From the parking and natural planting areas, visitors proceed to an entry courtyard providing visual amenity to the site location. The courtyard is anchored by an attractive water feature symbolizing the hydrological significance of the building. The courtyard surfacing is integrally colored, sawcut, exposed concrete and is interlaced with seeded concrete bands imitating the agricultural row crops of the area. Concrete seating benches and planting in the courtyard will follow the geometry of the seeded bands. Planting shall be comprised of a single ornamental, architectural grass, also reminiscent of agricultural patterns. The entrance courtyard would include an integrated water feature, "molecular" architectural features, and patchwork native plantings.

Voluntary Alternative No. 4 increases the capital cost of any alternative it is applied to by approximately $395,000.

GENERAL NOTES:

1. Result of easement reports and underground utilities may affect final placement of solar arrays.
2. Conflicting trees and other obstructions will have to be removed, trimmed, or relocated.
3. Detailed analysis of the effect of shade on arrays has not been performed.
4. Soil analysis has not been performed.
5. It is assumed that the site is not in a flood plain.
6. Point of interconnection is assumed to be within 400 feet of array (unless specified).
7. No shading.

California American Water

Preliminary PV Site Plan

Lat: 36.71586° Long: -121.77226°

LEGEND:

- Carport Solar Arrays
- High Bay Solar Arrays
- Ground Mount Solar Arrays
- Roof Mount Solar Arrays
- Solar Pavilion Solar Arrays
- Point of Interconnect
- DC/AC Feeder
- Power Conditioning System
- Meter Location
- Array Location
- Property Boundary

Sunora energy solutions

REVISIONS

DATE	DESCRIPTION	APPROVED
09/2013	Prelim LO	CDB

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AZIMUTH
90° -90°
0°

0 125 250
SCALE IN FEET

Scale: 1" = 250'

Sheet 1 of 1

Table of Solar Arrays

Location	Reference Frame Type	# of Sunora Frames	Total # of Modules	Nominal Module Power (W)	Azimuth (degee)	Tilt (degree)	System Size (kWdc)	Estimated Production Factor (kWh/kW/yr)	Estimated Yearly Output (MWh/yr)
A	Fixed Tilt	448	3,584	305	0	26	1,093.1	1,607	1,757
B	Fixed Tilt	210	1,680	305	0	26	512.4	1,607	823
	Totals	**658**	**5,264**				**1,605.5**		**2,581**

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N. Proposal Form 23: Governmental Approvals Schedule

N. Proposal Form 23: Governmental Approvals Schedule

PROPOSAL FORM 23

GOVERNMENTAL APPROVALS

The required Governmental Approvals are:

Governmental Approval	**Issuing Agency**	**Governmental Approval Application Submission Date (Number of days from Contract Date)** (Calendar Days)	**Assumed Approval Issuance Date (Number of days from Date of Application Submittal)** (Calendar Days)
MWH PERMITS			
Permit to Operate a Public Water System	California Department of Public Health (CDPH)	**48D**	844D
Use Permit	Monterey County	**266D**	224D
National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges	Regional Water Quality Control Board (RWQCB)	**357D**	84D
Waste Discharge Requirements per Porter-Cologne	Regional Water Quality Control Board (RWQCB)	**357D**	84D
Authority to Construct	Monterey Bay Unified Air Pollution Control District (MBUAPCD)	**357D**	84D
Permit to Operate	Monterey Bay Unified Air Pollution Control District (MBUAPCD)	**357D**	84D
Encroachment Permit	Monterey County	**411D**	59D
Grading Permit	Monterey County	**411D**	59D
Tree Removal Permit	Monterey County	**411D**	59D
Building Permit	Monterey County	**411D**	59D
Erosion Control Plan	Monterey County	**411D**	59D
Combined Development Permit Process	Monterey County	**411D**	59D
Permit to Construct Desalination Treatment Facilities	Monterey County	**459D**	22D

OWNER PERMITS			
State revolving fund – CEQA –plus (Subsequent EIR)	U.S. EPA; administered by SWRCB	*** Date of Application Submittal Unknown**	223D 31-July-14
Certificate of Public Convenience and Necessity	California Public Utilities Commission (CPUC)	*** Date of Application Submittal Unknown**	241D 18-Aug-14
Section 7 Consultation	U.S. Fish and Wildlife Services (USFWS)	**242D**	165-360D
Fish and Wildlife Coordination Act	U.S. Fish and Wildlife Services (USFWS)	**242D**	60-120D
Section 404 CWA	U.S. Army Corps of Engineers (USACE)	**242D**	200-420D
Incidental Take Statement	California Department of Fish and Wildlife (CDFW)	**242D**	120-200D
Streambed Alteration Agreement (fish & Game Code Section 1600)	California Department of Fish and Wildlife (CDFW)	**242D**	120-200D
Coastal Development Permit	California Coastal Commission (CCC)	**242D**	180-360D
National Pollutant Discharge Elimination System (NPDES) - Clean Water Act Section 402	Regional Water Quality Control Board for the Central Coast Region (RWQCB)	**242D**	120-200D
Water Quality Certification Section 401	Regional Water Quality Control Board (RWQCB)	**242D**	200D
Water System Expansion Permit	Monterey Peninsula Water Management District (MPWMD)	**242D**	120-234D
Brine Line Connection to PCA Outfall	Monterey Regional Wastewater PCA	**242D**	120-234D
NHPA Section 106 Consultation	California Department of Parks and Recreation Office of Historic Preservation	**671D**	60-120D

(Expand the table as necessary)

*** Date of Application Submittal Unknown**

MWH Constructors, Inc.

Name of Proposer

Blair M. Lavoie

Name of Designated Signatory

Signature

President, MWH Constructors

Title

Appendices

Appendices

Prepared for

CALIFORNIA AMERICAN WATER

Spill Prevention and Control Plan

Spill Prevention and Control Plan

Preliminary Spill Prevention and Control Plan for the Design and Construction of Desalination Infrastructure for the Monterey Peninsula Water Supply Project

California American Water

Monterey County, California

Prepared for CAW

October 16, 2013

Prepared by MWH
2121 N. California Blvd
Walnut Creek, CA 94596

TABLE OF CONTENTS

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INTRODUCTION

This Spill Prevention Control Plan (SPCP) has been prepared by MWH to satisfy CAW contract requirements for the Desalination Infrastructure Project (Project). This is a site-specific SPCP plan that outlines the project scope of work (including equipment, materials, and activities) and presents a comprehensive plan to prevent, respond to, and report spills or releases to the environment. The SPCP plan will be updated as project work progresses or site activities change. An updated copy of this SPCP plan will be maintained at the project site and provided to CAW.

1.A. SITE INFORMATION

This SPCP plan was developed for the Desalination Infrastructure Project that MWH is proposing on to design and build the planned improvements.

General Site Information

The southern portion of the site is located on gently sloping older dune deposits ranging in elevation from about 80 feet to 115 feet (Mean Sea Level). The northern portion of the site slopes moderately towards the north and northeast down to the floodplain of the Salinas River, at an elevation of about 10 to 20 feet. A dirt road roughly bisects the site in a northwest to southeast direction. The property north and west of the site is actively being farmed and the Monterey Peninsula Landfill is located east of the site. Vegetation on the site consists of grasses and a few low shrubs. Access to the site is from Charles Benson Road.

Topography and Surface Water Flow

Although the entire 46-acre site is available for development, the plant is sized to fit on less than half the total property area. The southerly half of the property is considered more desirable for the plant location. This elevated area will require less site grading than the sloping terrain of the northerly half of the site. The north half of the property is also impacted by geotechnical constraints associated with the shallow depth to groundwater near the northerly property line. The southerly half of the site where the plant will be located is relatively flat and ranges from approximately elevation 107 to 97 feet.

Groundwater Flow

The project site is located within the Fort Ord Aquifer Sub-basin of the Salinas Valley Groundwater Basin. A regional groundwater elevation map of the Salinas Valley area published by MCWRA, (2011) records the depth to groundwater for the East Side shallow aquifer at about elevation 14 feet in the vicinity of the project area.

Groundwater was encountered at a depth of 57 feet in the central portion of the site, or at about elevation 40 feet. Along the northern portion of the site, closer to the Salinas River, groundwater was encountered at a depth of about 7 to 48 feet, or at about elevation 29 to 35 feet, indicating groundwater flow is to the north towards the Salinas River.

No springs have been noted on the site. Along the northern site boundary vegetation is relatively heavy with a thick growth of shrubs suggesting groundwater seeps may be present at or near the ground surface. Standing water also was noted in a drainage ditch at the base of the slope at about elevation 20 feet along the edge of the active farm fields.

Sensitive Areas/Receptors

Construction activities on the project site have the potential to introduce pollutants to adjacent areas and resources. Adjacent areas of concern include the following:

- Salinas River – A Stormwater Pollution Prevention Plan (SWP3) will be developed to capture stormwater from migrating to the Salinas River. Silt fencing will be installed all along the north property line and will be buried 6 inches below grade and will be 36 inches high.

- Nearby wetlands – The SWP3 will also provide the same protective measures to protect nearby wetlands.

- Drainage ditch – The SWP3 will also provide the same protective measures to protect a drainage ditch along the edge of the active farm fields.

- Charles Benson Road – Access to the site is from Charles Benson Road. The road has one lane each direction that serves for access and egress for the regional landfill and wastewater treatment plant. Care will need to be taken to ensure that sediment is not tracked onto this public street. A construction traffic wheel wash will be used if tracking of dirt onto the roadway becomes an issue. If needed, they will be installed at the location where the construction traffic leaves the excavation site and not at the main entrance to the plant.

Potential Spill Sources or Releases

Potential spill sources at the site include materials and equipment brought on-site and potential unknown site conditions.

<u>Equipment and Materials Brought On-site</u>

- Equipment staging and maintenance areas (fuel, lubricating oil, and hydraulic oil from drill rig, backhoes, bulldozers, piling drivers, water trucks, pickup trucks, support truck equipment, lighting units, pumps, and generators)
- Fuel staging areas

<u>Unknown Site Conditions that may Be Encountered</u>

There was no contaminated soil observed in the geotechnical study performed by URS in the Geotechnical Baseline Report. Groundwater was observed but not at depths that will affect the project. No soil at this time is expected to be contaminated. The site has been balanced so no soil will have to be disposed of.

Contractor Personnel

The MHW designated person responsible for managing, implementing, and maintaining this SPCP plan is Shon Fandrich. His designated alternative is Mike Price. Phone numbers for project contacts are as follows:

- Shon Fandrich, Construction Manager cell: (512) 705-9310

- Mike Price, Project Manager, cell: (925) 818 6850
- John Cevaal, Project Executive, cell: (303) 250 2823

1.B. PROJECT SITE DESCRIPTION

Staging, storage, maintenance, and refueling areas are shown on the site plan in Attachment A.

Table 1. Items Brought Onsite

Each sub-contractor will be required to provide a list of equipment and materials expected to be used during the completion of their work. This table will be used to determine and keep track of the type and level of spill prevention equipment that should be maintained on the project site. The table will be updated when there are significant changes to the items listed.

Equipment Brought On-Site	Quantity	Materials Brought On-Site	Maximum Quantity

Equipment Staging and Maintenance Area. Heavy equipment (backhoes, track hoes, scrapers, bulldozers, water trucks, support trucks, and pickup trucks) and smaller portable equipment (generators, pumps, and light units) will be stored in a secured equipment parking area. All repairs and routine maintenance will be performed in this area.

Fueling Area. No fuel tanks will be stored on site for the project. All equipment will be serviced using portable fueling trucks.

Pre-existing Site Conditions

The GBR identified no pre-existing site conditions requiring precautionary or mitigation measures.

1.C. SPILL PREVENTION AND CONTAINMENT

Spill Prevention Best Management Practices

This section describes spill prevention methods (e.g., Best Management Practices [BMPs]) that will be used for the project. BMP training will consist of an initial training session provided by MWH that will discuss cleanup methods and notification procedures. Further training will be provided by MWH as new subcontractors start working on the project site and will consist of pre-installation sessions by the subcontractor responsible for the installation and in weekly training sessions for all subcontractors who may be affected by the control measures.

Equipment Staging and Maintenance

- Store and maintain equipment in a designated area.
- Reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials.
- Use secondary containment (drain pan) to catch spills when removing or changing fluids.
- Use proper equipment (pumps, funnels) to transfer fluids.
- Keep spill kits readily accessible.
- Check incoming vehicles for leaking oil and fluids.
- Transfer used fluids and oil filters to waste or recycling drums.
- Inspect equipment routinely for leaks and spills.
- Repair equipment immediately, if necessary.
- Implement a preventative maintenance schedule for equipment and vehicles.
- If necessary, remove equipment from the site.

Fueling Area

- Perform fueling in designated fueling area.
- Do not “top-off” tanks
- Use secondary containment (drain pan) to catch spills.
- Use proper equipment (pumps, funnels) to transfer fluids.
- Keep spill kits readily accessible.
- Inspect fueling areas routinely for leaks and spills.

Hazardous Material Staging Area

Hazardous materials such as fuel will be stored in an offsite location. Materials such as paint will be stored onsite in suitable containers. The onsite storage area locations will be within one of the authorized staging areas and each site will be selected and prepared prior to bringing the materials onsite. The staging of this material will be based on a location that minimizes the possibility of material entering either the onsite storm or sanitary sewer systems. The following BMPs will be implemented:

- Reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials.
- Minimize the quantity of hazardous materials brought on-site.
- Store hazardous materials in a designated area away from storm drains.
- Store hazardous materials in covered containers.

Hazardous Waste Storage Area

- Use all products before disposing of the container.
- Retain the original product label or MSDS.
- Recycle any useful material (used oil, water-based paint)
- Segregate wastes by waste type.
- Minimize the quantity of hazardous waste generated and stored onsite.
- Arrange for waste disposal before containers are full.
- Dispose of hazardous waste at an approved waste disposal facility.
- Train employees in proper hazardous material and waste management.

Spill Containment Methods

This section identifies the types of secondary containment or diversionary structures that will be used to handle spills.

- **Equipment Staging and Maintenance Area.** An equipment leak from a fuel tank, equipment seal, or hydraulic line will be contained within a spill pad placed beneath potential leak sources. Temporary berms will be installed to contain accidental spills at locations within the staging and maintenance area that are within 100 feet of catch basins or flow paths that lead to sensitive receptors.

- **Fueling Area.** A spill during fueling operations will be contained within a spill pallet for small container handling. The transfer of fuel into portable equipment will be performed using a funnel and/or hand pump, and a spill pad used to absorb any incidental spills/drips. A leak of a drum will be repaired with a patch kit. A spill response kit will be located near the fueling area for easy access.

- **Hazardous Materials**. A spill pad will be used to absorb any incidental spills of hazardous materials such as solvents, paints, and other liquid chemical. Used spill pads will be disposed of in a designated waste bin.

- **Hydraulic and pipeline testing** – All water-bearing structures will be hydraulically tested to verify their integrity to hold water. Similarly, all pipelines will be pressure and/or leak tested for specified durations to verify integrity. Contractor will be required to provide on-site dechlorination and verification sampling for any water discharged from hydraulic structure and pipeline testing. Test water will be monitored for total dissolved solids, chlorine, and other parameters prior to discharge.

1.D. SPILL RESPONSE

Response in the first ten to fifteen minutes is critical to minimize the impacts to human health and the environment and to minimize property damage and cleanup costs. MWH will respond immediately to spills of regulated materials. The standard approach toward spill response will be as follows:

- Stop operations.

- Stop the source of the spill.
- If the spill is moving towards a catch basin, put a cover over the grate to stop the flow. Grate covers and sand bags may be needed to control the spill.
- If the spill is moving towards a flow path, sand bags and berms may be needed to control the spill
- Use the appropriate material to berm the area to prevent further contamination.
- Contact the Monterey Regional Water Pollution Control Agency Operations Center (831) 883-6166.
- Immediately notify the construction site manager.
  - Construction Manager – Shon Fandrich: (512) 705-9310
- MWH will determine the method of clean up required. All methods shall comply with State and Local requirements for spill response. Cleanup must be complete and done immediately. The MSDS sheet for the chemical spilled should be used for the proper method of clean up. Notification and all required paperwork shall be provided to CAW.

Mitigating, Removing, and Disposing of Spilled Material

Only trained personnel will perform spill cleanup activities. The spill response contractor is responsible for cleanup activities as a result of spills or leaks when MWH does not have the training, equipment, or materials to cleanup spills.

The following cleanup firm has been identified as a primary contact for an emergency response:

- Disaster Kleenup Specialists

The following procedures shall be followed subsequent to a spill:

- **Spills Onto the Ground (Soil):**
  - Clean up the spill immediately.
  - Apply absorbent material, berm, divert or contain the spill.
  - Collect spilled material and place into labeled drums.
  - Collect absorbent and other material used to clean up the spill, label the container, and properly dispose of waste at an approved disposal facility.
  - Notify the project's spill response contractor, if necessary.
  - Notify California State Warning Center
  - Decontaminate the affected area, equipment and surfaces that have contacted the spilled material.
  - Restore habitat, if necessary.

- **Spills Into Waterways:**
  - Notify California State Warning Center
  - Notify the project's spill response contractor, if necessary.
  - Stop the source of the spill immediately.
  - Shut down all equipment and ignition sources in the area.
  - Deploy boom and absorbent to contain the spill.
  - Clean up absorbent and waste materials and dispose of at an approved waste disposal facility.
  - Decontaminate the affected area, equipment and surfaces that have contacted the spilled material.

1.E. STANDBY, ON-SITE MATERIAL AND EQUIPMENT

Spill response equipment will be stored in spill response kits. The project site must have at least one spill response kit, but more than one kit may be necessary or warranted. The locations of all spill response kits at the project site will be clearly marked and accessible. The locations will be identified to all personnel prior to beginning work.
Table 2 summarizes the spill response material and equipment designated for equipment and maintenance, fueling, hazardous material staging, and hazardous waste storage areas.

1.F. REPORTING

The MWH person responsible for the SPCP plan, Shon Fandrich, will contact CAW project representatives and the regulatory agencies regarding spill response activities. We will work with CAW's Construction Coordinator for the project, to ensure the proper information and data are collected and communicated to the appropriate agencies. Table 3 identifies local, state, and federal authorities and private resources that may be used in implementing this SPCP plan. In addition, any spill occurrence will require the completion of a Spill & Incident Report Form which is included in Attachment B of this report. Attachment B provides a record of spills occurring on the site. MWH will keep all such records on file.

1.G. PROGRAM MANAGEMENT

Site security measures, site inspection procedures, and personnel training related to spill prevention, containment, response, management, and cleanup are outlined below.

Security

Proper site security is important to minimize accidents, trespassing, and potential spills and releases. Equipment staging and maintenance, fueling, hazardous material staging, and waste storage areas for the project will be located in a fenced area. The fence and all heavy equipment are locked at the end of each workday. Only authorized personnel are permitted onto the project site.

Table 2. Spill Response Equipment Brought On-Site

The following items shall be in each spill kit kept on the site. Spill kits shall be easily carried by two workers and transported in the bed of a pickup truck. Boxes shall be painted safety yellow and labeled: "SPILL CONTAINMENT KIT – EMERGENCY USE ONLY".

Item	Purpose	Quantity
SPCP Plan	Reference	1
SWPP Plan	Reference	1
Site Utility Drawings for the Storm and Sanitary Sewer Systems	Reference	1
Emergency response telephone numbers	Reference	1
Emergency response handbook	Reference	1
Grainger 95-gallon over pack		1
95-gallon plastic drum		1
Absorbent pads – 16x20"		100
SOCs - 3"x4'		12
SOCs - 3"x12'		8
Pillows - 18"x18"		8
Disposable bags		10

Oil Absorbent Pads – 16” x 20”		100
Broom		1
Shovel		1
Disposable bags		10

Table 3. Agency Notification Reference List

Agency & Responsibilities	Phone Contacts
Fire Department • Fire fighting • Emergency medical response • Community evacuation	911
Police Department • Police authority	911
Monterey Regional Water Pollution Control Agency Operations Center • Waste treatment and outfall	(831) 883-6166
Monterey Regional Waste Management District • Solid waste disposal	(831) 384-5313
Hospital • Emergency medical treatment: Natividad Medical Center 1441 Constitution Blvd Salinas, CA	(831) 647-7611
California State Warning Center • Any actual release or threatened release of a hazardous substance	(800) 852-7550
National Response Center • Reporting spills to water	(800) 424-8802
California Emergency Management Agency / Cal EMA • Reporting spills to water	(800) 258-5990
Department of Fish and Wildlife / OSPR • Reporting spills into water	(800) 852-7550
Spill Response Contractor – Disaster Kleenup Specialists • Emergency spill response	(800) 427-1769

Site Inspections

MWH will conduct daily inspections of the equipment staging and maintenance, fueling, hazardous material staging, and waste storage areas to ensure that spill control measures are in place. Inspections of the project site for general housekeeping and BMPs will be performed weekly.

Personnel training

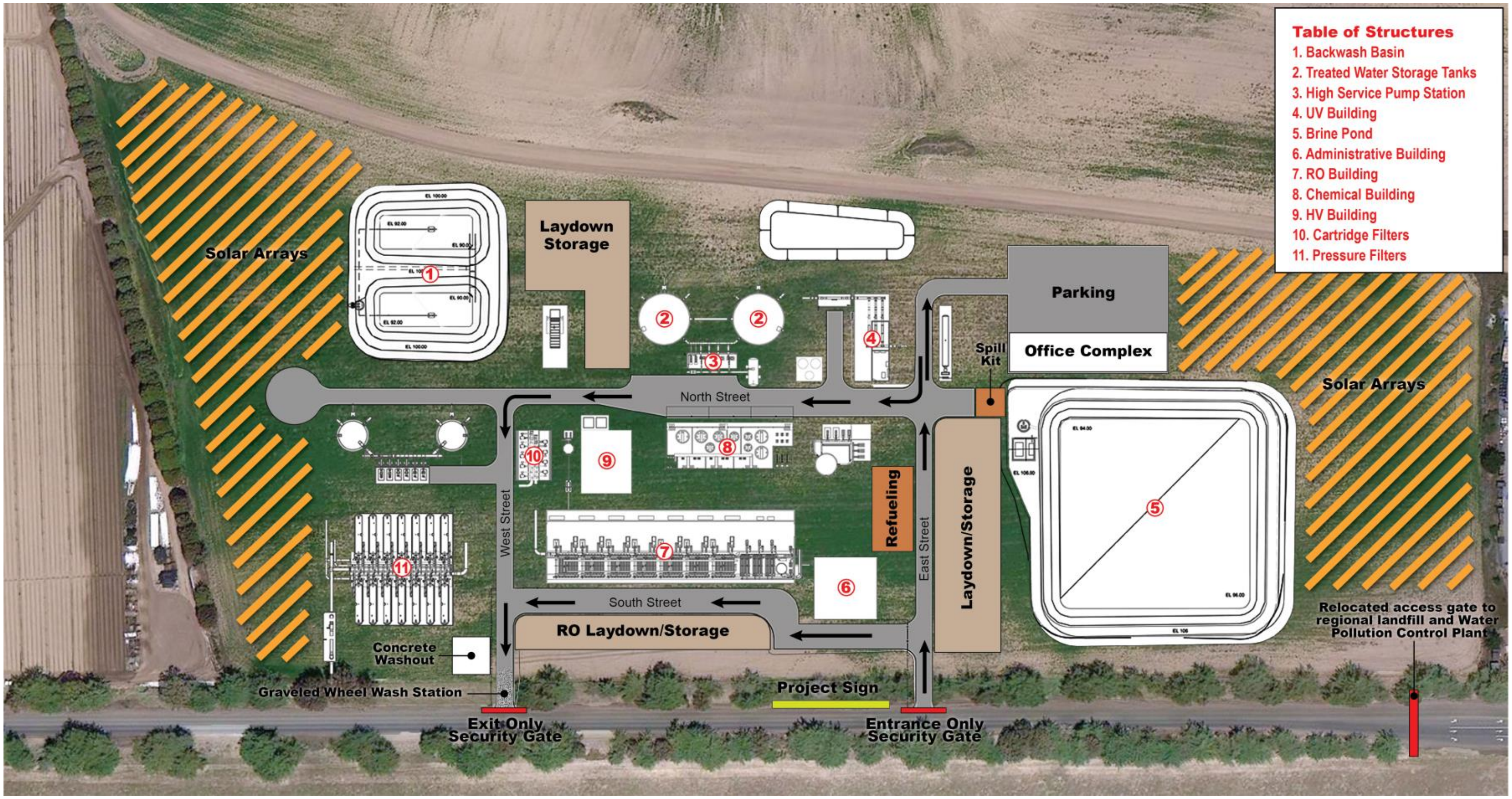
MWH employees and its contractors will be trained on the contents of this SPCP plan including spill prevention planning, spill source and receptor recognition, spill prevention and containment techniques, spill response measures, and spill reporting protocol.
Employees will also be briefed on the plant's emergency procedures for responding to a chlorine release. Employees will be briefed on emergency meeting locations and also on procedures for sheltering in place and evacuating the site.

General Responsibilities for Personnel

All personnel have responsibility for spill prevention. Any MWH employee who notices a leak will respond as appropriate based on their training, or if a spill has occurred, they will assume a defensive posture by avoiding the area and immediately notifying the site construction manager.

The local fire department is responsible for emergency containment procedures when called to the site. The fire department takes measures necessary to prevent fire and explosion and to protect people and property in the event of a fire or explosion.
The spill response contractor is responsible for cleanup activities when MWH does not have the training, equipment, or materials to cleanup spills safely and effectively.

ATTACHMENT A: SITE PLAN



ATTACHMENT B: SPILL AND INCIDENT REPORT FORMS

Instructions: Complete for any type of petroleum product or hazardous materials/waste spill or incident. Provide a copy of this report to management.

1. Person Reporting Spill or Incident:
2. Type of Spill:
3. Location of Spill:
4. If no spill, describe incident:
5. Actions taken:

Name		Address	
Organization			
Title			
Telephone			
Fax		Signature	

Common Name of Spilled Substance	
Quantity Spilled (Estimate)	
Concentration (Estimate)	
Date of Spill	____/____/____

Time Spill Started	___ AM __ PM	Time Spill Ended	___ AM __ PM

SPILL TO LAND	SPILL TO WATER BODY
Name of Site:	Name of Water Body:
Street Address:	Location of Discharge with Reference to Fixed Point:
City/Town:	Description of Area from which spilled material may reach:
County:	

6. Person responsible for managing termination/ closure of incident or spill:

Name: ___________________ Phone: __________________ Fax: __________________

Prepared for

CALIFORNIA AMERICAN WATER

Traffic Management Plan

Traffic Management Plan

Preliminary Traffic Management Plan (TMP)

California American Water

Monterey County, California

Prepared for CAW

October 16, 2013

Prepared by MWH
2121 N. California Blvd
Walnut Creek, CA 94596

Preliminary Traffic Management Plan (TMP)

This preliminary construction Traffic Management Plan (TMP) provides information regarding the associated hazards and issues to be addressed during the construction of the Desalination Infrastructure Project (Project) involving exposure to vehicle traffic and traffic control on Charles Benson Road and on the project site.

Responsibilities

Safety Manager – The Safety Manager, Laura Casey, is responsible for the development and maintenance of a TMP that complies with regulatory requirements and is effectively implemented at the project level. Ms. Casey is also responsible to ensure personnel performing traffic control work activities are trained in the performance of their activities and that the training is documented. She will also provide oversight of subcontractor traffic control work activities to ensure they are conducted in accordance with contract and regulatory requirements.

Project Managers/Supervisors – Project Manager, Mike Price/Construction Manager, Shon Fandrich are responsible for ensuring personnel and material resources needed to effectively implement the provisions of this procedure are provided for their work activities.

The MWH designated person responsible for managing, implementing, and maintaining the Traffic Control Plan is Laura Casey. Her designated alternative is Shon Fandrich. Phone numbers for project contacts are as follows:

- Laura Casey, Safety Manager, cell: (720) 308-9902
- Shon Fandrich, Construction Manager, cell: (512) 705-9310
- Mike Price, Project Manager, cell: (925) 818-6850
- John Cevaal, Project Executive, cell: (303) 250-2823

Safety Equipment – MWH will provide PPE for its own employees. Subcontractors are responsible for providing all personal protective equipment (PPE) necessary for their employees. Other safety equipment will be provided as delineated in the subcontract and referenced documents.

- Safety-toed shoes or boots, hard hats, and safety glasses.
- Body protection such as gloves, coveralls.
- Hearing protection when working in close proximity to loud equipment and vehicle traffic.
- Reflective/high-visibility safety vests for personnel signaling or working on or adjacent to live roadways.
- Road flares, reflective triangles, and other temporary, high visibility warning devices.
- Signs, barricades, channelizing devices, markings, and lighting devices

Planning Activities – The TMP must be approved by the regulatory or contractual authority having jurisdiction over the location prior to commencing work that may affect traffic and roadway worker safety. Where MWH acts as such an authority, all traffic control requirements shall be incorporated in the plans and specifications or in the contract requirements for our subcontractors. Personnel designing, reviewing, and supervising the installation and removal of traffic control zones shall be certified as required.

Project Execution at Charles Benson Road

This is a public road that serves both the Monterey Regional Waste Management District's (MRWMD) landfill and the Monterey Regional Water Pollution Control Agency's treatment plant. Additionally, this road will also serve as the primary access to the project site during construction and permanent access/egress for CAW upon completion of the facility. MWH's scope of work is nominal and will have minimal impact on Charles Benson Road consisting primarily of constructing an entrance and exit serving the project.

All personnel working on or adjacent to Charles Benson Road must conform to standard safety practices for road work. This requirement applies to all work activities regardless of duration (e.g., survey crews, site walk-through, emergencies, utility tie-ins, road repair and other short duration operations) and includes the following requirements:

- Work areas along Charles Benson Road will be protected by barriers
- Lookouts should be used when physical barriers are not available or practical.
- All vehicles will be equipped with operational backup alarms and wheels blocked when not in use
- Signs, barricades, channelizing devices, markings, and lighting devices used for traffic control shall be in accordance with state requirements and will be inspected continuously to ensure that they are good condition and adequate to protect the traffic control zone.
- Flagging will only be used when required to control traffic and when all other means of traffic control are inadequate to warn and direct drivers.
- Cranes will not swing loads or booms over live roadways. Closings, temporary shutdowns, or slowdowns shall be performed as needed.
- Supplemental equipment and work activities shall not interfere with traffic (for example, temporary light towers shall be placed and aimed so as not to create blinding conditions for approaching vehicles; dust and particle generation shall not migrate into traffic; cranes shall not swing loads over live roadways, etc.).

Traffic Control Zones – The temporary traffic control zone include the entire section of roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. These zones can be divided into five areas: advance warning, transition, buffer space, work area, and termination (See Attachment B – Areas of Traffic Control Zones).

- A lane closure is required when work is performed within six feet of, on, or above a live roadway.
- The advance warning area will utilize a series of signs in advance of the temporary traffic control zone transition area.
- A transition area will be used to channel traffic from the normal lanes to the path required to move traffic around the work area.
- A buffer area, free of equipment, workers, materials and vehicles, will be used to provide a margin of safety for both traffic and workers. The length, in feet, of the buffer area shall be two times the posted speed limit.
- The work area shall be that portion of the traffic control zone that contains the work activity and is closed to traffic and set aside for exclusive use by workers, equipment, and materials.
- A termination area shall be provided for traffic to clear the work area and return to normal traffic lanes.
- A downstream taper shall be placed in the termination area.

Traffic control devices will be installed in the direction of traffic flow starting with the sign or device that is farthest from the work area and progressing as the work area is approached. Traffic will be moved out of its normal path through the use of a taper using a series of channel devices such as signs, traffic cones or barrels. The length of taper used to close a lane shall be determined by the speed of traffic and the width of the lane to be closed (the lateral distance that traffic is shifted). The formulas and their criteria for application are shown in table 1.

Table 1: Formulas for Taper Length

Posted Speed	Formula
40 mph or less	L = W x S2/60
45 mph or over	L = W x S

L = taper length
S = posted speed, or off-peak 86 percentile speed
W = width of lane or offset

Flagging – Flagging should be employed only when all other methods of traffic control are inadequate to warn, direct, or control traffic. Only persons who have successfully completed an approved flagging course and who possess current flagging certification can be used as flaggers. If more than one flagger is required to achieve traffic control in both directions, flaggers will be provided with radios for communication. All signs indicating the presence of a flagger will be in place prior to commencing work activities and will be removed or covered when flagging is not actually being done or if work operation no longer requires flagging.

Inspection and Maintenance – Temporary traffic control zones will be carefully monitored to ensure that traffic control measures are operating effectively and that all devices used are clearly visible, clean, and in good repair. Traffic control devices are to be inspected at the beginning of each work shift and periodically throughout the day. Damaged traffic control devices or those in poor condition will be immediately removed from service and replaced before work commences or continues.

Self-Assessment Checklist

The “EHS Self-Assessment Checklist – Traffic Control” found in Attachment B is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to traffic control operations. Completed checklists will be maintained in project EHS files.

Desalination Infrastructure Project Site Traffic Management Plan

MWH has prepared a preliminary construction traffic management plan for construction activities on the site during project execution. See site logistics plan for references on page 7.

Access gate – Access to the project site is currently controlled by the MRWMD with a gate at the intersection of Charles Benson Road and Del Monte Blvd. Prior to beginning construction activities, this gate will be relocated between the landfill and the Project site to provide access to the site 24/7. Once relocated, this will serve as the primary access to the project site during construction.

Site access and egress – There are two points of access and egress to the project site on Charles Benson Road. The east is designated for entering into the project site and the west for exiting. These will be clearly marked with signage indicating “Entrance Only” and “Exit Only.” Both points will be gated for traffic control and security and will be managed by MWH.

Directional traffic flow – With minor exceptions, all roads on the project site will be one way for efficiencies and to minimize congestion. This will eliminate heavy equipment and construction traffic from having to pass one another contributing to a safer site. Turnarounds will be strategically located on the site to further enhance traffic flows and reduce congestion.

Deliveries – All deliveries will check in with MWH upon entering the site for security and for ownership verification. The appropriate subcontractor will be responsible to direct the delivery to its appropriate location for off-loading. Days that will experience significant deliveries, e.g., large concrete pours, MWH will notify the Monterey Regional Waste Management District and the Monterey Regional Water Pollution Control Agency of the increased traffic.

Fuel stations – All contractors will be required to refuel construction vehicles and equipment at a dedicated fuel station on an impervious surface protected by secondary containment. Emergency spill kits will be located at the station. Boxes shall be painted safety yellow and labeled: “SPILL CONTAINMENT KIT – EMERGENCY USE ONLY” (see Spill Prevention Control and Countermeasure Plan for spill kit contents).

Signage – Signage will be posted throughout the project site to facilitate traffic management. A project sign at the intersection of Charles Benson Road and Del Monte Blvd will direct construction traffic to the project site and entrance. “Entrance” and “Exit Only” will be posted at both points of access and egress. At the exit, a “Do Not Enter” will be posted on Charles Benson Road to alert operators/drivers. 10 MPH speed limit signs will be posted on the project site for all construction traffic for heavy equipment, construction and personal vehicles. To benefit first time visitors, signage will be posted to direct them to the project office. Additional signage such as First Aid, Fueling Station, Exit, etc. will be posted throughout the project.

Exiting the site – A concrete washout is located at the exit for expediency to provide concrete trucks a quick and efficient location to washout upon exiting the site. A gravel pad is located at the exit along with a wheel wash station to remove all mud and debris before entering Charles Benson Road.

Emergency responders – Emergency responders will be invited to the project to familiarize themselves with the site layout, access and egress points, and site personnel.

Containment fencing – Orange fencing and barriers will be placed around the construction areas to prevent vehicles from straying from the construction areas. Roads are named to facilitate site logistics, orientation and familiarization with the project site.

Avoiding Impact to Sensitive Nearby Wetland Habitats

The Project is located near the Salinas River and wetlands, environmentally sensitive habitats that are home to species identified as rare, threatened, endangered, candidate, sensitive, or other special status by the California Department of Fish and Game or USFWS. These include the California red-legged frogs, California tiger salamander, and Santa Cruz long-toed salamanders. Other species include the burrowing owl, raptors, and special status birds which nest in the area from February 1 through August 31. Construction in and around these habitats could result in direct take of individuals and loss of habitat by changing vegetation composition.

Protecting Nearby Wetlands

Prior to any construction activities, the boundaries of construction areas will be clearly delineated with construction fencing to prevent workers from inadvertently straying from the construction area. All construction activities, laydown, staging and prefabrication areas have been located near the project site to eliminate any unnecessary traffic in undisturbed areas on the property protecting established natural control measures for stormwater such as vegetation and groundcover.

MWH will prepare a Stormwater Pollution Prevention Plan (SW3P) for the site in accordance with State and Federal regulations. The plan will contain specific provisions that identify the nearby wetlands, potential hazards and mitigation measures to be put in place to avoid impacts.
Additionally the SW3P will contain specific provisions for spill control and prevention including requirements for vehicle refueling (see site logistics plan), checking of vehicles for leakage, cleanup of spilled materials and storage of chemicals, fuels, and lubricants during construction. The plan will also contain provisions for maintenance and inspection of provisions requiring documentation of maintenance

and inspection activities. MWH will utilize the following measures at a minimum to manage stormwater events:

- Implement erosion control measures such as slope stabilization, hydroseeding, mulch logs, gravel berms, sandbags, etc.
- Inspection of the project site prior to anticipated storm events and after the actual storm event
- During extended storm events, the inspections will be conducted after every 24-hour period
- Installation of silt-fencing at least 36 inches high that is buried at least 6 inches in the ground to prevent incursion
- Capturing stormwater runoff

Mitigation Measures for Endangered Species

We do not anticipate encountering any federally listed species during construction. However, if any are encountered MWH will follow the mitigation measures as outlined in the Mitigation, Monitoring and Reporting Plan as identified in the Draft EIR.

VI. ATTACHMENTS

Site Plan
Attachment A– Subcontractor Safety Procedures Criteria – Traffic Control
Attachment B – Areas in Traffic Control Zones
Attachment C – EHS Self-assessment Checklist – Traffic Control

SITE PLAN

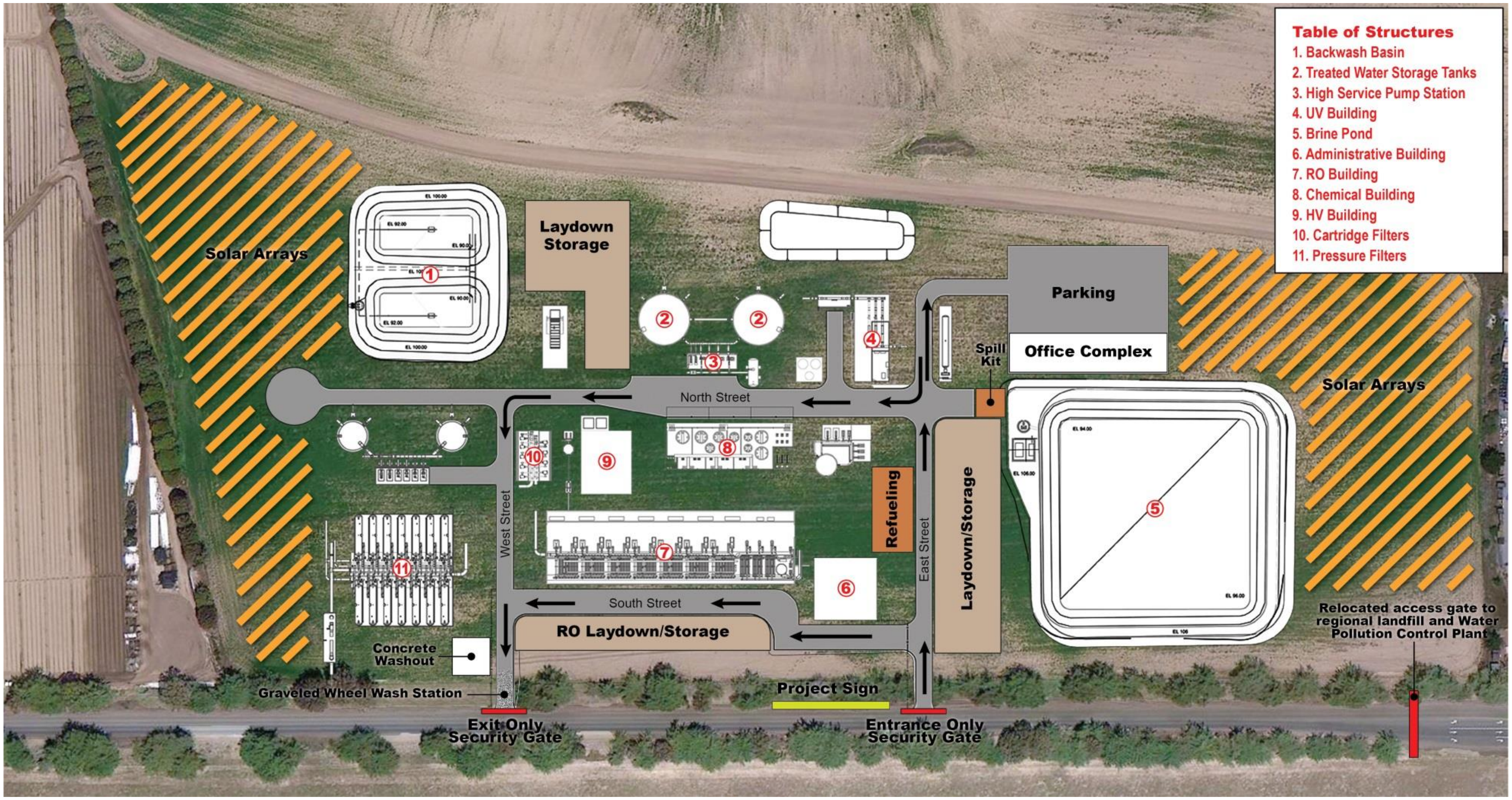


Table of Structures
1. Backwash Basin
2. Treated Water Storage Tanks
3. High Service Pump Station
4. UV Building
5. Brine Pond
6. Administrative Building
7. RO Building
8. Chemical Building
9. HV Building
10. Cartridge Filters
11. Pressure Filters
Solar Arrays
Laydown Storage
Parking
Office Complex
Spill Kit
North Street
West Street
East Street
South Street
Refueling
Laydown/Storage
RO Laydown/Storage
Concrete Washout
Graveled Wheel Wash Station
Project Sign
Exit Only Security Gate
Entrance Only Security Gate
Solar Arrays
Relocated access gate to regional landfill and Water Pollution Control Plant

ATTACHMENT A

MWH Subcontractor Safety Procedure Criteria – Traffic Control

The following criteria are not intended to be all-inclusive, but are provided as a tool to facilitate development and review of subcontractor traffic control procedures. Subcontractors are expected to address the following items in their safety procedures.

Minimum Acceptable Criteria for Subcontractor Traffic Control Procedures:

1. Provide the name and qualifications (years and type of experience, training background, state certification, etc.) of the individual responsible for designing and supervising traffic control.

2. Provide the qualifications (years and type of experience, training background, etc.) of personnel working in traffic control zones as flaggers.

3. Provide a list of work areas and activities where traffic control will be required.

4. Provide an inventory (amount and type) of traffic control devices and equipment to be used for traffic control operations (truck-mounted crash cushion or attenuator vehicles, cone trucks, message boards, arrow boards, signage, channeling devices, barriers, etc.).

5. Provide a copy of the traffic control plan for the traffic control zones anticipated to be required for this project.

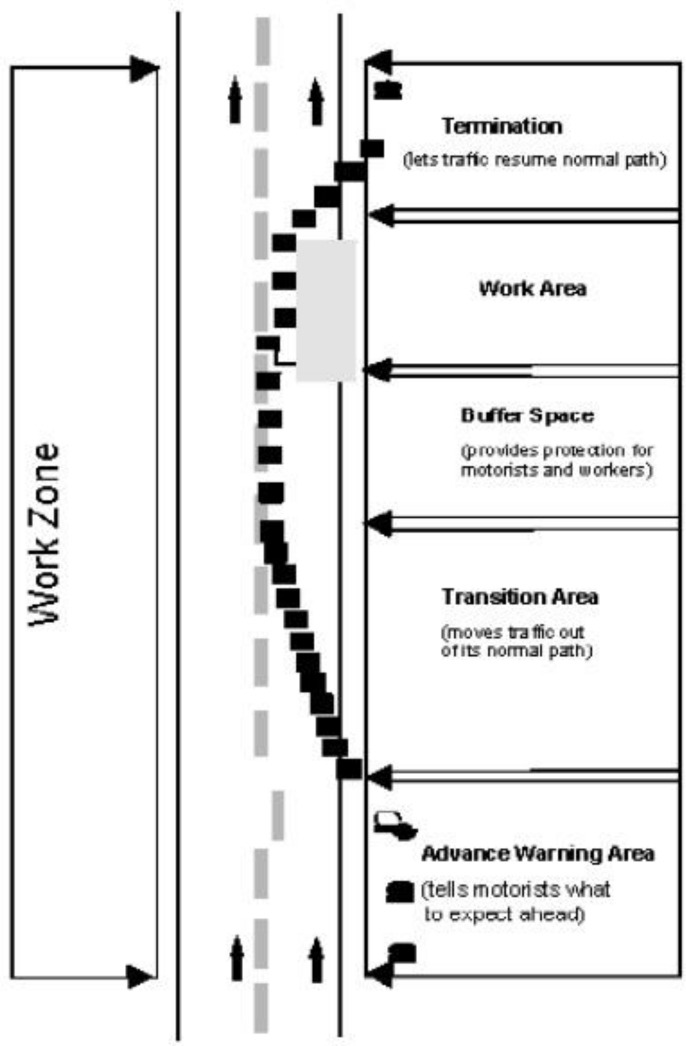
6. Provide a copy of an engineering study of the location for which the traffic control plan was developed.

7. Provide a description of traffic control device inspection criteria or procedures (frequency of inspections and items that are inspected).

8. Describe the arrangements to be made with local police or highway patrol to facilitate traffic control device installation and removal.

ATTACHMENT B

Areas in Traffic Control Zones



ATTACHMENT C

Self-assessment Checklist – TRAFFIC CONTROL

This checklist shall be used by MWH personnel only and may be completed at the frequency specified by the Local EHS Representative or as specified in the HASP.

This checklist is to be used at locations where : 1) MWH employees are exposed to traffic hazards and/or 2) MWH performs traffic control work activities or provides oversight of subcontractor personnel who are exposed to traffic hazards.

The Local EHS Representative may consult with subcontractors when completing this checklist, but shall not direct the means and methods of traffic control operations nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies, and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed MWH and MWH Subcontract personnel shall be removed from the hazard until corrected.

Completed checklists shall be maintained in the Project EHS files.

Project Name: ______________________________ Project No.:_____________

Location: ______________________________ PM: ______________________

Evaluator: ____________________ Title: ________________ Date: _________

This specific checklist has been completed to:

☐ Evaluate employee compliance with requirements

☐ Evaluate an MWH subcontractor's compliance with requirements

Check "Yes" if an assessment item is complete/correct.

Check "No" if an item is incomplete/deficient, section 2 must be completed for all items checked "No."

Check "N/A" if an item is not applicable.

Check "N/O" if an item is applicable but was not observed during the assessment.

ATTACHMENT C

SECTION I

		Yes	No	N/A	N/O
SAFE WORK PRACTICES					
1.	Personnel working on/adjacent to active roadways or in control zones are wearing safety vests	☐	☐	☐	☐
2.	Traffic control plan (TCP) is consistent with roadway, traffic, and working conditions	☐	☐	☐	☐
3.	TCP has been approved by regulatory or contractual authority prior to work	☐	☐	☐	☐
4.	TCP considers all factors that may influence traffic-related hazards and controls	☐	☐	☐	☐
5.	Work areas are protected by rigid barriers	☐	☐	☐	☐
6.	Lookouts are used when applicable	☐	☐	☐	☐
7.	Vehicles are parked 40 feet away from work zone or are equipped with hazard beacon/strobe	☐	☐	☐	☐
8.	TMCC or TMA vehicle is used where appropriate	☐	☐	☐	☐
9.	All MWH traffic control devices conform to MUTCD standards	☐	☐	☐	☐
10.	Traffic control devices are inspected continuously	☐	☐	☐	☐
11.	Flagging is only used when other means of traffic control are inadequate	☐	☐	☐	☐
12.	Additional traffic control zone controls have been implemented	☐	☐	☐	☐
13.	Cranes do not swing loads/booms over workers, nor do workers enter/cross live roadways (as defined)	☐	☐	☐	☐

SECTION 2

		Yes	No	N/A	N/O
GENERAL					
14.	Lane closings are performed when required by this procedure	☐	☐	☐	☐
15.	Traffic control configurations are based on an engineering study of the location	☐	☐	☐	☐
16.	If no study, traffic control is performed with approval of the authority having jurisdiction	☐	☐	☐	☐
17.	TCP has been prepared and understood by all responsible parties prior to work	☐	☐	☐	☐
18.	Special preparation/coordination with external parties has been conducted where applicable	☐	☐	☐	☐
19.	All contractor traffic control devices conform to MUTCD standards	☐	☐	☐	☐
20.	Traffic movement and flow are inhibited or disrupted as little as possible	☐	☐	☐	☐
21.	Supplemental equipment and activities do not interfere with traffic	☐	☐	☐	☐
22.	Drivers and pedestrians are considered when entering and traversing traffic control zone	☐	☐	☐	☐
TRAFFIC CONTROL ZONES					
23.	Traffic control zones are divided into the necessary five areas	☐	☐	☐	☐
24.	Advanced warning area is designed based on conditions of speed, roadways, and driver needs	☐	☐	☐	☐
25.	Advanced warning signage is spaced according to roadway type and conditions	☐	☐	☐	☐
26.	Transition areas are used to channel traffic around the work area	☐	☐	☐	☐
27.	Buffer areas are used to provide a margin of safety for traffic and workers	☐	☐	☐	☐
28.	The buffer area is free of equipment, workers, materials, and worker vehicles	☐	☐	☐	☐
29.	The length of the buffer area is two times the posted speed limit in feet	☐	☐	☐	☐
30.	All work is contained in the work area and is closed to all traffic	☐	☐	☐	☐
31.	A termination area is used to provide traffic to return to normal lanes	☐	☐	☐	☐
32.	A downstream taper is installed in the termination area	☐	☐	☐	☐

ATTACHMENT C

	Yes	No	N/A	N/O
DEVICE INSTALLATION AND REMOVAL				
33. All vehicles involved with device installation/removal have hazard beacons/strobes	☐	☐	☐	☐
34. Devices are installed according to the order established by this procedure	☐	☐	☐	☐
35. Devices are removed in the opposite order of installation	☐	☐	☐	☐
36. Tapers are used to move traffic out of its normal path	☐	☐	☐	☐
37. Tapers are created using channel devices	☐	☐	☐	☐
38. The length of taper is determined by posted speed and width of lane to be closed (see formula)	☐	☐	☐	☐
39. Local police or highway patrol assist during taper installation and removal	☐	☐	☐	☐
40. TMCC/TMA vehicles are used to protect personnel during installation and removal of devices	☐	☐	☐	☐
41. Cone trucks are equipped with platforms and railings	☐	☐	☐	☐
42. Cones are the appropriate height for the specific roadway and are reflectorized	☐	☐	☐	☐
43. Temporary sign supports are secured using sandbags to prevent movement	☐	☐	☐	☐
44. Arrow panels are used on lane closures where required	☐	☐	☐	☐
45. Concrete barriers are used where required	☐	☐	☐	☐
46. Barrels, crash cushions, or energy-absorbing terminals are used to protect traffic as required	☐	☐	☐	☐
47. Changeable message signs (CMS) are used as required	☐	☐	☐	☐
48. CMS are not used to replace required signage	☐	☐	☐	☐
49. No more than two message panels are used in any message cycle on CMS	☐	☐	☐	☐
FLAGGING				
50. Flagging is used only when other traffic control methods are inadequate	☐	☐	☐	☐
51. Only approved personnel with current certification are allowed to be used as flaggers	☐	☐	☐	☐
52. Flaggers are located off the traveled portion of the roadway	☐	☐	☐	☐
53. A communication system is established when more than one flagger is used	☐	☐	☐	☐
54. Hand signaling by flaggers is be means of red flags, sign paddles, or red lights	☐	☐	☐	☐
55. Flaggers are alert, positioned close enough to warn work crews, and easily identified from crew	☐	☐	☐	☐
56. An escape plan is established by crew and flaggers prior to traffic control set up	☐	☐	☐	☐
57. Signs indicating a flagger is present are used and removed as required	☐	☐	☐	☐
INSPECTION AND MAINTENANCE				
58. Traffic control zones are monitored to determine their effectiveness under varying Conditions	☐	☐	☐	☐
59. Traffic control devices are inspected at the beginning and continuously during the work shift	☐	☐	☐	☐
60. Traffic control devices are restored to their proper position immediately and continuously	☐	☐	☐	☐
61. Devices using reflected light for illumination are cleaned and monitored continuously	☐	☐	☐	☐

ATTACHMENT C

EHS Self-Assessment Checklist – TRAFFIC CONTROL

SECTION 3		
Complete this section for all items checked "No" in Sections 1. Deficient items must be corrected in a timely manner.		
Item #	Corrective Action Planned/Taken	Date Corrected

Evaluator: _________________________________ Project Manager: ____________________________

Design-Build Quality Management Plan

Design-Build Quality
Management Plan

CALIFORNIA AMERICAN WATER
MONTEREY PENINSULA WATER SUPPLY PROJECT
DESALINATION INFRASTRUCTURE
DESIGN-BUILD PROJECT

Preliminary Design-Build Quality Management Plan

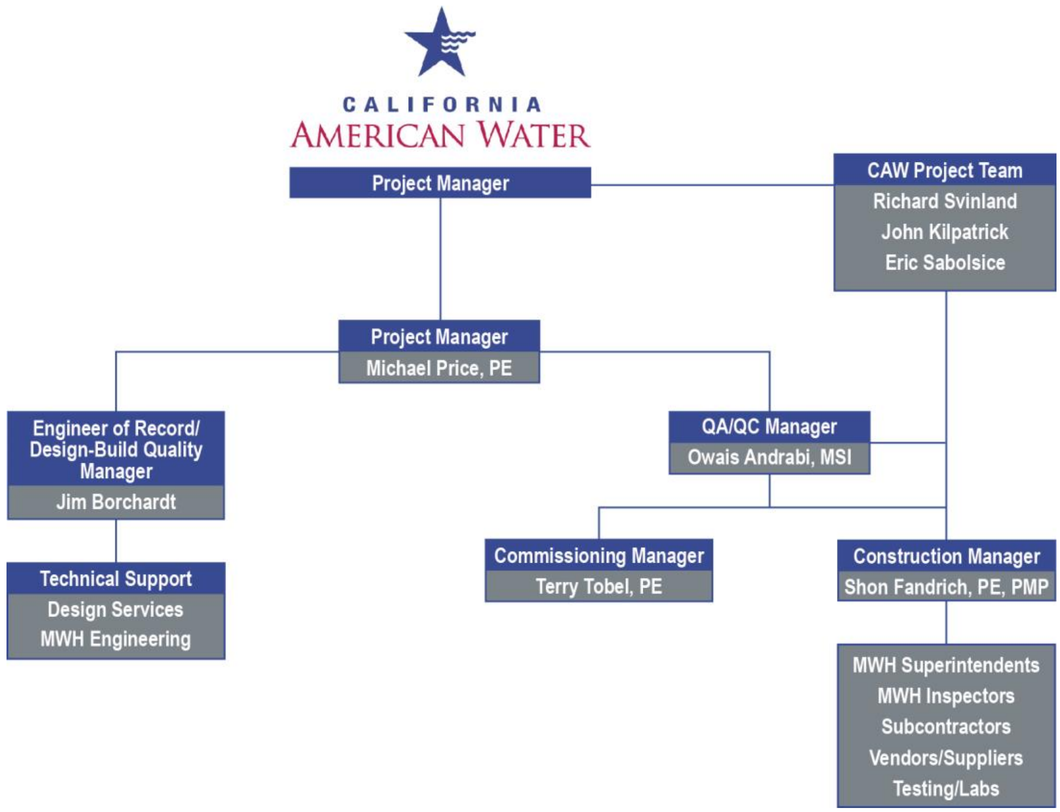
October 16, 2013

MWH Constructors

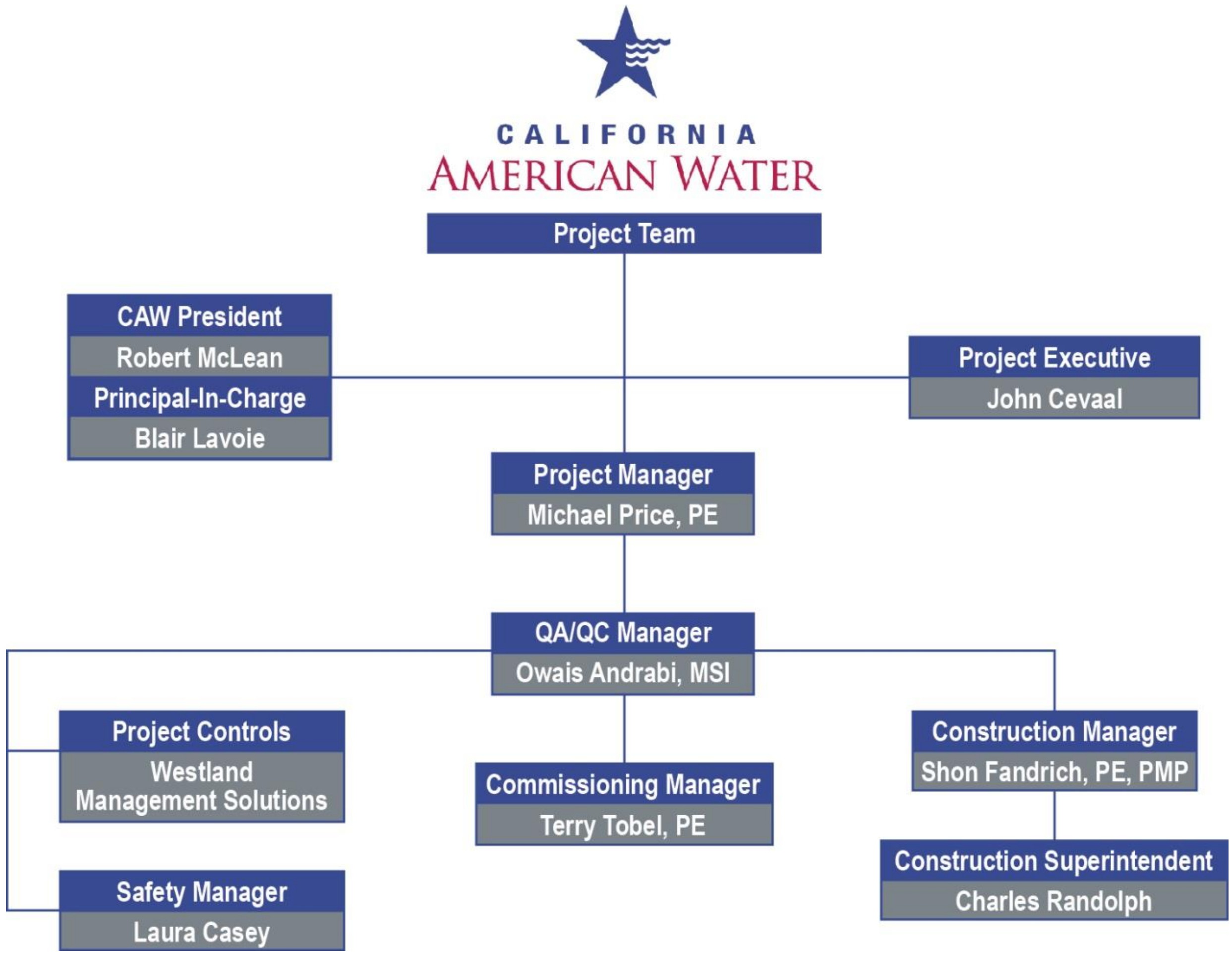
Table of Contents

Revision 3

Quality Management Team Functional Organization Chart



Quality Management Team Project Reporting Structure



Quality Management Team Project Directory

Name	Organization	Office Phone	Cell Phone	Fax	Email address
Blair Lavoie	MWH	(303) 439- 2803	(303) 601-1452	(303) 439- 2851	Blair.M.Lavoie@mwhglobal.com
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Michael Price	MWH	(925) 627-4712	(925) 818-6850	(925) 627-4501	Michael.L.Price@mwhglobal.com
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Carlos Villalpondo	MWH	(916) 418-8319		(916) 924-9102	Carlos.Villalpando@mwhglobal.com
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Jim Serpa	Overaa Construction	(510) 719-3935			jims@overaa.com

Quality Management Plan Revision Log

Section	Description	Revision Date	Revision #

1 Introduction

1.1 General

MWH utilizes a team approach to Quality Management functions, where Quality Managers are assigned as the leaders for each phase of the project Quality Management Team. For this project, Owais Andrabi is assigned as the QA/QC Manager and Jim Borchardt as the Design Quality Manager. The Quality Management Team is made up of personnel from MWH, independent testing laboratories, MWH and its subcontractors, suppliers, and subconsultants. The Quality Managers provide direction to and information for the Quality Management Team. The purpose of this direction and information is to identify the necessary interfaces and reporting procedures, as well as the required coordination between Quality Management Team members, CAW's Project Team, the construction staff, and independent testing laboratories. Members of the Quality Management Team are listed on the organizational chart provided on the previous page.

Under the MWH quality team approach, the person performing the work is responsible for the quality of the work, and their supervisor is responsible for ensuring that the quality requirements are achieved. Under the direction of the Quality Managers, Quality Management Team members responsible for QC will conduct phased inspections for all aspects of the specified work in accordance with the contract specifications. Each assigned member of the quality team is responsible for verification that the work performed under their supervision is in conformance with the requirements of the contract drawings and specifications.

1.2 Project Quality Goals and Objectives

MWH has established project specific QA/QC goals and objectives. These goals and objectives have been developed from two sources. The first source is our corporate Quality Management Program, the second source is a set of project specific goals and objectives based specifically on the work to be performed on the Desalination Infrastructure Project. The established quality goals and objectives include measurable quality criteria that allow the comparison of planned quality with that actually achieved during project execution.

In our evaluation of this project and CAW's requirements, MWH has established the following general QA/QC objectives for this project:

- Implement a well-developed Quality Management Program to describe how the project will meet CAW and MWH's quality objectives for the project. The primary goal of the MWH Quality Management Program is to provide CAW with complete confidence that the work we perform or manage is in full conformance with CAW requirements.
- MWH will provide CAW with documented, objective evidence that quality requirements have been met.
- MWH will ensure that permitting, design, construction, transition planning, startup, testing, commissioning, and Acceptance Testing are consistent with the Design-build Contract and result in a project that meets the overall Performance Standards for the Project.
- Integrate and coordinate permit specialists, designers, construction contractors, and CAW operators into all review phases of the project.

- At all times MWH will provide adequate resources to enable effective maintenance, promotion and implementation of the project Quality Management Program.

- During project execution, we will continually improve the Quality Management Program by monitoring Program conformance, identifying the root cause for weakness in the Program and develop and implement the solutions for necessary improvements.
- MWH will ensure that the project QA/QC objectives and specific quality standards are conveyed to each of our subcontractors, material and equipment suppliers and vendors and that these objectives and standards are met.
- At all times MWH will maintain positive supplier and subcontractor relationship by treating them as partners in the delivery of CAW requirements.
- MWH will work to provide durable, dependable, and high-quality materials, installation, and equipment compatible with and proven in wastewater treatment applications.
- MWH will develop systems to assure that problems are discovered early, corrected adequately, and do not recur.
- MWH will provide appropriate training in the application of the QA/QC process and procedures to meet the identified QA/QC objectives for this project.
- MWH will provide independent oversight equipped with adequate resources to assure that quality is not compromised by production goals.
- MWH will work to provide for a superior level of workmanship for finishes.
- Specific quality goals and objectives that we are committed to achieving are listed below:
- MWH will work to maintain the cost of quality related issues on this project to less than one-tenth of one-percent of the total project cost.
- MWH will work to maintain the cost of internal design changes to less than 0.5% of the total design budget.
- All hydraulic structures will pass their leak test on their first fill.
- Plant operations will operate at full capacity upon completion
- As the new process units are brought on-line, start-ups will be smooth and trouble-free.
- Accomplishing these goals and objectives requires a dedicated Quality Management Team that works across the Design, Construction and Operations Integration project phases. As depicted through the organizational charts provided on pages three and four, the Quality Management Team is truly incorporated into the Project Delivery Team.
- Our experience shows that combining these Teams promotes a constant focus on project quality goals and objectives, the most critical step in delivering a quality project.

2 Quality Management Team Organization

Members of the Quality Management Team are illustrated on the functional organizational chart presented in this Plan. The Team's Project Executive will be supported by the QA/QC Managers for Design and Construction. Within the team, the Quality Managers have a primary line of communication to the MWH Project Executive. In addition, there is a secondary line of communication between the Quality Managers and the MWH Principle-in-Charge. This secondary line of communication provides the Quality Management Team a mechanism to seek resolution for any quality issue that cannot be satisfactorily resolved within the project team.

As shown on the organizational chart, Jim Borchardt is the Engineer of Record and will provide design QA/QC. Technical resources to be utilized by the Design QA/QC Manager will be obtained from MWH's Municipal and State Services, the Water/Wastewater Process Knowledge Center, and the Chief Discipline Engineers from the Design Services Groups, as well as MWH's Engineering Department. These technical resources will be utilized for design reviews, project checking and constructability reviews.

As Project Manager, Mike Price has the ultimate responsibility for meeting project quality requirements. Owais Andrabi will fill the role of Construction QA/QC Engineer. This position will be supported by MWH's Quality

Control Inspectors as well as Quality Control staff from MWH's subcontractors, suppliers, vendors and testing labs. The QA/QC Manager will be responsible for organizing these resources as required to meet the requirements of the construction schedule. Responsibilities for Operation Integration will be assumed by Terry Tobel. Terry will work with the Design and Construction QA Managers, as well as the design and construction teams to prepare for the start-up of the new facilities.

Page four of this plan presents an organizational chart depicting the reporting structure of the Quality Management Team represented within the framework of the Design-Build Project Team. This illustration is to show that the Quality Management Team is not a group that is isolated from the daily work being performed by the Design-Build Project Team. Rather the Quality Team is an integrated function of the Project Team and will actively participate in each major phase of the Design-Build project

This organization chart also illustrates that within the framework of the Design-Build Project Team, direct communication is maintained between the QA/QC Managers and CAW.

3 Quality Management Team Management Responsibilities

3.1 MWH Project Management Responsibilities

John Cevaal, the MWH Project Executive, has the overall responsibility for establishing and maintaining quality for the project and also assuring quality to the design phase aspects of the Quality Management Program. As Project Manager, Mike Price, is responsible for insuring that the MWH Project Team achieves the stated objectives of the MWH Quality Policy during the construction phase. Owais Andrabi, the MWH QA/QC Manager, with support from the Quality Management Team and all project participants, will insure that established project specific quality goals and objectives are achieved.

Technical support for the Quality Management Team over the term of this project will be provided by members of MWH's Engineering and Construction Operations Groups. Jim Borchardt has been assigned the role of overall Design QA/QC Manager to assure that the design effort quality review is conducted in accordance with this plan.

3.2 QA/QC Manager Responsibilities

Owais Andrabi, has been assigned the role of QA/QC Manager for this project. As the QA/QC Manager, he will be responsible for ensuring that the project Quality Management Program is properly implemented during the Construction Phase. Following the development and implementation phase, he will be responsible for the subsequent tracking and evaluation of the effectiveness of the Quality Management Program. Any issue related to quality that cannot be satisfactorily addressed within the construction team will be resolved by the QA/QC Manager in concert with the MWH Project Executive.

The Project Executive will also perform randomly scheduled quality audits as the project is executed. The purpose of the quality audits is to evaluate Quality Management Team conformance with the project specific Quality Management Plan. Any changes or adjustments to the Quality Management Plan deemed necessary as a result of these audits are to be implemented by the Project Executive.

3.3 Principle-In-Charge Responsibilities

Blair Lavoie has been named the Principle-in-Charge for this project. As Principle-in-Charge, Blair will offer an alternative line of communication between the Project Team and the Quality Management Team. This alternative line of communication is very useful in the event there are specific quality-related issues that cannot be satisfactorily be resolved between the Quality Management Team and the Project Team. This alternative line of communication allows the Quality Management Team to maintain independence from schedule and performance pressures that can sometimes negatively impact the quality of the completed work.

As needed, Blair will be available to mediate, suggest alternatives or apply additional resources as required to balance and satisfy the requirements of the Project and Quality Management Teams, without sacrificing the quality of the completed work

Section 4

Permitting Quality Management Plan

4 Permitting Quality Management Plan

4.1 Roles and Responsibilities

Denise Duffy will fill the role of permit coordinator for the project. Her role will be to assist the project team is preparing and obtaining any permits that are required for implementation of the Desalination Infrastructure Project. She will review the individual requirements where permits may be required, identify the application and compliance of the permit conditions and prepare with assistance from the project team the elements required for permit review and approval. She will maintain a log of permit submittal, permit conditions and permit approvals. She will delegate specific permit application development to other team members to maximize the effectiveness of the project team capabilities and technical knowledge.

4.2 Documentation of Assumptions

Table 3-1 and 3-2 of Appendix 3 in the RFP identifies a responsibility matrix prepared in Table 3-1 which lists the permit, approval or certification, the agency, the responsibility to obtain, and the responsibility to obtain prior to the close of the Development Period. Each agency has a set of guidelines and criteria that they apply for meeting permit requirements on projects. MWH reviews each of these sets of guidelines to confirm the work required and validate assumptions the team applies from preparing similar permits on other projects. MWH reviews any assumptions made relative to the specific guidelines in person with the permitting agency and adjust the approach to securing the permit based on the feedback from these sessions. Any assumptions that have been made and are valid to the permit are incorporated directly in to the permit scope of work prepared by MWH. John Cevaal or environmental scientist designee approved by the MWH Project Executive will review the individual permit types for application to this project with the project team members. He will prepare a summary of the permits to be obtained based upon input from the project team and review of the individual permit requirements applicable to the project. He will work with the specific technical project team resources to prepare and complete the permit applications and manage the permit review and approval. As the project continues to develop and if any unlisted permit requirements are identified by the project team. Mr. Cevaal or the environmental scientist designee approved by the MWH Project Executive will work collectively with the team to prepare the application for approval.

4.3 Standards and Methods

Permits for each related agency will be prepared in accordance with their guidelines and standards. The permit form, format and delivery will be prepared in accordance with the agency requirements. Each permit to be obtained will be reviewed with the agency prior to preparing the application. John Cevaal or environmental scientist designee approved by the MWH Project Executive and identified project team members will meet with the agency, identify a prime contact, and review the specific information that the agency requires in the application. A draft of the proposed application will be prepared by MWH and reviewed face to face with the agency prior to submittal. These up front steps have been proven effective in reducing the agency review time and assuring that the correct information is contained in the permit application. John Cevaal or environmental scientist designee approved by the MWH Project Executive will also utilize proven methods that MWH has used effectively on other permitting activities with individual agencies. The applications will be reviewed for technical accuracy and completeness by John Cevaal, or his designee, before the application is submitted. CAW will also be solicited for review and input on selected permits or applications such as the Amended Facility Plan prior to application of the final documents.

4.4 Communication Protocol

John Cevaal or his designee will provide the common point of contact between MWH and the agency. As noted, each permit application will be precluded by informational review sessions with each agency to identify requirements and review draft submittal documents prior to application. Other communication protocol will follow the guidelines established in the Communications Plan prepared for the Desalination Infrastructure Project.

4.5 Procedures for Assuring Permit Compliance

Once a permit has been obtained, any conditions applied to the approval will be reviewed with the project team to assure that they are understood. If there are any schedule related impacts, particularly activities that must be performed during certain windows of time, the project schedule will be amended to reflect the duration and activity. If there are written compliance certifications to be provided, John Cevaal or environmental scientist designee approved by the MWH Project Executive will identify the responsible party and confirm the completion and submittal of such documents. John Cevaal or environmental scientist designee approved by the MWH Project Executive will conduct monthly reviews of permit compliance and schedule and provide input to the Project Executive for incorporation into the monthly report to CAW. This input will constitute a permit performance and completion checklist. If John Cevaal or his designated reviewer identifies a permit condition that has not been addressed or inadequately followed, he will notify the Project Executive of the non-compliance and provide a recommendation for meeting permit requirements.

Section 5

Easement Quality Management Plan

5 Easement Quality Management Plan

No easements are to be acquired by the Project Team. This section of the Quality Management Plan will not be used.

Section 6

Project Design Quality Management Plan

6 Project Design Quality Management Plan

6.1 General Philosophy and Approach

All projects executed by MWH that include design engineering are required to have a Design Quality Management Plan in-place prior to commencing project design. The Design Quality Management Plan is intended to be a stand alone plan that covers specifically the engineering design aspects of the project. As such, the Design Quality Management Plan is intended to augment the MWH Construction Quality Management Plan.

As previously stated, MWH's approach to the Quality Management Plan is to equally reach every major phase of project execution including design, construction and operation. The Quality Management Plan is a fundamental part of performing and meeting contract responsibilities. As such, the philosophy of MWH is that design preparation is not complete without the checking of that design, and delivery of the completed project results in the confirmation that the quality standards have been met. Each project team member is an integral part of the Quality Management Plan to assure that Quality is carried forward in all elements of the work and to ensure that all plans, specs and design calculations are in compliance with applicable codes and requirements of the Contract.

6.2 Staff Roles and Responsibilities

6.2.1 MWH Project Manager

Section 1 of this Quality Management Plan described the overall Quality Management responsibilities for MWH's Project Manager. For the design phase of the project, the MWH Project Manager is additionally responsible for insuring that the Design Quality Management Plan is prepared, implemented and maintained over the course of the design phase. It is also the responsibility of the MWH Project Manager to monitor the Quality Management Plan on a regular basis and report the results of this monitoring activity to MWH Management and CAW.

MWH's Project Manager is also responsible for implementing corrective measures generated through design project audits (Section 6.13) and as reported by the Quality Management Team. As previously noted, the MWH organization during the Development Period of the project utilizes a Project Manager to fulfill the duties of this position. The Development Period primarily consists of completing the design of the project prior to construction.

6.2.2 MWH Design Manager

Under the MWH Quality Management Team approach, the person performing the work is responsible for the quality of the work, and their supervisor is responsible for ensuring that quality goals are achieved. Ensuring that the design team prepares a coordinated design with appropriate detail, within schedule and budget is the primary responsibility of the MWH Design Quality Manager. To help achieve this, the MWH Design Manager shall require the Design Team to follow the Design Quality Management Plan Elements described in Section 6.3.

Elements of the Design Quality Management Plan require the performance of a variety of detailed design and technical reviews. It is the Design Quality Managers responsibility to cooperatively resolve and incorporate review comments between the Design Team and project reviewers.

After construction commences, the Design Quality Manager and Design Team are also responsible for timely responses to submittals, Requests for Information, and the generation of Design Clarifications. Over the course of the design process, the Design Quality Manager, or their designee, is responsible for maintenance of the document control system. All of these tasks are to be performed in accordance with the requirements of the Design Quality Management Plan.

6.2.3 Quality Manager

In addition, during the design process, the Design Quality Manager has the responsibility to prepare the Design Quality Control Plan within the framework of the Design-Build Quality Management Plan. Details of these responsibilities are provided in the following sections of this document. The following list summarizes distinct areas where the Design Quality Manager will either lead or verify that the following quality related tasks are accomplished.

- Verify with the Project Manager the design Project Execution Plan that is to be performed for the project. Summarize and distribute the plan details to the Design Team and the Quality Management Team. For the Desalination Infrastructure Project, a formal Project Execution Plan will be developed. The execution phase during the Development Period of the Project consists of; 1) identifying the design submittals required during the period, 2) summarizing the level of additional detail that was required for each submittal, and 3) identifying the delivery date for each submittal. The design team resources will be assembled such that the required detail could be prepared during the time periods identified prior to the delivery date. This execution plan will be presented to the entire design team at the outset of the Development Period. The required detail, the milestone schedule, and the listing of submittals will be reviewed in detail. Examples of the detail for each deliverable will be provided to each team member to be used as a guide for setting expectations of level of effort. The Project Manager will manage the design production based on this execution plan with schedule for completion of each submittal on the specified date being the critical path. The design Quality Manager will utilize the schedule developed in the Project Execution Plan to coordinate reviewers who would be performing QA/QC review concurrent to CAW review of the submittals. The MWH review comments will be distributed to each discipline engineer at the same time as CAW comments are received so they could be address at the same time.
- Lead the preparation of the Design Quality Control Plan as prescribed through form EN-65. The EN-65 is a summary for of each design delivery milestone, QA/QC activity milestone, and formal reviews conducted. It summarizes the completion dates for deliverables and reviews and provides a confirmation date that when the work was actually complete. This form is intended to be used as a reference by the Project Manager Design Quality Manager in monitoring project performance and completion and document the progress of this completion. The EN-65 is completed by the Project Manager, Design Quality Manager and assigned reviewers of specific milestone submittals or QA/QC events. A copy of the EN-65 is attached to this Quality Management Plan.
- Verify that the Design Quality Control Plan is developed, distributed and tracked over the course of the project including identification of appropriate technical experts and coordinating review schedules with their schedule.
- Organize, schedule, conduct and report on all project design and constructability reviews as listed in the EN-65.
- Organize, schedule and conduct Process Review. Process Review was conducted during the proposal stage on the Desalination Infrastructure Project. This was performed early since MWH will be responsible for process and performance risk according to the contract. MWH needed to assure its Senior Management that the process selection and design criteria would achieve the contractual performance requirements without risk. This review allowed MWH to correct any risk which would be unacceptable or result in not achieving the performance requirements. A check of conditions provided to the design team by the Process review was conducted during the later stages of the Development Period to assure that they were incorporated into the design. The EN-65 provides the signoff that the conditions were incorporated.
- Verify the MWH Project Execution Requirements are followed.

- Understand lessons learned from other MWH design build projects and ensure they are applied to this project.
- Verify that proper Quality Standards are employed by the design disciplines.
- Perform regular reviews of the project file system.
- Verify upon project completion that proper design closeout procedures as specified in EN-67 are carried out. Or a design build project, the EN-67 is not effectively completed until the project has been built. This is due to the fact that design may not be totally complete on all elements when construction commences. This form was originally developed for conventional design-bid-build projects where the design is 100% complete before the project is built. Once the design activities have reached conclusion during construction, each discipline reviewer will complete and execute the signoff of the EN-67 for the Desalination Infrastructure Project design. The Design QA/QC Manager is responsible to assure that the EN-67 is complete at the end of construction. A copy of the EN-67 is attached to this Quality Management Plan.
- Monitor and report on the effectiveness of the design Quality Management plan, and provide suggestions for continuous improvement to the Quality Manager.

The Design Quality Control Manager has the responsibility of monitoring the design development progress as it impacts the scheduled reviews, checks and criteria review meetings. If subconsultants are used, each subconsultant will identify a quality control coordinator within their organization such that the Design Quality Control Manager can communicate project progress. The Design Quality Control Manager will notify the Project Manager immediately if there is any deviation to the quality control program, procedures or schedule.

Coordination of design development will be performed through electronic mail, Lync, phone conversation and visits to the site of design production-both MWH and their subcontractors. It is essential that the Design Quality Control Manager periodically witnesses production being prepared within the Design Quality Management Plan guidelines and not wait until deliverables are produced to identify problems. This coordination effort is a proactive program to assure quality production.

Additional details regarding the responsibilities of the Design Quality Manager are described in Section 6.6.1.

6.3 Design Quality Management Plan Elements

Content and degree of detail for Design Quality Management Plans may vary with project size and complexity. It is intended that the following minimum list of Quality Management Plan elements to be developed for each MWH project. However, the MWH Design Manager and Project Manager may elect to customize the Design Quality Management Plan elements to more closely meet the needs of the project. In this event, approval to deviate from the Design Quality Management Plan elements listed below requires review and approval from the MWH Director of Engineering, MWH Quality Manager and the Design Manager’s Business Unit Leader (BUL). For the Desalination Infrastructure Project the BUL is located in the MWH Walnut Creek, CA office.

The Quality Management Plan for design engineering is composed of the following elements.

- Design Quality Control Plan
- EN-65
- Project Staff Identification
- Development/Tracking and Design Progress Reporting
- Project Reviews at noted review milestone dates
- Contract Schedules (with emphasis on Schedules 1 through 7)

- MWH Proposal Design and associated Text from Section 2
- Checking and Certification (EN-67) at noted review and milestone dates
- Quality Management Standards, and
- Project File System Guidelines and Requirements per MWH standard WBS to be administered for this project using ProjectWise

Detailed discussion of the requirements for each of the Quality Management Plan elements are provided in the following sections.

6.4 Design Quality Control Plan

The first element of the MWH Quality Management Plan for design is the preparation by the Project Manager, Design Manager and Design QA/QC Manager of the Design Quality Control Plan. The Design Quality Control Plan consists of a single form EN-65. The EN-65 provides the following information consolidated in one location:

- Project description and special conditions
- Project staff and QC personnel
- Technical Review Committee Members
- Process Review Members
- Technical reviews by discipline
- Subconsultants
- Major submittal delivery dates
- Project Quality Control Schedule with identified key milestones, and
- Process Review

The form entitled Detailed Design Project Quality Control Plan (EN-65) provided in Appendix C was used in the preparation of the Design Quality Control Plan. The MWH Project Manager and Design Quality Manager are to sign the form. Updates to the Design Quality Control Plan are to be made as required by each of the three team members, reflecting the current status of the project schedule and work. A current copy of the Design Quality Control Plan is to be placed in the project files and the Project Notebook.

Changes in the project scope of work will require a review and possible update of the Design Quality Control Plan. Plan revisions may require a need to update the Quality Management budget. It is intended that the Quality Management activity budget be utilized for any Technical Review Committee activities, comprehensive design interdiscipline (for non-design services group disciplines); engineering calculation checking; QC audits, and other project-related Quality Management activities at key milestone points during the project work.

Design discipline reviews (intra-discipline reviews) are not to be considered part of the Quality Management activity budget, and are to be budgeted separately by each of the design disciplines. For construction projects, the Quality Management activities are to be separately defined on a case-by-case basis at the time the work is budgeted. As a minimum, sufficient Quality Management budget shall be provided for periodic audits of the field inspection and office engineering activities, and Quality Management support activities.

6.5 Project Notebook

Upon completion of the Design Quality Control Plan, the MWH Project Manager and Design Quality Manager prepared the Project Notebook. The Project Notebook is maintained by the Design Quality Manager throughout the duration of project design. The objectives for development and maintenance of the Project Notebook are to:

1. Provide the Design Quality Manager guidance with respect to organizing a new project effort and to identify the minimum requirements for locally (i.e. at the Design Quality Manager's desk) maintained documentation
2. Furnish project reviewers and auditors a basis to assess the current project status
3. Serve as a source of information for every member of the design team and the MWH Project Manager
4. Project Notebooks are required on all MWH projects unless an exemption is received in writing from the MWH Project Manager and the design office Business Unit Leader. In order to facilitate reviews, Design Managers are encouraged to develop and organize Project Notebook information as discussed in the following paragraphs

6.5.1 Contract Materials

Provide in the Project notebook appropriate sections of the contract which relate to design criteria and requirements, design schedule, and budgeting. Pertinent data to include in this section are:

- Project description
- Contract terms and conditions
- Design scope of services
- Summary of project design criteria
- Design budget costing back-up, and
- Project schedule or completion requirements

Contract amendments, if they occur over the duration of the design effort, should also be included with the original contract materials provided in the Project Notebook.

6.5.2 MWH Project Documents

Required documents used to setup the project in the accounting system, bill the project and track the financial status of the project are to be provided.

- ***Design work breakdown per MWH standard***
- ***Contract brief and billing summary***
- ***Discipline and Non-Discipline Project budget worksheet and calculations***

Revised budgets, schedules or critical control documents are included in the Project Notebook by the Design Manager when these documents are generated.

6.5.3 Schedule and Deliverables

An overall schedule for the project is prepared which illustrates design submittal dates, review dates and project completion dates. Depending upon the complexity and magnitude of the project, this can be presented in several different manners. The Desalination Infrastructure Project will utilize a tabulation listing of major milestones (including Quality Management activities, such as Technical Review Committee Meetings, design reviews, constructability reviews, etc.), deliverables, and the design completion date. This list provides a management tool to monitor project progress for the entire Development Period in the completion and submittal of all major deliverables. The MWH Project Manager will establish the scheduling requirements, level of detail, and scheduling method to develop the design schedule and track its progress over the course of the design effort during the Development Period. The schedule is updated when schedule dates are amended or additional tasks are added.

6.5.4 Project Organization

Include in the Project Notebook an organization chart depicting major project participants. The organizational chart includes the prime contact with CAW, MWH Project Manager, and all significant subconsultants. As a minimum, identify on the organizational chart the names and role of each design team member, and include brief summaries of roles and responsibilities for each identified team member. Support staff, Quality Management Staff should also be identified on the organization chart.

6.5.5 Communication and Coordination Plan

The Desalination Infrastructure Project will develop an important Plan related to Communication and Coordination of design and construction activities. This document is referenced here as the standard applied for these elements of the project and used by the Project Team for project communication and coordination.

6.5.6 Budget and Schedule Management

Design budget management is the responsibility of the Design Quality Manager. This responsibility begins with obtaining Design Quality Manager approval of the budget prior to commitment with the client and continues at design inception through the development of budget and schedule details. This process is intended to promote accurate tracking of cost and progress. This includes establishing the deliverables list and making assignments to project staff and subconsultants for deliverable generation. As the deliverables are being produced, the Design Quality Manager is required to track the progress of the deliverables with respect to budget expenditures and schedule. Several tools already exist within MWH that are available to assist the Design Quality Manager in communicating the status of the design budget and schedule. This includes ISBM (Integrated Schedule and Budget Monitoring) Graphs and Earned Value tabulations.

The Design Quality Manager shall include the design project numbers, work breakdown schedule (and cost codes) with individual budgets. This should include delineation by design discipline, and have the discipline lead engineer identified as PE in “options”. Include with the design project number a brief summary of the scope of work and deliverables for each job number. Sharing of these data to select project team members can be facilitated with the MWH Optimal system.

6.5.7 Quality Management Related

Included in the Project Notebook is the completed Design Quality Control Plan document completed at project inception. Prepared by the Design Quality Manager , the Plan should contain QC milestones including Technical and Process Review Meetings, workshops, project reviews and any other aspect of quality control. Meeting minutes of the Review Meetings should also be included in the Project Notebook as the meetings are conducted.

6.5.8 File System

To be established at project initiation, the project filing system should provide a list of files to be established and utilized through the duration of the design effort. The Design Quality Manager shall share this information with all design team members. In general, files are to be established in accordance with MWH's Master List and maintained in a central location with file access provided to all team members. A copy of the filing Master List is provided in

Appendix C.

6.5.9 Special Considerations

Each design and construction project is unique in its development, staffing, execution and management. The MWH Project Manager and Design Quality Manager should collaborate to identify if there are project or contract specific requirements that will negatively influence the success of the design project or impact day-to-day work efforts. If these conditions exist, then appropriate additional sections should be added to the Project Notebook alerting the project team to the special considerations. Additionally, directions, tools, techniques or guidelines addressing how to manage special project conditions should be prepared and included in the Project Notebook.

6.6 Project Staff Identification

Almost all projects are unique, and the requisite project team is composed of staff with the combined skill sets to successfully perform the project. It is the responsibility of the Design Quality Manager to develop the appropriate project design team. Once the design team has been selected, an initial Quality Management Plan responsibility for the Design Quality Manager is to establish “Project Roles and Responsibilities” for each design team participant. This information is prepared, summarized and distributed to each team member to ensure that individual roles, responsibilities and expectations are well established for the project team prior to design commencement.

6.6.1 Design Quality Manager

For every MWH project, coordination of the Quality Management Plan will be performed by a Design Quality Manager assigned by the Project Manager. The Design Quality Manager will report to the Project Manager and will evaluate the quality of design prepared by the MWH Design Team. In true continuous Quality Management fashion, this is to be a practice process, not a “wait and see” what the next submittal shows type of approach.

The Design Quality Manager’s project role is to administer and monitor the Design portion of the Quality Management Plan. This position requires the complete commitment and attention from this individual regardless of project size, complexity and detail. Primary responsibilities of this position will be to assure that MWH’s experts are available to meet the review dates defined in the Quality Management Plan; that the documentation of the review is performed as defined in the Plan; and the feedback is incorporated into the design, construction and operation of the facility. Hands-on management of the reviews, staffing, and documentation will be the primary focus of this assignment.

Identifying and assigning the staff required at all review milestones is another responsibility of the Design Quality Manager. This individual also has the responsibility for assuring that the reviews are performed as specified, documented relative to findings, and monitoring that comments are incorporated. If there is a breakdown in any of these areas, and are unanswered by the Project Manager, they shall be immediately brought to the attention of the Principle-in-Charge.

The Design Quality Manager will identify review and check staff as required for specific project design deliverables identified in the Design Quality Management Plan. These staff will be selected from offices located throughout the MWH system based upon their level of expertise and knowledge for the chosen review or checking assignment. Only experienced professional staff will be used for review and checking. Each reviewer or checker will be temporarily assigned to the Design Quality Manager during their assignment on the design project and will be responsible for completing the review or check activity per the prescribed procedures and within the schedule and budget provided to them. Each staff member will each be responsible for delivering a completed review or check and conducting a debrief with the design engineer(s) as a completion of their work effort. Each reviewer or checker shall report any major problems identified with the design to the Design Quality Manager as soon as they are discovered.

6.7 Project Work Plan Development, Tracking and Reporting

6.7.1 Design Project Management

Design Project Management requires creating a plan describing the deliverables to be prepared, available budgets, personnel assignments and the schedule for completion. These elements of deliverable production, budget, team personnel and schedule are to be communicated in a design project Work Plan, one of the major Design Quality Plan elements.

6.7.1.1 Work Plan Content

Work Plans are prepared to disseminate project data to the project team with sufficient detail to allow for accurate project understanding, progress evaluation and review. Preparation of the Work Plan is the responsibility of the Design Quality Manager and Design Implementer. Review of the design Work Plan will be conducted by MWH's Project Manager and MWH Department of Engineering. This review will be completed prior to the initiation of any detailed engineering design effort.

The primary elements to include in the project Work Plan include the work breakdown structure; deliverables list; segregation of project budgets with respect to deliverables; and coordination of project deliverables with respect to the project schedule. When completed, the Work Plan is used by the Project Manager and the Design Quality Manager as an evaluation tool allowing for prompt monitoring and evaluation of actual progress with respect to the planned progress of deliverable development and budget expenditures.

6.7.1.2 Work Breakdown Structure

If not already thoroughly familiar with the scope of services, the Design Quality Manager's initial activity is to review the contract scope of services, and on that basis, develop the Work Breakdown Structure (WBS). The WBS represents a logical ordering of the design effort into manageable tasks and subtasks that can be easily monitored and tracked. The breakdown may be prepared in terms of technical disciplines, individuals performing the work, offices involved, discrete deliverables, etc. The WBS should be large enough such that individual segments tracked are meaningful in terms of project progress; simple enough so that monitoring is not cumbersome or time consuming relative to the project's scope and magnitude.

Deliverable Listing
A list of all deliverables that will be prepared and submitted to CAW is prepared and included in the Work Plan. The planned schedule for submitting each deliverable is to be included in the Work Plan. Deliverables listed should be comprehensive, including all interim and final products. For MWH projects, deliverable submittals may correspond to internal constructability review requirements, internal progress reviews as well as CAW reviews.

Project Budgets
Using the WBS, budgets for all tasks and sub-tasks should be developed. The budgeting effort is useful in understanding the relative complexity associated with different work elements, and where the greatest effort is required. Development of a sub-task budget does not mean that a separate MWH job number will be opened and used. Budgeting is typically developed using a level of effort (hours, man-days, etc.) and converted to cost ($'s) based upon type of staff assigned. Subconsultant tasks may be based upon a lump sum quotation provided. In the budget process, include an appropriate amount of the total job cost for Quality Management activities.

Schedule

Scheduling consists of taking the tasks and sub-task of the WBS, and linking these activities across the time frame of the project effort. Start and end dates, as well as task durations should be provided. A wide variety of methods and software exist that can be used to schedule a project. The simplest form of a schedule is a tabulation listing the project notice to proceed date, major milestones (including Quality Management activities, such as Technical Review Committee Meetings, design reviews, constructability reviews, etc.), deliverables, and the design completion date. For more complex efforts and projects that are schedule critical, computer generated schedules may be appropriate. Regardless of the nature or the complexity of the project, all deliverable requirements and key milestones should be noted. Larger projects and programs typically require the expertise of a scheduler to establish and track the project schedule. The MWH Project Manager, and Design Quality Manager are to jointly establish the scheduling requirements, level of detail, and scheduling method (i.e. manual or computer based techniques) to be utilized to develop the design schedule and track progress over the course of the design effort.

Staffing

Using the budgets and schedules as a basis, a staffing plan should be developed for each project. This plan should be reviewed with the individuals who supervise the personnel resources required to execute the work effort.

6.7.1.3 Integrated Schedule and Budget Management (ISBM)

ISBM is a tool that assists the project team and Design Quality Manager in monitoring budget and schedule performance of the project. The project is separated into subtasks as created through the project WBS. Individual budgets are established with specific schedules for completion. The MWH Optimal system provides real time review of project budget and total project expenditures versus budget and also versus time. Additionally, the Optimal system allows printing of graphical performance for each job number relative to earned value, costs spent and time spent versus budget.

Reports produced by the Optimal system are to be monitored on a weekly basis by the Design Quality Manager. If there is deviation from planned budget or schedule, the specific budget task is to be examined in more detail with the responsible task team member. Mitigation planning is performed to correct any potential problems through measures including the addition or adjustments of manpower.

6.7.2 Design Progress Reporting

Design progress reviews will be performed on a monthly basis. These reviews will be conducted on Friday’s with the Design Quality Manager and the MWH Project Manager. The intent of these reviews is to evaluate the following project elements:

- Deliverable progress
- Budget status
- Work planned for the following week
- Information needs
- Staffing issues or needs
- Disputes
- Scope of service issues, and
- Issues of any other type

Notes for these weekly meetings will be recorded and placed in the Project Notebook by the Design Quality Manager. An Action Item list is to be developed and maintained by the Design Quality Manager and submitted through Lotus Notes to the project team and the MWH Project Manager for immediate attention and appropriate response.

At the end of every month, the Design Quality Manager will prepare a written progress report providing a summary of completed activities, upcoming activities, and the status of budget, schedule and scope issues. Monthly progress reports will be submitted to the MWH Project Manager and Director of Engineering.

6.8 Design Deliverable Definition and Project Reviews

An inherent part of the Design Quality Management Plan is the performance of Project Reviews. Project Reviews conducted over the course of the design effort are fundamental to project execution. These reviews serve the purpose of defining technical elements of the project; communicating the project vision to CAW; leveraging the technical expertise of the MWH organization; auditing the design effort for conformance with the Quality Management Plan and; auditing the project to independently assess project performance. The normal review meetings to be conducted during execution of the design aspect of MWH project include:

- Scoping Meetings at project initiation,
- Early Project Definition meetings which establish a shared project vision with CAW at the outset of the project
- Technical Review Committee (TRC) meetings that accesses MWH’s collective intellectual resources and past project experience
- Project Reviews (Process, Design, Mold Management, Constructability and Operations)

The Design Manager and MWH Department of Engineering is responsible for determining the frequency, attendance, content, and reporting of results for these meetings. The following sections list the types of reviews to be performed for this project.

6.8.1 Scoping Meetings

This project activity was completed during the Pursuit Phase of this project.

6.8.2 Early Project Definition Meeting

This project activity was completed during the Pursuit Phase of this project.

6.8.3 Design/Build Deliverable Definition

The Design/Build project delivery system is unique in several ways from the more usual Design/Bid/Build project delivery system. Most importantly, the Design/Build process is intended to deliver a completed facility in a compressed time frame when compared to the Design/Bid/Build delivery system. To facilitate this schedule compression, every step in the project development process must seek ways to economize the available project schedule, including the project design phase.

As such, design deliverable “completion” must be defined and identified to the project team in the terminology of Design/Build. The level of effort and degree of design development needed to achieve design “completion” is driven by the following ordered precedents:

- Contract stipulations
- Permitting requirements
- Bidding constraints, and
- MWH requirements

The Design/Build Deliverable Definition is an agenda item for the Project Kickoff Meeting. Appropriate discussion of the contract, permitting, bidding and MWH requirements will be performed to develop and document deliverable definition within project requirements. Proposed changes, modifications, or additions to the established Design/Build Deliverable Definition must be documented in the meeting minutes, and receive approval of the MWH Project Manager and Director of Engineering prior to commencing detail design activities.

6.8.4 Technical Review Committee Meetings

Scoping for this project has been completed during the Pursuit and Negotiation Phase of this project. Technical Reviews have been performed to establish the process design and facility requirements for the project.

No further Technical Review Committee meetings will be required. However, proposed changes in Design Criteria are expected to cause the TRC Team to reconvene.

6.8.5 Process Reviews

A Process Review will be conducted prior to MWH receiving Notice to Proceed on the project to confirm and validate the design prepared and utilized as the basis for MWH's response to CAW's Request for Design-Build proposals. As noted in paragraph 5.4.4 in Appendix 5, Controls shall be established to coordinate design development activities. Coordination shall include all internal and external parties involved in the design development and review process, including inter-discipline reviews, and the verification process used to ensure that changes are clearly and consistently shown on all affected Design Documents. Methods shall be incorporated to ensure that all design issues and reviewer comments are identified and tracked, until they have been addressed and incorporated into the design. Secondarily, it reviews the design criteria and approach to non-performance elements. The Process Review is performed as a separate activity on design build project where process performance requirements are part of the contract. The review offers MWH with the opportunity to identify if any undue risk is being taken, whether the design as prepared will meet the performance objectives and make any modifications to eliminate unacceptable risk.

6.8.6 Mold Management Review and Consideration During Design

The MWH Project Team is responsible for the design of a facilities envelope and its mechanical and HVAC Systems. Climate, temperature, relative humidity, facility envelope, air requirements, materials of construction and construction sequence are all elements to be considered in development of the project design.

The MWH Project Team shall evaluate the design for potential impact of moisture intrusion into the facility envelope and the subsequent development of mold infestation. These issues shall be discussed with CAW and with MWH to identify and manage those elements that may lead to a possible mold infestation during and after construction.

As the design is progressed, attention will be focused on the building envelope, windows, door, roofing system, vertical enclosures and HVAC systems to ensure that the correct systems are specified and correctly incorporated into the work. Additionally, the design of plumbing, HVAC, duct chases, tunnels and interior wall systems will be preformed considering the potential for moisture intrusion both during and after completing construction.

A project specific Mold Management Plan shall be prepared if it is determined that site conditions, selected materials of construction, and the exposure to moisture during construction will result in high probability of mold formation. This plan will be reviewed by in-house experts or outside consultants to evaluate the effectiveness of the Mold Management's Plan to minimize the risk of mold intrusion.

Mold management plans will also include those measures to be taken during construction to manage mold intrusion risk, if required.

6.8.7 Design Deliverable Reviews

Project deliverables will be concurrently reviewed by CAW and QA/QC staff. Examples of project deliverables that are to be reviewed include technical reports, design studies, testing plans, drawings and specifications.

Because these deliverables vary in scope and content, reviews to be performed will also vary in content and complexity. Based on this project the following list identifies the types of reviews to be performed:

- Studies/Report checking
- Coordination reviews
- Detailed discipline checks
- Code compliance checks
- Interdiscipline checks
- Final Reviews
- Project certification

Additional detail regarding the scope and procedure for performing these reviews and checks is provided in section 6.9.

Deliverable review and checking shall only be performed by staff thoroughly knowledgeable in the deliverables being reviewed. Review personnel shall not be directly involved in the preparation of the work product being checked.

Scheduling of the reviews and checks will be performed by the Design Quality Manager. Completion dates for deliverables will be established so that the review can be performed, comments resolved and corrections incorporated while maintaining the scheduled deliverable date to CAW.

6.8.8 Constructability and Operations Reviews

Constructability and Operations reviews will be performed on a regular basis throughout the design engineering process. These reviews will focus on identifying potential constructability and operational issues, and formulating and implementing solutions to these issues on a real-time basis.

The MWH Project Manager and Operations staff will review drawings and specification at the stages of design development indicated below. Reviews by MWH will be conducted on a schedule that will allow sufficient time for the design team to make any necessary modifications or corrections to the project deliverables prior to CAW submittal.

Constructability reviews will evaluate and address potential conflicts between the current design and planned construction methods. Several of the focus areas for this review will include the following:

- Construction sequencing
- Compatibility with construction methods and equipment capabilities
- Site layout and access
- Ability to meet performance requirements
- Temporary construction provisions, and
- Safety considerations

Constructability reviews will be performed on the design as it is developed. The Constructability Review process will be conducted as described in the following paragraph.

Constructability Review Meeting: At the 30%, 60% and 90% design review, the Project Manager, Construction Manager and Design Quality Manager will meet with representative(s) of MWH to review drawing developments from the previous iteration. When the project is prepared using BIM 3D, MWH will review the model progress and prepare written constructability input prepared on the Constructability - QA /QC Review Comments form. The purpose of the meeting will be to review the level of development and identify any obvious major constructability issues. Notes from the session will be recorded relative to action items required by the design team to modify the design or provide additional information to MWH with both parties agreeing to the action required prior to adjourning the meeting.

Operability reviews will be performed to include evaluations of the following major project considerations:

- Equipment access for removal and normal maintenance activities
- Safety considerations; ladders, confined space
- Communications and security
- Process startup and operations
- Staffing requirements
- Equipment selection and type for operability
- Vehicular access for maintenance
- Emergency operations
- Analytical equipment provided and location, and
- Other appropriate project-specific considerations

Operability reviews will occur at the 60% and 90% submittals. The format of the reviews and documentation of input for these reviews is defined as follows:

Review Format: Printed drawings will be made available to MWH and operations staff for review and input by the Design Quality Manager. A review session will be held between the design team and each party three working days following distribution of the documents to discuss comments. The meeting will record all action items to be taken by the design team with all parties agreeing to the list upon adjournment.

6.8.9 Deliverable Review Schedule

Deliverables to be prepared and their scheduled submittal dates to CAW will be established by contract. These deliverables include reports, technical scoping documents, design submittals (drawings and specifications), and project work plans.

The nature of the deliverables dictates the type of QA/QC review and checking procedures that are to be performed. Details regarding review and checking procedures are provided in section 6.9 of this Quality Management Plan. An illustration of the design deliverables, type of review and review schedules is illustrated in Table 6.8.9-1.

	PROJECT DESIGN QUALITY CONTROL SCHEDULE								REVIEW /CHECK SCHEDULE (See note 1)		
Deliverable	Studies/Reports	Coordination	Detailed Discipline	Code Compliance	Inter-Discipline	Other	Final	Certification	Initiate Review	Complete Review	Client Submittal
Initial Process Review											
Final Process Review											
Draft Communication Plan											
Draft Amended Facility Plan											
30% Design											
Protocols Draft											
Air Handling Assessment Scope											
Protective Device Scope											
Draft Maintenance of Operations Plan											
Facilities Plan Amendment											
60% Design											
Constructability Reviews											
Draft Quality Management Plan											
Draft Acceptance Test Plan											
90% Design											
100% Design to CAW											
100% Design to BLUS											

6.9 Project Deliverable Checking and Certification

Checking and review of project deliverables is the heart of the Design Quality Management Plan. As such, the Design Quality Management Plan represents the means and methods to ensure the quality of the deliverables submitted to the firm's Owners. All preliminary, draft and final deliverables are to be reviewed prior to submission to Owners. Review sessions, such as TRC's, are important tools in the Quality Management Plan, but are not a substitute for detailed checking. In addition, all review comments are to be resolved to the satisfaction of the reviewer and design team member and incorporated into the design before submitting to CAW. The integrated DB project schedule will reflect this activity.

It is MWH policy that no deliverable products be submitted to an Owner, unless the appropriate level of checking has been performed. However, due to the stringent time frame assigned for the development Period, MWH conducted concurrent reviews on the 30, 60, 90 and 100% design documents. The combined CAW and MWH review comments are then incorporated in one step into the design documents.

Project checking should only be assigned and carried out by staff thoroughly knowledgeable in the work being reviewed. Personnel should not be directly involved in the preparation of the work product being checked. The following paragraphs of this section describe the Quality Management procedures for review and checking of design deliverables.

Design checkers are assigned by the Design Quality Manager to individual aspects of the project checking. Each checker will be assigned based upon their level and area of expertise. The checkers are selected based on their lack of involvement on the project. They will be provided a review period to conduct the assigned check. Procedures used to document and record the check are identified in the subsequent individual review narratives.

6.9.1 Study and Report Checking

The Design Quality Manager is to insure that all interim and final products delivered to CAW are checked. In addition, the basis for assessments and findings are to be reviewed. This includes all calculations that are prepared. The major elements to be checked include:

- Report Outline (prior to start of text preparation)
- Design Criteria
- Construction Cost Estimates, if applicable
- Key Findings and Recommendations
- Major Strategic Decisions
- Draft and Final Reports

The checker is to obtain an advance version of the deliverable. Using a red pen, the checker is to sign and date their name of the front page. All comments are to be provided in red. The Project Manager and/or report/study author is to review and incorporate changes as appropriate. Incorporated changes are to have a red notation "yellowed" to note inclusions. Comments not included are to be circled in green, and reason for not including to also be noted in green adjacent to the red comment. The check copy is to be maintained in the QA/QC files.

6.9.2 Coordination Reviews

Coordination reviews are performed on design deliverables consisting primarily of drawings and specifications. The coordination check assures that the design deliverable is free of nuisance errors and that deliverable has been correctly assembled. Examples of coordination check elements include:

- Performance of spell-check on all specifications, drawing text and indexes
- Specification Tables of Contents that are coordinated with the specifications provided in the deliverable
- Drawing indexes that coordinate with the drawings provided in the deliverable
- North arrows correctly placed on all plan drawings
- Project coordinate systems correctly applied to the design drawings

The coordination check is to be performed by the Project Manager and Design Quality Manager before the design is presented to the QA/QC Review Team.

Prior to submitting the design deliverable to CAW, a final coordination check is to be performed, again by the Project Manager and Design Quality Manager.

6.9.3 Detailed Discipline Check

Discipline check will be performed on civil, mechanical, architectural, structural, electrical and instrumentation for all project elements. An overview type discipline check will be performed on each discipline at the 60% completion level. The overview check will include evaluation of process design and schematics, hydraulics (liquid and solid stream processes and each pumping system), operation and control concepts, architectural concepts, utilities, equipment selection and specification.

Produced from the overview check will be a list of comments and questions that will be used by the design engineer as the basis for changes, verifications or additional checking. This list will identify comments by drawing number and specification section, and the design engineer will provide a response to action items taken for each listed comment. It is the responsibility of the Design Quality Manager to review the comments and action(s) taken by the design engineer and confirm that the corrections are performed by spot checking later versions of the design drawings and specifications. It is the responsibility of each discipline lead to verify that all reviewer comments have been resolved to the satisfaction of the reviewer, and incorporated accordingly.

Detailed red/yellow checking will occur for each discipline on the 90% completion plans, specifications and engineering calculations. This check includes dimensions, elevations, coordinates, hydraulics and agreements between the plans and specifications. The reviewer highlights each correct item in yellow to indicate it has been checked. Incorrect items, additions, deletions, exceptions, revisions are marked in detail with red ink. Red marked comments are reviewed by the checker with the design engineer with the designer performing the agreed to changes and corrections.

The designer preparing the changes or corrections notes their input by marking the red comment with black pen or pencil. To complete the process, the design engineer backchecks that the corrections have been made by marking the red mark with a blue pen or pencil. Any disagreements on changes or corrections recommended by the checker are arbitrated by the Design Manager. The Design Quality Manager reviews the comments and action taken by the design engineer and confirms that the corrections are performed by spot checking later versions of the design drawings and specifications.

MWH's Project Manager will provide appropriate construction staff to perform an operability review at specifically designated design completion level drawings. They will review operability issues described previously and provide comments in a list form similar to the overview check. The comments will be reviewed with the design engineer and action will be agreed to relative to changes or corrections or additional follow-up.

6.9.4 Code Compliance Review

A code compliance review will be examined by the discipline checkers and the interdiscipline check during their corresponding checks of both the 60% and 90% design completion documents. The reviewer(s) will examine the plans, specifications and design calculations for compliance with applicable codes and requirements of the Contract.

6.9.5 Interdiscipline Check

Interdiscipline review and checking is performed for each discipline as part of the 90% design completion document review. This includes review and checking of engineering calculations, design drawings and specifications. Further detail regarding this review and checking procedure is discussed further in this document.

The interdiscipline check is performed to ensure that the details of the design disciplines are coordinated. For example, mechanical equipment power requirements for motors, valves and ancillary items such as pressure switches and solenoid valves are compared to the electrical drawing to assure the power supply is provided. The interdiscipline check is assigned to one individual who has a command of all disciplines and can trace the work of one discipline to the other looking for omissions or inconsistencies. The first interdiscipline check shall be performed at the 60% design completion level and a more detailed check performed at the 90% completion level. Recording of comments by the checker is done using the red/yellow line format described herein. Comments generated during the check are reviewed with each respective design engineer and acted upon similarly to the discipline check.

6.9.6 Final Review

The final review is conducted after the discipline and interdiscipline checks have been completed. This review is performed by the Design Quality Manager and design discipline engineers for the project. This serves as a review that all checked changes and or corrections have been included in the final documents and offers an opportunity to see that the plans and specifications integrate. Any revisions performed during the final review are listed and recorded by drawing number and specification.

Any changes made after the final review must go back to appropriate QA/QC review staff.

6.9.7 Project Certification

All required Design Quality Control Plan reviews and checks are to be documented on the Design Project Certification form (EN 79 Form) provided in Appendix C. The MWH Project Manager is to be responsible for completion of the form.

The form sign-off procedure will involve actual verification checking of the items certified as completed in the project certification form. The actual verification checking will involve randomly selected items and may not necessarily involve every item certified as complete on the form. It shall be the responsibility of the Design Quality Manager to produce copies of the items requested for verification checking.

6.10 Quality Management Standards

A variety of Quality Management Standards are available and are to be employed over the course of the design effort. The Design Quality Manager is responsible for ensuring that the appropriate Standards are made available to the design team to promote uniformity and consistency in the development of the design documents. Examples of several of the available Quality Management Standards are discussed in the following paragraphs.

Structural Design Manual
The Structural Design Manual for MWH is contained in the MWH intranet database system. This manual will be used by all structural engineers, including any subcontractor, for design standards.

Design Criteria Manual
The Design Criteria Manual for MWH is also contained in the MWH intranet database system. This manual will be used by all engineers, including any subconsultants, for design criteria standards related to the design of new facilities.

Drafting Standards
Drafting standards have been developed for all design development for the project. These standards identify design software requirements, job specific standards, directory structure, file naming conventions, line weight, drafting conventions, delivery of files, 3D file requirements, text/font resource file, base file level separation, civil composition file level separation, yard piping model file level separation, paving/grading model file level separation, electrical composition file level separation, mechanical composition file level separation, structural composition file level separation, production guide files, and excel drawing production guide files. All of this information is to be contained in the Drawing Production Guide assembled for this project. It is the responsibility of the Design Quality Manager to ensure that this guideline is prepared by the Lead Cad Designer, prior to executing production design work.

Engineering Calculation Standards
Engineering calculations are prepared by project team members for specific design components. Each sheet of calculation shows the name of the person performing the calculation, the date of the calculation and the page number. Each calculation shall clearly state the problem and the purpose of the calculation. A list of all given conditions shall be provided. A clear statement of all assumptions and constraints is also provided. Equations are to be presented in their original form followed by the calculation with units being carried throughout the calculation instead of providing a string of numbers. If equations are not common, their origin shall be noted included reference texts. Copies of catalog data including pump curves shall be provided when used in the calculations. Sketches shall be used to briefly identify the conditions of the problem. The end of the calculation shall provide a summary of findings. When computer spreadsheets are use for performing multiple calculations, a copy shall be attached to the calculation and a summary of the calculation equations and process provided.

Master Specifications
The specifications will be prepared in CSI format. A copy of the table of contents for the specifications will be provided with a designated project team member or subcontractor responsible for the preparation of the document. The CSI format will be modified for this project to delete the execution part of the specification. A sample format will be provide for all specification writers.

Design Review/Checking Procedure Checklist
A design review/checking procedure checklist is provided in the MWH Design quality Procedures website which identifies the individuals involved in each phase of checking, their area of check to be performed (discipline, interdiscipline, etc), the start and finish date of the check, and the procedures to be used for checking. The procedures shall summarize those described in this program, which include red/yellow line and follow-up review with the design engineer. The Checklist will be prepared by the Design Quality Manager.

6.11 Design Change Tracking Assessment and Approval

6.11.1 Design Change Log

Design Build projects have a high potential for generating design changes. Design changes have the potential to negatively impact the project schedule and budget, and so it is important that the Design Team communicate potential design changes to the Project Manager before the changes are incorporated into the design. For CAW's project, potential design changes will be communicated and tracked through the Design Change Log. The Design Change Log provides a forum for documenting, and a process for obtaining Project Manager and Owner approval, and further establishes an effective audit trail for all changes to the design. It is incumbent for the Design Quality Manager to track design changes that are approved to insure that approved changes are properly incorporated into the design.

Proposed changes to the design may be initiated by the Design Team, the Project Manager, and/or CAW. However, incorporating the change into the design requires Project Manager approval. All proposed changes are to be submitted initially to the Project Manager for evaluation, who may reject or have the proposed change incorporated into the Design Change Log.

The Design Change Log Manager is responsible for adding all new Design Change Log items, and updating the status of all past items, as required. New Design Change Log items are sent to the Design Change Log Manager by the Project Manager via email. The Design Change Log will be stored on ProjectWise and can be viewed as a 'read only' document; access will be provided to CAW.

All Design Change Log items are available for further evaluation by the Project Manager and the Owner. The Project Manager assigns a status to each item on the Design Change Log, as follows:

A/P = Approved/Pending
These items have been internally approved by the Project Manager for design purposes and are to be incorporated into the design. However items statused A/P are pending Owner approval.

P = Pending:
The Design Team is NOT to proceed with any changes. This Design Change Log item is currently under review

and the Design Change Log Manager will update its status as discussions continue between the Project Manager and the Owner.

A = Approved
The Project Manager and the Owner have approved of this change. The Design Team is to proceed with revising the design to incorporate the change.

D = Disapproved
These items have been rejected, and will not be incorporated into the design.

Design Change Log items are entered each Friday, and the status of past items are updated as further information is provided to the Design Change Log Manager. The status of the Change Log shall be a regular agenda item during the weekly design team conference call.

An electronic copy of the Design Change Log is provided in Appendix C of this Quality Management Plan.

6.11.2 Design Change Notices

After the design has been issued for construction and field activities have commenced, there are usually construction issues that need to be addressed by the Design Team. MWH Construction staff will generate and submit formal Requests for Information (refer to section 7.2.2 for more detail) to the Design Team, describing the nature of the issue and the potential impact(s) to the work. In many cases, the Design Team will be able to answer the RFI with a written explanation of what is to be done to resolve the particular issue at hand. There will be other times, however, when a written response to the RFI is insufficient, and the design drawings or specification will need to be modified to satisfactorily resolve the field issue. In the case when the design needs to be modified, the Design Team will revise the affected design documents and formally reissue them to the field with a Design Change Notice (DCN).

Design Change Notices issued by the Design Team will be managed and tracked by the MWH Project Engineer. Upon receipt of a DCN, the MWH Project Engineer will review the DCN for clarity and completeness with respect to the particular RFI that has generated the design change. In addition MWH shall provide CAW with a minimum of 10 days for review and comment prior to the actual change being implemented or constructed. If the DCN is determined not to satisfactorily resolve the RFI, the MWH Project Engineer will meet with the Design Team to efficiently address outstanding or incomplete items.

If the DCN is determined to be complete, the MWH Project Engineer will log the DCN into Prolog. Copies of the DCN with the revised design documents will be transmitted by the MWH Project Engineer to each subcontractor, vendor or supplier that is affected by the design change.

The Design Team is responsible for clearly denoting all changes, additions or clarifications to design documents that are modified and reissued. An appropriate method to record changes to design drawings is to cloud the area of the drawing that has been affected by the change. The drawing revision block is also to be modified to record the date, RFI and DCN number (as applicable) and drawing revision number that records the changes, prior to issuing the drawing to the field through the DCN process.

Project reports, construction specifications and similar documents should record changes generated from RFI's utilizing the red-line/strike-out method of revision tracking. The particular drawing or specification shall also carry a revision number and date in the footer of the document to record the change, prior to being reissued with the DCN.

6.12 Project File System Guidelines and Requirements

MWH will utilize the MWH Project File Master File List standard file system for all projects. As previously indicated, this Master File List is provided in Appendix C. This Master List provides an overall framework for setting up project file systems. Each project must tailor its own file system to match the specific needs of that effort, while adhering to this basic structure. Projects are required to:

- Establish a central set of files
- Set up files in accordance with the Project File Master List
- Maintain a hard copy of all materials in the central project files
- Ensure that originals are kept in the central project files – copies of specific materials can be made and kept in individual's offices for reference only

The file system can be expanded or contracted in accordance with project needs. As an example, for a small project, all correspondence may be kept in a single file folder (e.g. 3.0 General Project Communications). For a large program, the file "Section 3.1.2 – Correspondence with CAW could be expanded (e.g. 3.1.2.1, 3.1.2.2, etc) to track correspondence with different groups within the CAW's organization.

In many projects, electronic communications will be increasingly used. Many Owners use email to communicate directly with project staff. This is an efficient means, however, a hard copy record must ultimately be place into the central file of any such exchanges. Maintaining these records exclusively in an electronic format is not acceptable.

6.13 Design Project Audits

Internal and external audits will be performed at random during this project. The primary purpose of an audit is to evaluate the effectiveness of the Quality Management Plan as well as conformance with project schedules, budgets and project contract requirements.

Audit findings are discussed with the project team. These findings are used to reinforce effective practices and provide a forum for making improvements, where necessary.

6.13.1 Internal Design Audits

Internal design audits are undertaken to provide an independent review of various facets of a project's execution. The focus of internal design audit is to assess if the Project Manager and Design Quality Manager have set up the job within the framework of the Quality Management Plan, and if the project is current in terms of Quality Management activities planned versus actually undertaken. The primary mechanism to accomplish an internal design audit is to review the budget and schedule status, review how changes in scope are managed internally and with CAW, evaluate the effectiveness of checking of documents, evaluate the project filing system for completeness and overall use, and review compliance of the work prepared versus contractual scope of work. It is not intended to provide CAW with copies of the audit reports but verbal summaries can be provided if desired since the internal audits are conducted to monitor project progress and provide mitigation if it is discovered areas are not in compliance.

During the Development Period, estimates-to-complete the work is prepared monthly by the Project Manager evaluating design progress versus costs spent. During each evaluation, it is noted if the project is meeting or seeing early completion of major milestone (primarily design completions and Facility Plan Amendment) delivery dates within or under budget.

All projects should be audited at a minimum on a quarterly basis; MWH may require a more frequent interval of audit for all, or some projects, within their operation. Internal results are to be compiled on the audit form provided in Appendix C and submitted to the appropriate project or management personnel. A copy of this summary is also to be forwarded to the MWH Director of Engineering. It is the responsibility of the MWH Management to have immediate corrective action taken for any project noted as having major deficiencies. Time spent on internal design auditing should be charged to the projects Quality Management job number.

6.13.2 External Design Audits

External design audits are undertaken to provide an independent review and assessment of the current performance of the project in term of:

- Progress
- Budget
- Schedule
- Owner satisfaction
- Compliance with project and MWH requirements, and
- Overall quality

One or more auditors will conduct the external design audit. The auditors will be "independent" third parties involved in the project and optimally from other parts of the MWH operation. There are no fixed requirements as to when and which projects an external design audit will be conducted. A number of situations could be used as indicator relative to the desirability of an audit:

- Strategic project: outcome could have significant impact on the operation
- Staff changes: key personnel are transitioned from the project
- Time/money: challenging initial schedules and/or budgets
- Approach: innovative or new approaches being used
- Technology: new technologies being considered or implemented
- Subconsultants: large number of different subconsultants on project
- Management: Project Manager with record of past difficulties or a staff with limited similar experience
- Other concerns: an audit may be initiated based on other project performance concerns

The external design audit may be triggered at the request of the MWH Project Manager, Design Quality Manager, Business Unit Manager, and MWH Director of Engineering, MSS Senior Project Manager, or Chief Operations Officer. Time spent on the audit is to be charged to the project Quality Management job number.

At the conclusion of the external design audit, the audit team prepares a summary of recommended actions on the External Design Audit form provided in Appendix C. These are sent to the MWH Project Manager, Design Quality Manager, and MWH Director of Engineering. The MWH Project Manager is responsible for formally accepting or rejecting recommendations, and to report on implementation progress of accepted recommendations.

It is envisioned that external audits will be conducted semi-annually during the construction phase.

6.14 Document Release and Approval

The Engineer of Record (EOR) is responsible for providing and is authorized to make design changes necessary to complete the project components for the intended purposes. The EOR shall approve all documents issued for the construction permit(s). Any Design Changes that occur following receipt of construction permits or prior to construction of the work commencing shall be approved by the EOR through the DCN process described herein. The EOR shall approve by signing each DCN for implementation.

No DCN shall be implemented for construction without EOR approval. The EOR is not authorized to unilaterally institute changes that result in a deviation from any of the Project requirements established in the Contract unless the changes have been reviewed and approved in advance by the Owner.

6.15 Project Close-Out Guidelines

At a project's completion, Close-Out forms are to be completed in accordance with Design – EN 67. Completion in a timely and accurate manner is the responsibility of the Design Quality Manager. All project job numbers should be closed upon project completion when no further job charges should be accrued to the project. An email message should be sent to all persons involved in lead roles on the project informing them of the closure.

Completion and closing of the project files is an important step to ensuring all reference materials are readily available in the future for retrieval should they be needed. Steps to close the files include:

- Making sure all files are complete and up-to-date
- Review project staff materials to make certain all original documents have been sent to the central project files
- Contact project personnel to make certain that all electronic communications (e.g. emails) have been printed and are in the central files, and
- Collect all calculations, consolidate and label in central files. Design disciplines should retain copies of their design calculations

Remote archiving of project files should be conducted in accordance with MWH Policy.

Section 7

Construction Quality Management Plan

7 Construction Quality Management Plan

7.1 General

Integral to the MWH Project Management Plan is the construction Quality Control Program (CQCP), which describes the means of assuring that completed permanent work conforms with the contract drawings, and specifications, and/or referenced quality standards. It further describes the inspections and tests that will be performed to verify and document such conformance. This Plan is to be implemented and managed by Owais Andrabi, MWH's QA/QC Manager. It is the QA/QC Manager's primary responsibility to ensure that MWH personnel and MWH's Subcontractors and Suppliers follow the provisions of this Plan.

To establish a culture of effective quality control/assurance planning and implementation, and to enforce compliance with the MWH Quality Management Plan, MWH will work with subcontractors and suppliers to develop Inspection and Test Plans (ITP) for MWH approval in advance of initiating any fabrication or construction work. For each significant work activity associated with a particular subcontract, ITP's list the required inspections and tests and specification references, identify the parties involved, identify hold points, and identify inspection or test reports to be submitted for each significant scope item. MWH personnel will assist each supplier and subcontractor and provide the ITP form, to ensure compliance with the Plan while maintaining the project schedule. ITP's will provide the necessary advance planning and training for implementation of the quality program by MWH's personnel and its subcontractors. By implementing ITP's for each significant scope item, a high quality project will be provided in accordance with MWH Corporate policy and the requirements of the Contract. Subcontractors or Suppliers will not receive final payment until all required quality control documentation identified on the ITP's has been received.

7.1.1 Coordination with Design Team

The QA/QC Manager shall work with the MWH Project Executive and Project Manager to determine the Quality Management Plan parameters and administrative interfaces with the Design Team regarding Quality Management activities. This effective up-front planning will ensure there are no misunderstandings regarding the Quality Management requirements for the project and to develop a mutual understanding relative to the Quality Management Plan.

7.1.2 Application of the Quality Management Plan

As the ITP's are developed, they will become the basis for the Subcontractor and Supplier Quality Management Plans. The QA/QC Manager will review and comment on all submitted Plans. Payment for both off-site or on-site work will not be approved unless the quality requirements for that work have been completed in accordance with the approved ITP's. The ITP's are developed following negotiation and execution of the Subcontracts and Purchase Orders.

7.1.3 Revisions to the Quality Management Plan

Proposed revisions shall be drafted by the QA/QC Manager, and submitted to the MWH Project Manager for approval. The QA/QC Manager is responsible for the preparation, review, issuance, maintenance and revision control of the Quality Management Plan prior to implementation. The MWH Project Manager shall perform document review and approval by signing each approved revision. Approved Quality Management Plan revisions will be transmitted to the respective Quality Management Plan holders of controlled copies with a copy of the updated Table of Contents and a Transmittal form. Shadows will be placed over the revised text and the revision number and date will be indicated on the Table of Contents. Revisions will be made in response to changes in the Quality Management Plans and when the plan is found to be inadequate through implementation. The Quality Management Plan holders are responsible for incorporating the transmitted revisions into their copy of the Quality Management Plan.

7.2 Document Control

This section describes the responsibilities and requirements for the control of documents affecting quality.

7.2.1 Responsibilities

The MWH Project Manager establishes the standardized document control system for construction. The receipt and issuance of instructions, procedures and drawings, such as contract drawings and specifications, installation drawings and specifications, and fabrication drawings shall be controlled by the Design Manager, or their designee. Changes to these documents shall be controlled in the same manner.

The MWH Project Manager, or designee, will send all document holders a current list of contract drawing and specification documents whenever document revisions are issued, so they may verify the current status of their documents. The updated drawing and specification list is maintained by the Project Engineer utilizing the Prolog drawing register. Subcontractors and Suppliers are responsible for checking the list of current documents and verifying the current status of their documents.

7.2.2 Submittals and Requests for Information

Submittals provided to MWH by our subconsultants, subcontractors, suppliers or equipment vendors may take the form of shop drawings, installation instructions, brochures, samples, catalogue cuts or certifications and calculations. Submittals are to be processed in accordance with the procedures described in the following paragraphs and as illustrated on the Submittal and RFI Flowchart provided in Appendix D.

MWH will provide CAW with a submittal log for review. MWH asks that CAW identify which submittals require review by their Engineering and/or Operation/Maintenance staff. These submittals will be routed to CAW as indicated below.

MWH's Office Manager will receive submittals and log the required information Prolog and then forwarded to the MWH Project Engineer. The submittal will be reviewed for completeness, technical content and to identify any variations from the contract drawing and specification requirements. Such variations are to be identified and described in writing at the time of submittal to the Design Team. If the Project Engineers do not consider the submittal to be complete and accurate, the submittal will be rejected and returned to the subcontractor for additional information or rework. Technical support, as required, for the initial review by the Project Engineers will be obtained from the MWH Technical Review Leaders and/or the MWHA Design Manager.

If the initial review determines that the submittal is complete, the Project Engineers will forward the submittal to CAW and Design Team for review by the Technical Review Leaders and Subconsultants, as applicable.

Samples, if provided, will be transmitted with the submittal for review and approval. Each sample will be identified as to the intended use and shall be accompanied by a transmittal letter from the organization submitting the sample stating that the samples comply with the contract drawings and specifications.

All submitted manufacturer's certificates of conformance or compliance will identify the item being certified to the specification or standard it is certified to meet. Copies of certified test reports upon which the certifications are based will be attached to the submittal, as appropriate.

Certified factory test reports for materials and equipment to be provided on the project shall be reviewed against the contract specifications and referenced publications to ensure conformance. The QA/QC Manager will review the submittals to ensure compliance with the ITP, and to ensure that the test reports are complete and have been signed.

Written technical comments generated by the Design Team will be consolidated by the Technical Review Leader into a single copy of the submittal, and transmitted to the Project Engineer, who will compile comments from all reviewers, discuss the submittal status with the Responsible Person, update Prolog and complete the transmittal to the Originator. One hard copy of the reviewed submittal and transmittal is returned to the Office Manager.

Requests for Information
Requests for Information (RFI's) are formal project documents that seek additional definition, explanation or illustration of contract drawings or specifications. RFI's can be submitted to MWH by our subconsultants, subcontractors, suppliers or equipment vendors, preferably via Prolog Responses to RFIs prepared by the MWH Project Team are generally provided within ***48 hours*** of receipt **(**responses to RFI's are not vehicles that can authorize contract scope and/or time changes. Assessment, evaluation and authorization of contract scope and/or time changes are the responsibility of MWH's Construction Manager and Superintendent.

RFI's are to include the name of the organization submitting the RFI, and shall be processed in the same manner as that previously described for submittals. Refer to Appendix D for this flow chart.

Obsolete Documents
A record copy of obsolete documents will be retained by the MWH Office Manager in the Project Files. Such documents are marked "VOID" in conspicuous lettering on the face of the document.

7.3 Procurement Document Control

This section describes the responsibilities for the preparation, review and approval of procurement documents.

7.3.1 Procurement Document Control

The MWH Project Manager, or their designee will assist the Procurement Manager in the preparation of the Request for Proposal (RFP) for all permanent material and equipment to be procured directly by MWH and incorporated into the work.

Changes in the technical procurement documents shall be reviewed and approved by the MWH Project Manager and Procurement Manager prior to submitting these documents to prospective vendors.

The procurement documents shall include, as a minimum, the following:

- Scope of work

- Technical requirements
- Quality Control requirements (when required)
- Right of access into vendor facilities (when required), and
- Quality verification documentation requirements (when required)

Off-site shop inspections required by the specifications will be arranged by the QA/QC Manager, their designee, or independent testing laboratory, as determined by the QA/QC Manager.

7.4 Control of Construction Quality Management Plan Records

Quality Control records shall be compiled and maintained by the QA/QC Manager, or their designee. The records shall be logged into Prolog, filed and maintained to allow access for retrieval and review of information. Hard copy files shall be protected against deterioration and damage.

All test reports shall be signed by the person performing the test as well as the QA/QC Manager, or their designee, if witnessing the test.

Quality Management records, including inspection and test documents required by the ITPs, are logged into Prolog and will be available to the MWH Project Team for review including:

1. Latest revision of the contract drawings and specifications
2. Certificates of compliance
3. Deficiency reports
4. Trend data logs
5. Non-Compliance reports
6. Rework notices
7. Inspection check lists
8. Test reports
9. Test procedures
10. Shipping documents, and
11. Other records specified in the contract drawings and specifications

A copy of the quality records file will be maintained by MWH for at least three (3) years after acceptance of the work by CAW, whereupon they may be destroyed.

CAW will be provided electronic or hard copies of all Quality Program documentation including:

- Quality control inspection reports
- Quality control test reports
- Nonconformance reports
- Quality assurance reports
- Equipment test reports
- Material test reports
- Quality control personnel qualifications and certifications

7.5 Control of Special Processes

Special Processes to verify quality shall be performed by qualified outside inspection and testing consultants, who can provide qualified personnel using qualified procedures in accordance with specified requirements.

Special Processes that will be utilized for this project include:

- Testing of the proposed concrete mix design
- Concrete aggregate tests
- Strength of concrete field test cylinders
- Gradation and moisture density relationships of soils
- Concrete slump
- Concrete air entrainment
- Concrete temperature
- Casting of concrete test cylinder specimens
- In-place testing of concrete strength
- Compaction density testing of soils
- Pentrometer testing
- Coating thickness measurements
- Anchor bolt pull tests
- Structural bolting torque
- Non-destructive testing of welds

Implementation of Special Processes will only be allowed after review and approval of the consultant qualifications and proposed inspection/testing processes by the QA/QC Manager.

Special Processes shall be documented through written procedures and instructions. Methods that are necessary to provide the required verification that the quality of the completed work is in accordance with project specifications shall be included in the written procedures and instructions. These procedures and instructions shall be prepared with sufficient detail that will allow project personnel and tradesmen to accomplish their work without ambiguity as to the intent of the project requirements.

Procedures that are prepared to verify quality shall be based on governing local, state and federal building codes.

7.5.1 Responsibility

All Special Processes that are required to verify the quality of the work will be prepared by MWH, the subcontractor, supplier or vendor responsible by contract for the work.

The QA/QC Manager shall perform the necessary evaluation and review of the Special Process. Written approval for use of the Special Process must be received from the QA/QC Manager prior to commencing any affected work.

7.5.2 Personnel

Personnel performing Special Processes shall be qualified and certified. Qualifications and certification requirements will be specified in the Special Process procedures.

Training records or certifications validating that personnel to be used in the performance of the work are qualified shall be submitted. The Quality Management Team will confirm worker qualifications prior to the commencement of the work.

7.5.3 Procedures

Special procedures used to meet specific requirements shall be demonstrated to the satisfaction of the QA/QC Manager and the MWH Project Manager as being capable of producing measurable results and achieving the project quality requirements.

7.5.4 Subcontractors

MWH is responsible for all Special Processes performed by subcontractors. Special Processes submitted by subcontractors will be reviewed by the QA/QC Manager prior to utilization for conformance with project requirements.

7.5.5 Records

Procedures, written practices, personnel qualification/certification records, and reports, including those of subcontractors, are documented in the ITP's and shall be maintained in the project files.

7.6 Control of Measuring and Test Equipment

Measuring and test equipment will be calibrated and maintained to traceable national standards in accordance with written procedures that contain calibration frequency and duration of calibration. Where no national standards exist, the basis employed for calibration shall be documented or demonstrated. Recalibration frequencies will be made available to the QA/QC Manager upon request.

7.6.1 Responsibilities

The QA/QC Manager, or their designee, will monitor the calibration of tools and gauges furnished or used on the project. Each subcontractor/supplier is responsible to ensure only calibrated measuring and test equipment, if required, is used for acceptance tests.

7.6.2 Equipment

Typical items to be calibrated may include the following (Note this is a sample list and should be modified to reflect project-specific requirements):

- Pressure gauges
- Torque wrenches
- Meggar testers
- Survey instruments
- Nondestructive examination equipment
- Scales and balances
- Voltage and amperage meters, and
- Material testing equipment

7.7 In-Progress Testing of Work

Tests are required to demonstrate that items will perform in accordance with the requirements of the contract drawings and specifications. All test reports, including instrument calibration records, will be submitted to the QA/QC Manager and MWH Design Manager for their review.

Testing requirements are identified prior to each subcontractor starting work on the Inspection and Test Plans (ITPs) for each Subcontract (sample form provided in Appendix D). For each significant work activity, this form lists each required test or inspection, whether on or off site. For each, the specification reference, test method and acceptance criteria are listed, and the required test form or report identified for all work to be performed on the project.

7.7.1 Test Procedures

All tests shall be performed in accordance with written test procedures. In lieu of specially prepared written test procedures, appropriate sections of related documents such as ASTM standards, supplier manuals, equipment maintenance instruction, or the contract drawings and specifications which contain a written test procedure and acceptance criteria may be used. The test procedures shall include:

- Prerequisites of the test
- Instrumentation to be used
- Measuring and monitoring requirements
- Environmental considerations, and
- Acceptance criteria

The QA/QC Manager will be notified by MWH Construction Superintendents and the Subcontractors QC Representative seven (7) calendar days in advance of all functional and operational testing and for specific materials tests. Daily production testing will be conducted per the specification requirements based on the scheduled construction activity. The QA/QC Manager will be notified at least 24 hours prior to production testing. Inspection and testing requests are to be submitted to the QA/QC Manager on the Inspection Test Request form provided in Appendix D.

7.7.2 Test Review and Acceptance

The test results will be reviewed and accepted by the QA/QC Manager and the Design Manager, or their designee, to assure the test requirements have been satisfied.

7.7.3 Test Records

All tests will be documented. The test records shall include the following:

- Items tested
- Date of test
- Test conductor or data recorder
- Acceptance criteria
- Type of observation
- Results and acceptability
- Action taken in connection with any deviation noted
- Signature, affiliation and title of person evaluating test results, and

- Location of test

The QA/QC Manager, or their designee, will witness and document all tests performed by MWH or its subcontractors to demonstrate that items will perform in accordance with the requirements of the contract drawings and specifications.

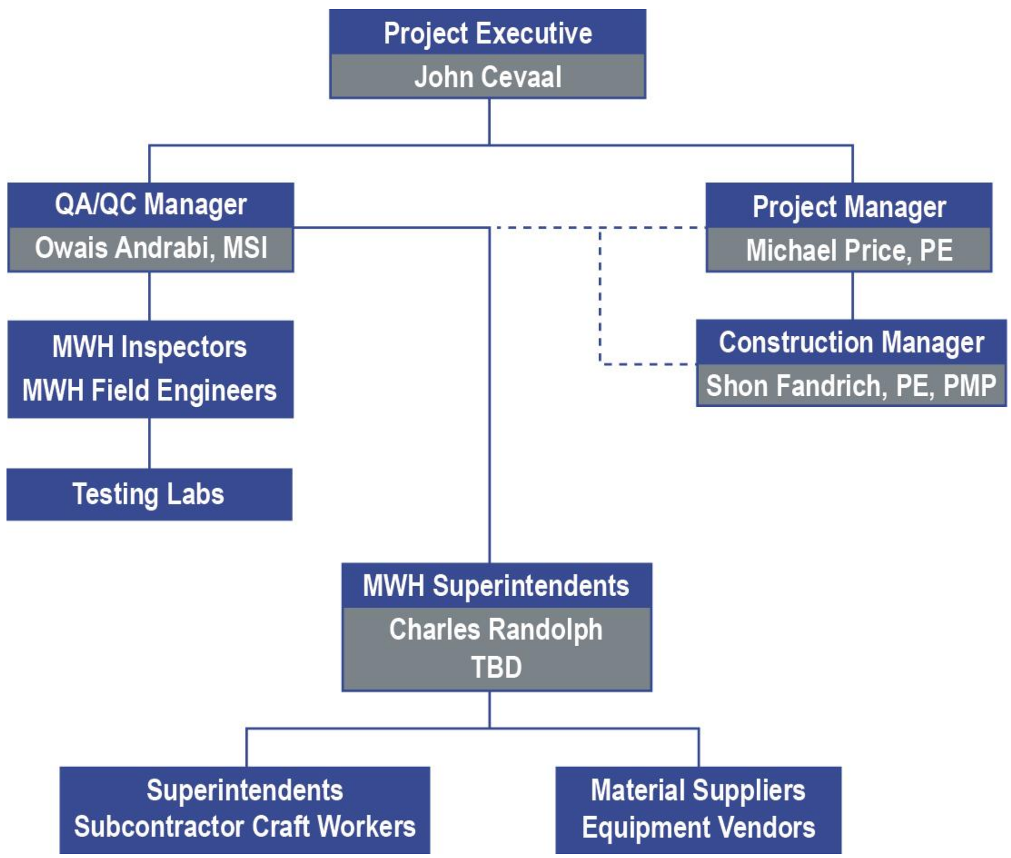
7.7.4 Material Testing Laboratories

The services of an approved commercial testing laboratory will be used to perform the required material tests and nondestructive examinations. The laboratory shall have a copy of each test and/or examination procedure and shall have facilities, qualified personnel and calibrated test equipment to perform the tests and examinations.

7.8 Inspections

QA/QC Inspections will be performed by the Construction Phase Quality Management Team. This Team, illustrated on the following organizational chart, is composed of personnel from MWH, our subcontractors, equipment vendors and material suppliers.

Quality Management Reporting Structure
Construction Phase



MWH construction management and Superintendents are responsible for building quality into this project. For the Desalination Infrastructure Project, MWH will utilize our own forces and subcontractors to perform the construction work. Quality requirements specified by CAW are conferred to our subcontractors through our Subcontract agreements. Through this subcontracting arrangement, quality becomes the responsibility of every employee working on the project, with Subcontractors and Suppliers responsible for quality control, and MWH responsible for quality assurance.

The MWH Construction Manager and Superintendents are responsible for making sure that our subcontractors deliver quality in the completed work. This means that MWH must regularly communicate the project quality goals to all subcontractors. These goals have been identified in section 1.2 of this Quality Management Plan. Additionally, the requirements specified in the design drawings and specifications that establish the criteria for quality must also be communicated to our subcontractors. In the unlikely event that our subcontractors fail to meet established quality criteria, MWH Construction Managers and Superintendents are responsible for motivating the subcontractor to correct substandard work.

As illustrated on the organizational chart, MWH Construction Managers and Superintendents are supported by MWH's QA/QC Manager and Inspection and Field Engineering staff. Although the QA/QC Manager and staff are on a separate branch of the organizational chart, it is mandatory that the communication between all members of the Construction Phase Quality Management Team occur on a daily basis.

The following lists provide examples of several of the major tasks to be performed by the QA/QC Manager and staff.

- Assist with pre-work planning and phasing, focusing on those activities that assure quality work is being constructed
- Organize and schedule QC Inspections and Tests to prevent impacts to work progress
- Generate and manage QC documents that validate the quality level of the work being performed.
- Inspect in-progress work to accurately identify deficient quality and work cooperatively to develop solutions for deficiency correction.

The previous list names many of the major Construction QA/QC tasks to be performed. However, the Inspection Performance narrative in the following section provides further detail on the daily activities to be performed by the Construction Quality Management Team.

7.8.1 Inspection Performance

Regular inspections of in-progress work will be performed by the Construction Quality Management Team. These inspections will follow a four-point inspection play described in articles 7.8.1.1 through 7.8.1.4 below.

The four point inspection plan will be initiated by the QA/QC Manager or their designee for each definable feature of work. It is the goal of these inspections and tests to verify and document that quality requirements have been met in the completed work.

7.8.1.1 Preparatory Inspection

Preparatory inspection(s) will be performed by the QA/QC Manager, or their designee, accompanied by the MWH Superintendent and Subcontractor Supervisor responsible for the work being inspected. Preparatory inspections are arranged as requested by our subcontractors. The preparatory inspection will include:

- Review of contract requirements
- Review and approval of shop drawings, layout drawings and other submittal data
- Check to assure that required quality control testing will be provided
- Physical examination to assure that all materials and equipment conform to approved shop drawings and submittal data
- Check to assure that all required preliminary work has been completed
- Identify preparatory steps dependent upon the particular operation, and
- Inspection and testing requirements

7.8.1.2 Initial Inspection(s)

Initial inspection(s) will be performed by the QA/QC Manager, or their designee, accompanied by the MWH Superintendent and Subcontractor Supervisor responsible for the work being inspected. Subcontract Supervisors will submit this request on the Inspection Test Request form, as provided in the appendix. The initial inspection will include:

- Performance of scheduled inspection or tests
- Examination of the quality of workmanship
- Review of test results for compliance with contract requirements, and
- Review of omissions or dimensional errors

7.8.1.3 Follow-Up Inspections

Follow-up inspections and tests will be performed by the QA/QC Manager, or their designee, as the work progresses to assure the continuing conformance of the work to workmanship standards established during the preparatory and initial inspections.

7.8.1.4 Pre-Placement Inspections

Pre-placement inspections shall be performed by the QA/QC Manager, or their designee. The purpose of pre-placement inspections is to ensure that subsequent construction is not impacted by mistakes or omissions in the current work. An example of a pre-placement inspection would be validation by the Quality Management Team that concrete forms are correctly placed and that embedded items like anchor bolts, ducting, piping, and conduit are properly located prior to concrete placement. Any items known to be deficient or nonconforming that would adversely affect further work upon, or integral to, the item or segment of work under inspection shall be corrected as described in Section 7.10. A Deficiency List generated from individual Deficiency Reports will be issued to the respective MWH Superintendent and Subcontractor Supervisor of the work for correction, rework or replacement of deficient or nonconforming items.

7.8.1.5 Project-Specific Inspections

In addition to the above four-phase inspections, certain special inspections and documentation inspections will be performed by the QA/QC Manager, or certified Special Inspection Agency, as described in the contract technical specifications. ***These inspections include the following:***

- Special Inspection for reinforced concrete
- Special Inspection for reinforced masonry?
- Special Inspection for stone column installations (a detailed design submittal will be provided to CAW Building Official)
- Special Inspection for structural fill
- Special Inspection for Seismic Resistance
- In place density testing will be performed for pipe bedding materials, pipe zone materials, and trench zone materials in accordance with the specifications. All test reports will be maintained in the project files.

Forms for Special Inspections will be provided by a certified Special Inspection Agency.

Documentation Inspections include:

- Factory test certifications for mechanical equipment including pumps, motors, valves, grit equipment.
- Manufacturer certifications
- Welder qualifications

Inspections will also be performed by Monterey County in accordance with several building permits issued for this project. These inspections include the following:

- Erosion Control
- Building Footings
- Building Foundation walls
- Plumbing/Mechanical
- HVAC & Exhaust
- Gas Piping
- Sanitary Sewer
- Sanitary Drains
- Electrical

During the acceptance inspection, the QA/QC Manager, or their designee, and the MWH Project Manager will prepare a final project Punch List of deficient items discovered during final acceptance inspection. The Project Punch List form, provided in Appendix D, will be transmitted to the respective supervisor of the work for estimated dates of completion for the correction of any deficient items. Upon completion of the listed deficiencies, the QA/QC Manager will submit a certification to the MWH Project Manager stating that all work, except as specifically noted, is complete and in accordance with the contract plans and specifications.

The QA/QC Manager, or their designee, will ensure that all Inspection Testing Requests and Inspection Reports required by the approved Inspection and Test Plans are maintained in the project files.

7.8.2 Qualification of Inspection and Test Personnel

Prior to the assignment or designation of personnel to the Quality Management function, the QA/QC Manager will evaluate the candidate's experience to assure the individual is capable of performing the assigned or designated Quality Management function.

Personnel assigned or designated by the QA/QC Manager to perform inspections and testing functions will be informed of the technical objectives of the respective contract drawings and specifications, the requirements of the applicable Codes and standards, and the inspection and testing elements that are to be employed.

7.8.3 Inspection and Quality Management Reporting

Quality Management Team Members responsible for inspection of the work will communicate their activities and observations to the QA/QC Manager on a daily basis. This information is compiled by the QA/QC Manager into the Prolog Daily Quality Report prior to the end of each workday. The QA/QC Manager ensures that daily field inspection activities are being documented in a complete manner.

The QA/QC Manager is responsible for preparing the summary of Quality Management activities data regarding construction deficiencies, non-conformances, corrective and preventive actions to be incorporated into the MWH and

Client Monthly Reports prepared by the Project Manager. Internal and external audit results, if performed that month, will also be incorporated into this report.

7.9 Special Inspections

Special Inspections will be performed in accordance with the Contract and *2013 International Building Code (IBC)*. Such Inspections will be performed by certified inspectors provided by an independent Special Inspection Agency certified by the *California Association of Building Officials (CABO)* as well as the *American Association for Laboratory Accreditation* . Work areas where Special Inspections will be performed are listed in Section 7.8.1.5.

7.10 Quality Assurance for Seismic Resistance

The design criteria for the Desalination Infrastructure Project are in accordance with the *2003 International Building Code* (IBC). Seismic loading design is in accordance with Design Category D, Site Class F, Use Group II. The MWH Quality Assurance program for seismic systems complies with section 1705.2 of the IBC.

The quality of seismic force resisting systems installed in accordance with the Contract documents will be assured as described below:

7.10.1 Special Inspection for Seismic Resistance

Special inspection for seismic resistance will be performed in accordance with IBC-03 1707. The type and frequency of special inspections is listed below:

- Reinforced masonry:
  - Continuous special inspection will be performed during grout placement and specimen preparations
  - Periodic special inspection will be performed during masonry construction
  - Periodic special inspection will be performed at metal roof deck connections at wall pockets

- Reinforced concrete:
  - Continuous special inspection for embedded anchors
  - Continuous special inspection during concrete placement
  - Periodic special inspection for reinforcing steel installation
  - Periodic special inspection at metal roof deck connections at wall pockets

- Mechanical components:
  - Periodic special inspection during the installation and anchoring of smaller diameter piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units
  - Periodic special inspection during the installation and anchoring of reciprocating and rotating-type machinery
  - Periodic special inspection during the installation and anchoring of piping systems three inches in diameter and larger
  - Periodic special inspection during the installation and anchoring of tanks
  - Periodic special inspection during the installation and anchoring of heat exchangers
  - Periodic special inspection during the installation and anchoring of pressure vessels.

- Electrical components:
  - Periodic special inspection during the installation and anchoring of electrical motors
  - Periodic special inspection during the installation and anchoring of transformers
  - Periodic special inspection during the installation and anchoring of switchgear unit substations
  - Periodic special inspection during the installation and anchoring of motor control centers.

- Steel Construction:
  - Periodic special inspection for welded connections
  - Periodic special inspection for bolted connections

7.10.2 Structural Materials and Equipment Testing for Seismic Resistance

Structural testing for seismic resistance by material and equipment manufacturers will be in accordance with IBC-03 1708. Manufacturers will be asked to provide certificates of compliance for the following:

- Reinforced masonry
- Reinforcing steel
- Structural Steel
- Mechanical equipment
- Electrical equipment

7.10.3 Structural Observations

Structural observations will be performed in accordance with IBC-03 1709. Structural observations will be conducted during the following construction activities:

- Reinforced concrete construction
- Reinforced masonry construction
- Installation of metal roof deck systems
- Structural steel erection

MWH and its Special Inspection Agency shall report any deficiencies in accordance with our 'Control of Deficient and Nonconforming Items' procedures. Copies of the resulting Notices of Non Conformance are provided to the Client and Building Official. During construction and upon Substantial Completion of Contract work, documentation of completed structural inspections will be available for review by the Client and Building Official.

7.11 Control of Deficient and Nonconforming Items

All work performed for this project will be inspected by the MWH Construction Quality Management Team. Any work, which is believed to be deficient, and which has not been brought into compliance with the contract requirements, procurement requirements and referenced quality standards, shall be identified and corrected. The following paragraphs describe the process for recording, tracking and correcting deficient work. The flowchart, "Quality Management Deficiency Observation and Correction Process" (see Appendix D) illustrates the process to be used in this operating procedure.

7.11.1 Responsibilities

Responsibility for the identification and reporting of deficient or noncompliant work will usually be the responsibility of the MWH Construction Quality Management Team. However, MWH Construction Operations and Engineering staff, CAW, or other project stakeholders can also identify and report deficient or noncompliant work to the MWH Construction Quality Management Team.

The QA/QC Manager has the authority and responsibility to direct the removal and replacement of any deficient or defective work and has the authorization and responsibility for initiating Notice of Noncompliance Reports (NNC) when deficient work is not corrected to the requirements of the contract documents. In this capacity, the QA/QC Manager will work closely with the Construction Quality Management Team to develop appropriate Actionable Options and to monitor the subcontractor's compliance efforts as noted on the NNC.

In the event that the subcontractor fails to implement the corrective measures described in the NNC, the Construction Quality Management Team will develop a Subcontractor Quality Correction Plan. The Site QA/QC Manager will interface at a contractual level with the Project Manager and Subcontractor to arrange the remedial work necessary to correct the deficiency.

The QA/QC Manager is also responsible for recording all quality-related issues that are experienced on the project. The QA/QC Manager will evaluate the collected data and identify project specific trends that can impact the overall level of project quality. These records will also be evaluated to assist in the formulation of recommendations to be incorporated into NNC's and any Subcontractor Quality Corrections Plans that may need to be generated. Additionally, quality trend data will be used by the QA/QC Manager to evaluate the need to implement project specific Preventive Actions so that improper work practices are corrected before project quality becomes impacted.

7.11.2 Deficient Work

Work performed on the project that is determined not to be in accordance with contract requirements will be regarded as deficient. Deficient work may be caused by a variety of reasons including the use of improper materials, lines and grades of finished surfaces that are outside the limits established by specification, insufficient compaction of foundation subgrade material, or poor construction means and methods, etc. Regardless of the source or cause of the deficient work, MWH Construction Quality Management Team Members are to document the deficient work on the Project Deficiency Report form and on the Project Deficiency Log. Copies of these forms, which are provided in ProLog, record pertinent information regarding the deficient work.

Processing of the Project Deficiency Report is indicated on the flowchart provided in Appendix D. After generating the Deficiency Report, the QA/QC Manager will submit the report to the MWH Superintendent responsible for supervising the subcontractor performing the work. The MWH Superintendent will seek correction of the deficiency through direct communication with the subcontractor's superintendent. If the deficient work is corrected to the satisfaction of MWH's Superintendent and QA/QC Manager, the appropriate documentation will be provided on the Deficiency Report and the report will be closed.

7.11.3 Noncompliant Work and Corrective Actions

Deficient work, which is not corrected by the subcontractor to specified contract requirements, is considered to be Noncompliant work. Noncompliances are considered to be significant if the noncompliant item(s) could invalidate the results of the work at hand, affect the final quality of work, or be detrimental to the safety of personnel or the general public. The Quality Management Team is required to take appropriate measures to document the Noncompliance and pursue appropriate corrective actions.

When deficient work is not corrected by the subcontractor at the request of the MWH Superintendent, the QA/QC Manager will initiate a meeting with the Construction Quality Management Team. Prior to convening the meeting, the MWH QA/QC Manager will prepare a Notice of Noncompliance (NNC) Report. The NNC Report identifies the deficient work that is to be corrected by the subcontractor. Additionally, the NNC report will reference the particular contract document(s) (drawings, specifications, etc.) that provide the benchmark for determining the as-constructed work as deficient and noncompliant.

The focus of the meeting will be to develop Actionable Options that will result in correction of the deficiency. At this time, and depending on the particular circumstances, the QA/QC Manager may elect to issue a Stop Work Notice to the subcontractor as an immediate Actionable Option. Additional Actionable Options are developed as the circumstances warrant and based on collective input received by the MWH QA/QC Manager from the MWH Superintendent, Construction Manager and other members of the Construction Quality Management Team.

After evaluation of the Actionable Options, agreement shall be reached among the members of the Construction Quality Management Team as to the probable cause, disposition, and recommended corrective action in order to prevent the possibility of a recurrence of this type of deficiency. The Deficiency Report and the NNC Report summarize the likely cause of the deficient work, and describe probable impacts that the deficient work will have on subsequent work activities if not corrected. The NNC Report also recommends corrective actions to be taken by the subcontractor to correct the deficient work and establishes a completion date for correcting the deficiency.

The completed NNC Report is to be submitted to the subcontractor. The Trend Log, discussed further in Section 7.12, shall be updated by the QA/QC Manager with pertinent information from the NNC Report.

After the NNC Report has been issued to the subcontractor, it is expected that the work will be corrected to the requirements of the contract documents. The QA/QC Manager or its designee will monitor the subcontractor’s actions. When the subcontractor corrects the deficient and nonconforming work in accordance with contract requirements, the QA/QC Manager will then record the results into the NNC Report, and update the original Deficiency Report and Trend Log.

7.11.4 Subcontractor Quality Correction Plan

Subcontractors may fail to act on the NNC Report and make the necessary corrections to their deficient work in a manner that meets contract requirements. In these circumstances, the QA/QC Manager shall convene a meeting with the Construction Quality Management Team to generate a Subcontractor Quality Correction Plan.

The Subcontractor Quality Correction Plan (Plan) identifies the uncorrected, deficient work. The Plan also summarizes prior steps taken by the Construction Quality Management Team to seek subcontractor correction of the deficiencies and documents the subcontractor’s efforts, if any, to achieve compliance with contract requirements. The Plan will also report actual or probable impacts (cost, schedule, etc.) that the project will experience in the event that the deficient work is not corrected.

These factors will be used by the Construction Quality Management Team to establish potential quality correction alternatives that will result in either subcontractor correction of the deficient work or correction by some other means. Examples of potential correction alternatives that may be considered by the Construction Quality Management Team include work reassignment, subcontract termination, or withholding payment for the defective work.

After developing and evaluating these alternatives, the Construction Quality Management Team will make a recommendation on which alternative is in the best interest of the project and will incorporate that recommendation into the Subcontractor Quality Correction Plan. The form for this Plan can be found in Appendix D. The QA/QC Manager will take final action based on the Subcontractor Quality Management Plan.

Action taken by the MWH QA/QC Manager will be recorded in the Trend Log.

7.11.5 Preventive Actions

Action taken to prevent or reduce the likelihood of future occurrences of deficient or non-compliant work are considered preventive actions. Examples of preventive actions are procedure clarifications, enhanced quality control monitoring, and refined work procedures or replacement or reassignment of personnel or subcontracting organizations.

All members of the project team, including MWH subcontractors and suppliers, may submit suggestion for quality improvements in the constructed work. It is in the best interest of the MWH project team to evaluate and improve means and methods, products or work processes resulting in improvement to the overall quality of the project. Suggestions for improvement could encompass redesigning systems that are not readily constructable as designed, clarifying conflicting instructions, selecting alternate sources of materials, or modifying the means and methods used to perform specific aspects of the work.

Preventive action measures will be taken by the MWH Quality Management Team to reduce the likelihood of future deficient or non-compliant work. Preventive measures shall be developed based on understanding the root causes behind previous deficient or non-compliant work. Preventive measures will be developed that are suitable and appropriate to the gravity of the deficient or non-compliant work and will also be realistic and achievable. Instruction for preventive actions will be developed by the MWH Quality Management Team and documented on the Lessons Learned (LSL) form provided in Appendix D.

Preventive actions may consist of specific instructions, memoranda distributed to the project team, training sessions. Project meetings may be convened to discuss preventive actions to be utilized by the project team.

After all required preventive actions are completed to the satisfaction of the MWH QA/QC Manager, the LSL form will be signed off and the Trend Log will be updated.

7.12 Quality Management Deficiency Trending

7.12.1 General

Construction quality requirements are communicated between the design and construction teams through the information contained in the contract drawings and specifications. Contractual requirements place additional conditions on the construction team, which requires active management to ensure contract conformance. If a contractor or subcontractor can meet all the contract document requirements, the quality of the constructed project can generally be assured to meet the design intent as well as the industry accepted quality standards.

However, there are many factors that can adversely impact quality of the delivered project. A few examples of these factors include unanticipated poor site weather conditions, shortages of qualified craft labor, and poor construction means and methods. If these circumstances are not properly managed by the subcontractor, the end result often-times is deficient work quality. Regardless of the circumstances, the subcontractor is obligated by contract to correct the deficient work.

Quality Management Deficiency Trending is performed on this project to provide the MWH Project Manager and Quality Management Team with an overall awareness of the factor or factors that are adversely impacting project quality. Recognizing the factors that are affecting project quality is invaluable to the MWH Quality Management Team as they develop recommendations to be presented in project NNC Reports, Subcontractor Quality Correction Plans and Lessons Learned.

7.12.2 Responsibility

MWH's QA/QC Manager is responsible for capturing, recording and reporting quality trend data.

7.12.3 Procedure

Data to be used in evaluating project quality trends will be assembled and organized by the MWH QA/QC Manager. Collected data is taken from the following source documents that are prepared by the MWH Quality Management Team as part of their normal job duties:

- Deficiency Reports
- Notice of Noncompliance Reports
- Subcontractor Quality Correction Plans
- Lessons Learned Reports

The Deficiency and Trending flow chart discussed in Section 7.11 provides an illustration of two processes that are utilized by the MWH Quality Management Team in the performance of their daily project responsibilities. Illustrated on the upper two-thirds of the flow chart is the Quality Management Deficiency Observation and Correction Process, which is discussed in Section 7.11. On the lower third of the flowchart is the Quality Management Deficiency Trending Process. The horizontal dotted line separating the two processes depicts the interface between Quality Management deficiency data generation and Quality Management deficiency data organization.

Quality Trend Data is assembled from the reports presented in the previous bullet list. The QA/QC Manager will gather three primary categories of quality data captured through Quality Management Report Development. The data categories and the specific data to be captured are listed below:

Deficiencies
- Deficiency Report number, initiation and closure dates
- Subcontractor
- Trend Item associated with each deficiency report
- Summary description of deficiency
- Deficiency source key
- Deficiency correction date

Corrective Measures
- Stop work order number and data, as applicable
- Notice of Noncompliance Report number, initiation and closure dates
- Subcontractor Quality Compliance Plan number, initiation and closure date

These data are to be entered into the Trend Data Log. The Trend Data Log (see Appendix D) is composed of an Excel spreadsheet that allows the data to be organized, grouped and presented in the following graphs:

- Targeted and Actual Direct Quality Project Cost vs. Time
- Monthly Deficiency by Source Key
- Monthly and Cumulative Deficiencies
- Cumulative Quality Reports Issued (i.e. Deficiency, Noncompliance, Stop Work, Subcontractor Quality Compliance and Preventive Action)

The MWH QA/QC Manager, or their designee, will be responsible for updating the Trend Data Log for each quality report generated and issued on the project. The MWH QA/QC Manager is also responsible for maintaining the Trend Data Log in an up-to-date manner. This is to ensure that Trend Data accessed and utilized by the MWH Quality Management Team in preparing Actionable Options for or recommendations for Notice if Noncompliance Reports and Subcontractor Quality Correction Plans consider all available project Quality Management information.

7.12.4 Reporting

The Trend Data Log and graphs will be produced as needed to support normal MWH Quality Management Team activities and the needs of the MWH Project Executive, Construction Manager, Superintendents and Construction Engineers. These documents will also be produced and copied to the master project files on at least a monthly basis. The MWH QA/QC Manager has responsibility for ensuring this information is properly maintained in the project files.

7.13 Subcontracted Work

This section describes the responsibilities for the monitoring and execution of quality control requirements by subcontractors.

7.13.1 Responsibilities

The MWH Project Executive is responsible for assuring that requirements for the subcontractor to execute quality control requirements as described in this Plan are included in the subcontract agreement.

The QA/QC Manager, or their designee, will monitor all work performed by the subcontractor(s) to assure conformance of the work to the contract drawings and specifications.

The subcontractor is responsible for the quality of the work performed by their work force on this project as well as the quality of the materials, equipment and supplies furnished by them to be incorporated into the work.

The subcontractor will designate a Quality Management Representative who will have the authority and responsibility to accept or reject items of work for the subcontractor. The subcontractor's Quality Management Representative will coordinate with the MWH QA/QC Manager, or their designee, for required inspections and tests.

7.13.2 Records

In accordance with section 7.7, the MWH QA/QC Manager, or their designee, will ensure that all subcontractor Inspection/Testing Requests and Inspection Reports are maintained in the project files.

7.14 Handling, Storage And Shipping

Materials and equipment that are handled, stored or shipped by MWH and its subcontractors and suppliers prior to and during installation will be handled, stored, and maintained according to the requirements of the manufacturer or supplier and project specifications. Materials and equipment purchased directly by MWH will be transferred to the installing subcontractor, who will assume responsibility for proper storage and handling of these materials or equipment.

7.14.1 Procedures and Instructions

Special handling instructions, when required, will be developed by the QA/QC Manager or designee to provide sufficient control to prevent damage or loss and to minimize deterioration and shall be in accordance with applicable Codes, standards and the contract specifications. These special handling instructions will be reviewed and approved by the QA/QC Manager.

7.14.2 Responsibilities

The QA/QC Manager, or their designee, shall:

- Verify that receiving and receiving-inspection documentation is complete and that the material and equipment is properly marked and tagged
- Verify that special storage requirements are implemented as required by the special storage directions contained in the contract specifications, and
- Verify that hazardous and flammable materials are stored in a segregated storage area and that warning signs are installed
- Assure that special handling instructions, proper storage of equipment and supplies and maintenance (both long & short term) are correctly addressed and adhered to

7.14.3 Handling

Special handling tools and equipment will be used to ensure safe and adequate handling. MWH and their subcontractors will be responsible for adequate maintenance of tools and equipment used.

7.14.4 Storage and Preventative Maintenance

The QA/QC Manager, or their designee, shall verify that approved material and equipment storage procedures are implemented as required by the manufacturer, and that any maintenance records are kept up to date for storage maintenance.

During the term of storage and preventative maintenance of equipment, the QA/QC Manager, or designee, will verify, through a periodic inspection of the material and equipment and the maintenance records, that the proper preventative maintenance activities have been performed and recorded. The QA/QC Manager, or their designee, is responsible for the preventative maintenance activities.

7.14.5 Shipping

Items prepared for shipping will be adequately protected from deterioration during shipping. Items requiring special environments or special controls will be identified by marking or labeling. Items shipped by our subcontractors and suppliers to or from the job site shall be identified with the contract number, purchase order number and shall be accompanied, when required, with the quality verification documentation relating to the respective item.

7.14.6 Records

Documentation of the receipt and physical condition of all materials delivered to the job site is to be performed by the QA/QC Manager or their designee. All items received will be inspected for their physical condition as well as the quantity actually received. The results of this inspection are to be recorded and logged into Prolog.

Any deficiencies, damage or special circumstances regarding the condition of received items are to be recorded on the form and communicated immediately to the QA/QC Manager for disposition and resolution.

7.15 Mold Management During Construction

MWH has responsibility for managing the risk of mold growth during Pre-job, Construction and Post-Construction Project Phases. The key to reducing the opportunity for mold growth is to eliminate moisture from entering the envelope of the constructed facility during each of these three phases.

CAW and MWH design and construction staff must work together during the design phase to develop appropriate details, incorporate suitable materials and specify installation requirements that will create a moisture free facility envelope. As important as these design activities may be, it is equally important to consider the sequencing of construction work activities to eliminate the potential of exposing building materials to moisture intrusion during the Pre-job, Construction and Post-Construction Phases.

Design development by the MWH Project Team will evaluate the risk of mold growth during the three phases of project construction. This evaluation may result in the need to develop a project specific Mold Management Plan. This Plan will guide both the Design Team and the MWH Construction Team with respect to the design and construction practices to be employed in developing the project so that the risks for mold growth is minimized. The MWH Project Team shall provide input into all project-specific Mold Management Plans and will have a primary role in carrying out the protocols established in the Mold Management Plan. Examples of the MWH Project Team responsibilities during the three major construction phases are provided below.

Pre-Construction Phase

- Perform training and education of the construction staff in the importance of preventing mold growth.
- Create and execute a project schedule that allows for the facility envelope to be completed prior to installing interior finishes.
- Consideration shall be given to the delivery schedule for materials and their protection during on-site storage.
- Receipt and inspection of materials delivered to the jobsite will specifically be inspected for pre-existing mold contamination and moisture damage before storing or directly incorporating to the on-going work activities.

Construction Phase

- Make sure that all interior materials are scheduled for delivery after the facility envelope has been sealed to minimize storage time prior to use.
- Thoroughly inspect all materials received for interior installation for the presence of pre-existing mold contamination.
- Maintain storage of interior materials off of the ground and away from potential sources of moisture.
- For all water systems, inspect and pressure test all sections to ensure that there are no leaks.
- Provide thorough inspection and leak test of all facility penetrations (doors, piping, ventilation and exhaust ducts, windows, and roof membranes). This is to ensure that proper sealing materials have been utilized in constructing the seal.
- Positive drainage is provided for all facility roof drains.
- Grading has been performed to ensure that a positive drainage slope has been established.
- Critical installations have been monitored during construction and a photographic record developed for documentation purposes.

Post Construction Phase

- Have manufacturer's inspect the installation of mold susceptible materials to certify their installation for warranty purposes.
- After construction is completed, monitor the installed systems for plumbing and piping leaks.
- Brief the facility owners on the proper operation and maintenance of HVAC systems.
- Adjust landscape watering systems to ensure that building foundations are not saturated with excessive moisture.
- Re-inspect building penetrations to ensure proper sealing is still in-place.
- Educate the owner with regard to their responsibilities to prevent mold growth.

While these lists serve as examples, it will be the MWH Quality Management Team responsibility for implementing and maintaining these measures/practices during construction. The MWH QA/QC Manager will have the same responsibility to the MWH Project Manager for ensuring that all subcontractors incorporate these practices and the requirements of the Mold Management Plan into their overall project-specific Quality Management Plan.

7.16 Control of Purchased Items and Services

Items and services furnished by MWH and its subcontractors will be subject to the following procedures to assure conformance with the requirements of the contract drawings and specifications.

7.16.1 Source Evaluation and Selection

The selection by MWH of potential suppliers of purchased items shall be made by the MWH Procurement Manager during the bid proposal preparation phase. The MWH Project Procurement Manager will verify that potential suppliers meet the contract requirements and will arrange for Owner review prior to issuance of Request for Proposals if an alternate product is proposed.

7.16.2 Receipt Inspection

All permanent materials, equipment or supplies furnished by MWH and delivered to the project site will be subject to receipt inspection by the QA/QC Manager or their designee. Each MWH subcontractor is responsible for receipt inspection of all permanent materials and equipment or supplies furnished by them and delivered to the project site.

Off the shelf stock items such as, but not limited to, structural steel, pipe and fittings, conduit, circuit breakers, bolts, nuts, etc., will be identified by the respective quality level, i.e., ASTM-A-36, ASTM-A-53 and others as specified in the contract documents.

Items which are found to be in Non-Compliance with the above requirements will be identified, recorded on the Notice of Non-Compliance (NNC) Report (see Section 7.10) and segregated, when possible, from accepted materials, equipment and supplies. They will not be incorporated into the work until corrective action acceptable to the QA/QC Manager and the MWH Project Manager has been completed. Items determined unsalvageable will be removed from the jobsite.

7.16.3 Equipment Field Services, Certifications and Operational Manuals

Any equipment field services, certifications and O&M manuals required by the specifications will be scheduled and received by the QA/QC Manager or their designee.

A program for tracking and scheduling field services, certifications and O&M manuals will be established and tracked by the QA/QC Manager, or their designee.

7.16.4 Records

Documentation of receipt and inspection will be provided on the Notice of Material Received and Inspected form.

Subcontractors will provide documentation of receipt and inspection on forms to be reviewed and approved by the MWH QA/QC Manager.

7.17 Operation and Maintenance Manuals

This work is a requirement under the Design Build Contract. MWH will work closely with CAW to develop the scope and requirements for the Operation and Maintenance Manual.

Upon completion of the design, an Operations Manual will be prepared by the MWH Project Team for each facility that provides a facilities' overview and process operations description.

The document will be reviewed by MWH and will serve as the operations element of the project O&M manual.

7.17.1 Procedures

Once project equipment has been procured, vendor equipment operations and maintenance data will be assembled into a project O&M manual. The project O&M Manual will be organized by facility and equipment type and contain the following information.

- Table of Contents
- Project Overview
- Process Description
- System Name
- Equipment Name
- Startup and Shutdown Procedures
- Standard Operating Procedures
- Manufacturer's O&M manuals
- Equipment test results
- Spare parts lists
- Maintenance Log Forms
- Safety Procedures
- Warranty Information
- Record Drawings (upon completion of the project)

The draft O&M manuals will serve as the basis for developing project-specific testing, startup and training programs.

7.17.2 Records

Upon the successful startup and commissioning of the facility and completion of record drawings, the O&M manuals will be finalized to reflect actual process conditions.

7.18 Project Controls

Tracking and monitoring of project progress for compliance with the project schedule and budget will be performed in accordance with contract requirements. Additionally, Progress Payments are to be developed and reviewed before submitting to the Owner.

7.18.1 Project Schedule

The MWH Project Manager, or their designee, will establish a realistic and achievable baseline schedule for the entire project. The baseline schedule will be established upon completion of final design and issuance of construction subcontracts for all work packages.

The project team will utilize the baseline schedule and subsequent updates to provide the following:

- Conduct detailed planning and scheduling
- Prepare 3-week look ahead schedules for short-term planning
- Identify, analyze, and report schedule variances promptly
- Develop and implement schedule recovery plans, and
- Provide accurate and timely progress reporting

7.18.1.1 Project Schedule Requirements

The project controls system shall be driven by P6. This system shall be maintained and updated at the construction field office by the construction staff.

The baseline schedule and subsequent updates shall meet or exceed the following minimum requirements:

- The schedule shall be organized by utilizing a comprehensive and logical Work Breakdown Structure (WBS)
- Activities for work associated with Project shall be identified and included in the schedule
- Activity durations of appropriate length shall be utilized. Durations of 30 calendar days or less shall be used except for equipment procurement or management support activities
- All activity relationships shall be identified and shown
- Appropriate project milestones and deliverables shall be identified and shown on the schedule
- Responsibilities shall be assigned to each activity
- Value associated with each activity shall be loaded into the schedule
- Monthly updating of the schedule shall be performed
- Two-week look ahead schedules shall be utilized
- Accurate, meaningful and timely progress reporting shall be utilized
- Recovery plans shall be utilized when necessary

Schedule variances from the baseline schedule shall be noted each month. Where appropriate, schedule recovery plans shall be developed for activities that have fallen behind schedule.

Monthly schedule updates indicating progress against the baseline schedule shall be incorporated into regular progress reports.

Any impacts to the schedule that either adds or deletes time shall be incorporated into monthly schedule updates. Proposed and approved time extensions and reductions shall be incorporated into revised baseline schedules.

7.18.1.2 Critical Equipment and Material Submittals

Procurement times required for certain items of equipment or types of material may have important effects on the progress of the work.

Critical equipment and materials shall be identified and the time necessary for the soliciting proposals, receipt and review of shop drawings, and fabrication and delivery shall be included in the schedule.

Items critical to the project shall be included in the schedule. The following items are examples of equipment and types of materials that are known to have the potential to adversely affect project progress.

7.18.2 Project Cost Control

This section describes the responsibilities and requirements for the control of project costs.

The MWH Project Manager or their designee will be responsible for tracking and managing the actual costs against the target price.

The project team will utilize cost management procedures to provide the following:

- Identify, analyze, and report cost variances promptly
- Develop and, upon the Owner’s direction, implement cost recovery plans, and
- Provide accurate and timely cost reporting

7.18.2.1 Project Cost Control Requirements

The project cost control system shall be driven by Prolog and supported by cost reports from subcontractors and suppliers, and cost reports from MWH’s cost accounting systems. These systems shall be maintained and updated at the MWH construction field office by the construction staff.

The target price shall be subdivided in accordance with the detail of the project work breakdown structure and schedule organization. The value associated with each discrete activity will be assigned and loaded into the Primavera project schedule.

The approved baseline schedule, target price and corresponding cost loading of the schedule will represent the baseline schedule and cost control “measuring stick” for the project. All subsequent schedule and cost updates will be compared to the baseline to evaluate cost and schedule status.

Approved changes in time and cost shall be incorporated into monthly schedule and cost updates. Revised baseline schedules and budgets shall be adopted and utilized for subsequent schedule and cost submittals.

Cost variance reports shall be utilized to monitor cost control for the project.

Where significant cost variances occur, the project team shall notify CAW. Upon direction of CAW to do so, the project team shall make every effort to implement cost recovery plans to minimize cost overruns on the project.

7.18.3 Progress Payments

The MWH Project Manager, or their designee, will be responsible for preparing periodic progress payment requests for the project.

Progress Payment Requirements

1. Periodic progress payments will be generated using the Prolog system, with input generated from MWH's accounting system and subcontractor's and supplier's cost reports.

2. As soon as the baseline schedule is reviewed and accepted by CAW, the schedule will be loaded with fixed costs associated with fixed-price subcontracts. Activities associated with cost-plus compensation will be loaded with estimated costs. Once the total cost for the project has been loaded into the baseline schedule, a total Project cash flow projection curve will be generated for CAW review and approval.

3. At the end of each month, or at such shorter intervals as may be agreed upon with CAW, the percentage completed for each activity will be entered into the Primavera P6 schedule. P6 will then generate the earned value associated with all fixed-price activities. Actual costs for cost-plus activities will be entered into P6. Actual costs will be generated by MWH's accounting system and/or subcontractor's and supplier's cost reporting systems. The P6 project management system will then generate a total progress payment request for that month.

4. This process will be repeated each payment period with a review and approval cycle allowed for the Owner.

7.19 Internal Quality Audits and Management Reviews

Internal audits will be performed to verify conformance with the MWH Quality Management Plan. This procedure establishes a uniform practice for conducting quality audits. Reasons for performing internal audits are listed below.

- Evaluate Quality Management Team compliance with the Quality Management Plan
- Verify that there has been compliance with project-specific and Owner-specific requirements
- Identify where Quality Management Plan Non-Compliances have occurred and to recommend corrective actions for improving conformance with the program
- Verify that prescribed corrective actions have been taken

Audits are performed to address the completeness of the project Quality Assurance File. Additionally, audits can also assess the effectiveness of the application of specific quality-control procedures.

7.19.1 Applicability

All MWH projects shall be subject to this procedure.

7.19.2 Terminology

Project Quality Audits are conducted by the MWH Project Executive to verify compliance with the Quality Management Plan and to assess the effectiveness of the implementation of the program on the project.

Department of Engineering Quality Audit is an audit conducted by the Department of Engineering. This audit is conducted to verify compliance with the MWH Quality Management Plan and the project-specific Quality Management Plan, and to assess the effectiveness of program implementation.

Audit Findings are written descriptions of a deviation in the project design process, and/or construction quality control process from the requirements specified within the MWH Quality Management Plan. Audit findings, in the opinion of the audit team leader, are likely have a definite adverse effect on the quality of the delivered project.

Corrective Action Reports are generated in response to audit findings. These reports are prepared by the MWH Project Executive and QA/QC Manager which includes their indication of agreement or disagreement with the audit finding, a description of the corrective action the MWH Project Executive intends to take, and a date by which the corrective action will be completed.

Corrective Actions are actions performed by or supervised by the MWH Project Executive and QA/QC Manager to eliminate the deficiency that resulted in the audit finding.

7.19.3 Scheduling

Project Quality Audits shall be conducted at least twice during the term of a project. The MWH Project Executive shall initiate the initial audit within 45 days from the project notice-to-proceed date. Project Quality Audits shall be performed to establish that the Project Central File and Project Quality Assurance File have been initiated and that they are correct and complete. This includes preparation of the project Quality Management Plan.

Department of Engineering Quality Audits will be performed for every project at a frequency of not less than twice a year during project execution.

7.19.4 Responsibilities QA/QC Manager

MWH Project Managers are responsible for conducting project quality audits in accordance with this procedure and for reporting audit findings to the MWH Director of Engineering and the project QA/QC Manager.

MWH Project Managers shall take corrective actions if any deficiencies in the Quality Management Plan are discovered. They are also responsible for implementing corrective action required as a result of the Department of Engineering Quality audit. This includes, if necessary, stopping deficient activities until appropriate corrective action has been taken.

The Director of Engineering is responsible for conducting Department of Engineering Quality audits in accordance with the requirements of this procedure. They report the audit findings to the MWH Core Management Team.

7.19.5 Procedure

A Project Quality Audit shall verify the completeness and correctness of the quality documentation contained in the Project Quality Assurance File. Specifically, it may be intended to review documentation of detail-checking procedures, independent technical reviews and coordination reviews. It also may evaluate the responses to comments resulting from these procedures and to spot-verify the incorporation of the comments in the final work product process output documentation.

Project Quality Audits shall verify conformance that project quality procedures are in compliance with the project Quality Management Plan.

The audit may evaluate project file organization and completeness, conformance with material certifications with project specifications, conformance with testing frequency requirements and correlation of Quality Control reports with material testing lab results. This audit may also be used to confirm that prescribed corrective actions have been incorporated into the work.

Findings that require corrective action shall be reported immediately to the Project Manager for action. The MWH Project Executive and MWH Project Manager have the authority to stop work on the project if required based on the audit findings.

Project Manager audits are conducted to verify that quality procedures are in compliance with the project-specific Quality Management Plan and the MWH Quality Management Plan. This audit may evaluate technical elements of the project design, and whether design checks have been conducted in accordance with the Quality Management Plan. Elements of construction quality and control will be evaluated for conformance with project and contract requirements. Material testing and conformance with specification requirements will be reviewed to assure that test results have been correctly interpreted, recorded, and reported.

A Project Team meeting will be convened by the Project Manager at the conclusion of the audit to report findings and lessons learned, and determine any required changes to quality procedures.

Quality system deficiencies, if found, will be reported to the Project Executive on an MWH External Audit Report form signed by the MWH Project Manager and the QA/QC Manager. The External Audit Report shall include the following:

- Project Name and Number
- Identification of the auditor
- Persons contacted during audit activities
- Summary audit results, including a statement regarding the effectiveness of implementation of the Quality Management Plan elements audited
- Full description for any reported adverse audit finding in sufficient detail to confirm that corrective action can be carried out effectively by the MWH Project Manager and QA/QC Manager. References to the specific project Quality Management Plan and/or Quality Management Plan section containing the quality requirement that was violated will be provided on the External Audit Report
- Recommendations for correcting the deficiencies or improving implementation of the Quality Management Plan's effectiveness (refer to the corrective action process)

Each External Audit Report shall be addressed to the MWH Project Executive and QA/QC Manager, and copies shall be sent to the Core Management Team and the Central Quality Assurance File.

The MWH Project Manager and QA/QC Manager shall implement appropriate corrective actions, and document their response on the Audit Finding Report within 30 days of receipt of the audit.

MWH's Project Executive shall conduct appropriate follow up actions to:

- Evaluate the adequacy and acceptability of each External Audit Report response
- Verify that formulated corrective actions are appropriate and scheduled for implementation
- Confirm that corrective action are accomplished as scheduled and in accordance with the response

The Project Executive will conduct follow-up actions through written communication, re-audit or other appropriate means.

After all corrective actions have been implemented and verified, the MWH Project Executive, Project Manager and QA/QC Manager shall sign and date the External Audit Report.

7.19.6 Documentation

The completed and signed External Audit Report and any other appropriate documentation shall be placed in the project Quality Assurance files.

7.20 Lessons Learned

MWH is dedicated to continually improving on a real-time basis the practices and procedures employed during the pursuit, execution and closure phase of each project engagement. The timely sharing of positive and negative experiences throughout the MWH organization expands the knowledge base and is a mechanism to facilitate continuous improvement.

MWH utilizes a Lessons Learned procedure as one part of our Quality Management Program that is intended to capture those experiences that are beneficial and offer an opportunity to improve our procedures and processes. All members of the MWH Project Team participate in the Lessons Learned procedure. Because many of the Lessons Learned can have a direct impact on Quality Assurance and Quality Control, the project QA/QC Manager serves as the focal point for the collection and dissemination of the Lessons Learned.

The focus of the Lessons Learned procedure is to gather constructive feedback and offer valuable alternatives to current practices that will result in immediate improvements to the final product.

To maximize the value of Lessons Learned, it is important to disseminate this information within the MWH organization as soon as practical. By making this a priority communication tool, several direct benefits can be accrued:

- Real-time learning from MWH experience on the project
- Guidance to MWH colleagues that may be facing similar project issues, and
- Promotion of internal discussion that identifies processes or procedures needing modification that will facilitate continuous improvement

7.20.1 Procedure

With most projects, unanticipated issues arise requiring the MWH Project Team to work through the development of alternatives and potential solutions to the challenge. The nature of these issues is diverse and come about as a result of incorrect bid assumptions, changed site conditions, changing Owner requirements, intractable contract terms, etc. Regardless of the nature of the issue, complete or partial solutions are developed for correction or amelioration of the issue.

After the issue has been resolved with CAW and the MWH Project Team, it is important to capture what was learned during the development and implementation of the solution. The Lessons Learned procedure facilitates the recording and sharing of the experience gained. The Prolog Lessons Learned form provided in Appendix D is used to document pertinent information

Information to be provided on the Lessons Learned form includes sections to record the Background Description of the Project, Issue Identification, Lessons Learned and Future Considerations.

The Background section of the Lessons Learned form describes the project setting, design and construction work to be performed, contract type, processes utilized by the new facilities, and any other useful information that allows the reader to gain an understanding of the project.

Issues are identified in the next section of the form. It is important to capture the genesis of the issue with respect to circumstances, events, and decisions that have spawned the issue.

The following portion of the form should provide a discussion of the Lessons Learned and the impacts, both positive and negative that ensued on the project. This discussion should include impacts on cost, schedule, quality, relationships, etc.

Future Considerations follow the Lessons Learned discussion and should provide suggestions on how best to improve our procedures and practices to anticipate, avoid or circumvent the current issue from occurring in the future.

7.20.2 Reporting

Upon completion of the Lessons Learned form by the QA/QC Manager, the Team is advised via email to maximize the speed in which this information can be shared. Monthly updates are provided in the Monthly Report for review and further corporate distribution by MWH senior management.

Problem identification and solution generation is a normal course of discussion at weekly or monthly construction project meetings. As such, these meetings are an ideal forum for capturing and documenting Lessons Learned. Including an agenda item in these meetings for Lessons Learned will serve as a forum for focusing the thoughts of the Project Team on learning experiences gained on a contemporary basis. Documentation of this experience can be readily advanced and prepared for distribution by the QA/QC Manager.

Section 8

Start-Up / Operations Integration Quality Management Plan

8 Start-Up / Operations Integration Quality Management Plan

A detailed project-specific testing and startup plan will be developed and submitted for review which will describe the management and supervision of the startup activities and provide detailed procedures for testing and commissioning the facilities. The testing and startup plan will be developed by MWH staff who specialize in the startup and operations of seawater desalination treatment facilities. The draft O&M manuals will serve as the basis for developing the testing and startup procedures.

8.1 Testing Plan

The testing plan will consist of a detailed checkout procedure for each piece of equipment followed by process system testing to confirm that related equipment is performing properly. Specific testing criteria will be developed to confirm performance to design requirements as indicated in Article 4 of the Contract.

The testing and startup operations will be fully documented and witnessed by project inspectors.

Each equipment manufacture will be responsible for performing the specified tests and for certifying correct installation prior to beginning facility startup.

During the system checkout, the following tasks will be performed by the Quality Management Team:

- Verify that all lubricants and coolants are properly installed
- Calibrate Equipment
- Receive Manufacturer's Certificate of Proper Installation
- Document equipment and process performance
- Document compliance with warranty requirements, and
- Verify operator training

8.2 Turnover

Once the equipment and system testing is complete, and the project facilities have been operated continuously for 16 days to demonstrate the achievement of design performance standards, the project will be considered mechanically complete and will be turned over to the operator for operations.

Appendices

(Insert Additional Appendices as Required)

Appendix A: Permitting Quality Management Project Forms

Contents

TO BE DEVELOPED AFTER
PERMITTING REQUIREMENTS
HAVE BEEN FULLY
IDENTIFIED

Appendix B: Easement Quality Management Project Forms

Not Used.

Contents

NOT USED FOR THIS PROJECT

Appendix C: Design Quality Management Project Forms

Item

1. Detailed Design Project Quality Control Plan (EN 65)
2. Project Files Master List
3. Design and Constructability QA/QC Review Comments
4 Design Change Log
5 Internal Design Audit Report
6 External Audit Report
7 Design Project Certification (EN 79)
8 Design Project Close-Out Summary (EN 67)

CLIENT: CAW	PHASE:______________OF_______________PHASES
	JOB NO.:_______________________________________
PROJECT NAME: Desalination Infrastructure Project	COST CODE RANGE:______________TO__________
	TOTAL PROJECT FEE: $________________________
	QC BUDGET FEE: $___________________________
CONTRACT START DATE (M/D/Y):______________	QC% OF TOTAL PROJECT FEE: ______________%
COMPLETION DATE (M/D/Y):___________________	QC COST CODES:______________________________
QC PLAN REVISION NO.:__________DATE:________	BUSINESS UNIT:______________________________
PROJECT DESCRIPTION (Max 850 Characters):	
SPECIAL CONDITIONS (Max 250 Characters): None known at this time.	

PROJECT STAFF AND QC PERSONNEL

ASSIGNMENT	NAME
PROJECT MANAGER	
DESIGN MANAGER	
DESIGN QA/QC MANAGER	
PROJECT QC ENGINEER/LEAD REVIEWER	
CALCULATION CHECKER	
COST ESTIMATE CHECKER	NA (By MWH)
QUALITY MANAGER	

CRITERIA COMMITTEE MEMBERS/DISCIPLINE	CCM PARTICIPATION #1	#2	#3
NOT APPLICABLE TO THIS PROECT	☐	☐	☐

PROCESS REVIEW MEMBERS	INITIAL	FINAL
1. ______________________	X	☐
2. ______________________	X	☐
3. ______________________	X	☐
4. ______________________	X	☐
5. ______________________	X	☐
6. ______________________	☐	☐

SUBCONSULTANTS

	NAME	PROJECT INVOLVEMENT	BUDGETED FEE	QC PLAN REC'D
1.	________ ________________		$__	☐
2.	________		$ __	☐
3.	______________________		$__	☐
4.	________ ________________		$__	☐
5.	________ __		$__	☐

PROJECT QUALITY CONTROL SCHEDULE – DETAILED DESIGN

	KEY DESIGN MILESTONES	AT % COMPLETE	Client Submittal DATE	PQCE/LEADE REVIEWER SIGNATURE	PQCE/LEADE REVIEWER DATE
1.	Prepare Project Notebook				
2.	Hold Project Team kickoff Meeting(s)				
3.	Distribute Project Design Information				
4.	Initial Process Review				
5.	Final Process Review				
6.	30% Design Review				
7.	60% Design Review				
8.	90% Design Review				
9.	100% Design Review				
10.	Constructibility Reviews				
11.	Drawings/Specs Certification (EN-79 Required)				
12.	Field & Office Audits–Construction Close-out Summary (EN-33)				
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Note: Additional detail found in Section 6.8.9 of the Quality Management Plan

ACKNOWLEDGEMENT

(This form must be completed and acknowledged prior to submission of budget and contract brief and billing summary to QA/QC manager for Approval.)

PROJECT MANAGER:_________________________________ DATE:________________

DESIGN MANAGER:__________________________________ DATE:________________

DESIGN QA/QC MANAGER:____________________________ DATE:________________

Project Files
Master List

Client: ______________ Project Engineer ______________ Date: ______________

Project: ______________ Project Manager ______________ Job No(s): ______________

1.0 Proposals & Contracts (Green*) ❑
- 1.1 Proposal ❑
- 1.2 Contact with Client ❑
  - 1.2.1 Amendment No. 1 ❑
  - 1.2.2 Amendment No. 2 etc. ❑
- 1.3 Contract with Subconsultant(s) ❑
  - 1.3.1 Breakdown as Required ❑
- 1.4 Contract Correspondence ❑
  - 1.4.1 With Client ❑
  - 1.4.2 With Subconsultant(s) ❑
- 1.5 Engineering Services, Cost Estimates & Backup ❑
- 1.6 Contract Negotiations ❑

2.0 Project Forms (White*) ❑
- 2.1 Master List of Files ❑
- 2.2 Special Project Forms ❑
- 2.3 Form Originals (Masters) ❑

3.0 General Project Communications (Red*) ❑
- 3.1 Correspondence ❑
  - 3.1.1 Interoffice Correspondence ❑
  - 3.1.2 Correspondence with Client ❑
  - 3.1.3 Correspondence with Subconsultant(s) ❑
  - 3.1.4 Correspondence with Contractor ❑
  - 3.1.5 Correspondence with JV ❑
  - 3.1.6 Correspondence with Others ❑
- 3.2 Other Communications ❑
  - 3.2.1 Telephone Memoranda ❑
  - 3.2.2 Field Memoranda ❑
  - 3.2.3 Field Orders (not involving changes) ❑
  - 3.2.4 Trip Reports ❑
- 3.3 Meeting Notes ❑
  - 3.3.1 Criteria Committee ❑
  - 3.3.2 Etc. ❑
- 3.4 Workshops, Presentation, Public Hearings ❑
- 3.5 Photos (Other than during post construction) ❑

4.0 Costs & Billings (Blue*) ❑
- 4.1 Budgets (Briefs Billing Summaries, Etc.) ❑
- 4.2 Weekly Labor/PCI ❑
- 4.3 Billings ❑
  - 4.3.1 Approved Billings ❑
  - 4.3.2 Monthly Estimates ❑
  - 4.3.3 Invoices from Vendors/Subconsultant(s) ❑

5.0 Project Management (Yellow*) ❑
- 5.1 Project Work (Control) Plan ❑
- 5.2 Budget and Manpower Projections ❑
- 5.3 Project Procedures-Project Control Manual ❑
- 5.4 Manpower/Schedule Evaluations ❑
- 5.5 Project Performance Summary ❑
- 5.6 Quality Control ❑

6.0 Studies Reports (EIR's, Etc.) (Orange*) ❑
- 6.1 Report Outlines ❑
- 6.2 Draft Reports ❑
- 6.3 Comment from Client/Agencies ❑
- 6.4 Cost Estimates ❑
- 6.5 Report Calculations ❑
- 6.6 Reference Materials ❑
  - 6.6.1 Breakdown as Required ❑

7.0 Design (Orchid*) ❑
- 7.1 Design Discipline Memos & Directives ❑
  - 7.1.1 General Process Engineering ❑
  - 7.1.2 Architectural ❑
  - 7.1.3 Civil/Survey ❑
  - 7.1.4 Electrical ❑
  - 7.1.5 Instrumentation ❑

Suggested file label color

- 7.1.6 Mechanical ❑
- 7.1.7 Structural ❑
- 7.1.8 Specifications ❑
- 7.2 Calculations (by process and design discipline) ❑
- 7.3 Equipment List ❑
- 7.4 Design Level Construction Cost Estimates ❑
- 7.5 Subconsultants' Product ❑
- 7.6 Value Engineering ❑

8.0 Bid Phase Activities (Black*) ❑

- 8.1 Advertisement for Bids ❑
- 8.2 Bidders Lists (record of documents issued) ❑
- 8.3 Addenda to Bid Documents ❑
- 8.4 Bid Opening Reposrts ❑
- 8.5 Summary and Evaluation of Bids (spreadsheets, etc.) ❑
- 8.6 Pre-Award Submittals ❑

9.0 Preconstruction Phase (Coral*) ❑

- 9.1 Inspection & Testing Manual ❑
- 9.2 R/W, Easement, and Permit Documents ❑
- 9.3 Preconstruction Conference ❑
- 9.4 Contractor Submittals ❑
  - 9.4.1 Bonds and Insurance ❑
  - 9.4.2 Bid Breakdown (allocations, sched. of values) ❑
  - 9.4.3 Preliminary Project Schedule (CPM,etc.) ❑
- 9.5 Notices to Contractor ❑
  - 9.5.1 Award ❑
  - 9.5.2 Proceed ❑

10.0 Construction Phase (Pastel Green*) ❑

- 10.1 Inspection Records & Reports ❑
  - 10.1.1 Daily Construction Reports by Contractor ❑
  - 10.1.2 Daily Construction Reports by Field Engineer ❑
  - 10.1.3 Field Diaries ❑
  - 10.1.4 Certificates & Delivery Tickets ❑
  - 10.1.5 Discrepancy (non-conformance) Reports ❑
  - 10.1.6 Batch Plant Records ❑
  - 10.1.7 Special Inspection Reports ❑
- 10.2 Quality/Materials Testing ❑
  - 10.2.1 Pipe ❑
  - 10.2.2 Concrete ❑
  - 10.2.3 Soils ❑
  - 10.2.4 Asphalt Products ❑
  - 10.2.5 Welding ❑
  - 10.2.6 Others ❑
- 10.3 Changes & Extra Work ❑
  - 10.3.1 Change Order ❑ (Filed by C.O. No.: Includes Estimate of Costs, Requests for Proposals, Etc.)
  - 10.3.2 Initiator Change Orders ❑ (Which do NOT result in a C.O.: includes Est. of Costs, Requests for Proposals, Etc.)
  - 10.3.3 Field Orders (Emergency Changes) ❑ (Which do NOT result in a C.O.: includes Est. of Costs, Requests for Proposals, Etc.)
  - 10.3.4 Change Order Log ❑
  - 10.3.5 Extra Work Reports ❑
  - 10.3.6 Deviation Reports ❑
- 10.4 Payment for Work or Materials ❑
  - 10.4.1 Contractors Monthly Pay Estimates ❑ (Includes: Payment Requests, Verification of Payment Quantities, Materials Delivered, Retainage, Contractor's Breakdown & Inv.)
  - 10.4.2 Procurement Contracts ❑
- 10.5 Progress of Work ❑
  - 10.5.1 Contractor Work Schedules (diagrams) ❑
  - 10.5.2 Schedule Updates (computer printouts) ❑
  - 10.5.3 Monthly Progress Reports ❑
- 10.6 Time of Work ❑
  - 10.6.1 Delays in Work ❑
  - 10.6.2 Time Extensions ❑
  - 10.6.3 Suspension of Work ❑
- 10.7 Contractor Submittals ❑
  - 10.7.1 Shop Drawings ❑
  - 10.7.2 Samples ❑
  - 10.7.3 Certificates ❑
  - 10.7.4 Mix Designs ❑
  - 10.7.5 Sheeting, Shoring & Bracing Plans ❑
- 10.8 Record Drawings ❑
  - 10.8.1 Updates During Construction ❑
  - 10.8.2 Final Record Drawings ❑
- 10.9 Photographic Records ❑
  - 10.9.1 Progress Photos ❑
  - 10.9.2 Claims Photos ❑
  - 10.9.3 Safety Hazard Photos ❑
  - 10.9.4 Accident Photos ❑

10.9.5 Public Relations Photos-------------- ----------------- ❑
10.9.6 Post-Construction Photos------------ ----------------- ❑
10.10 Disputes, Protests & Claims--------------------- ----------------- ❑
10.10.1 Contractor-Initiated Actions -------- ----------------- ❑
10.10.2 Owner/Engineer Documentation--- ----------------- ❑
10.11 Safety & Health (OSHA) ------------------------ ----------------- ❑
10.12 Beneficial Use/Partial Utilization -------------- ----------------- ❑
10.13 Maps -- ----------------- ❑
10.14 Outside Services---------------------------------- ----------------- ❑
10.14.1 Surveys --------------------------------- ----------------- ❑
10.14.2 Laboratories --------------------------- ----------------- ❑
10.14.3 Special Inspections ------------------- ----------------- ❑
10.14.4 Consultants --------------------------- ----------------- ❑

11.0 Project Closeout (Pastel Pink*)----------------------------- ----------------- ❑
11.1 Operational Testing & Validation ------------------ ----------------- ❑
11.2 Punch Lists -- ❑
11.3 Final Submittals from Contractor------------------- ----------------- ❑
11.3.1 Record Drawings --------------------- ----------------- ❑
11.3.2 Keying Schedule---------------------- ----------------- ❑
11.3.3 Spare Parts---------------------------- ----------------- ❑
11.3.4 Tools ----------------------------------- ----------------- ❑
11.4 Notice of Completion-------------------------------- ----------------- ❑
11.5 Final Progress Payment ----------------------------- ----------------- ❑
11.6 Release of Retainage & Withholding -------------- ----------------- ❑

12.0 O&M and Start-Up (Pastel Blue*)------------------------- ----------------- ❑
12.1 Correspondence w/Contractor/Manufacturers ---- ❑
12.2 Training --- ----------------- ❑
12.2.1 Manufacturers’ Training ------------- ----------------- ❑
12.2.2 Training Manual Draft --------------- ----------------- ❑
12.2.3 Operator Certification Material----- ----------------- ❑
(State Continuing Education
Points Authorization, Tests Scores,
Final Exam)
12.2.4 Audiovisual Aids, Materials--------- ----------------- ❑
12.3 O&M Manual --- ----------------- ❑
12.3.1 Draft O&M Manual------------------- ----------------- ❑
12.3.2 Review Comments from Client, EPA, Etc.--------- ❑
12.3.3 MW Staff Review/Technical Manual Summ.------ ❑
12.3.4 Graphic Materials, Photos ----------- ----------------- ❑
12.4 Start-Up --- ----------------- ❑
12.4.1 Equipment Inspection/Review Report--------------- ❑
12.4.2 Troubleshooting/Process Problems ❑
12.4.3 Scheduling (Plan of Operation)----- ----------------- ❑
12.4.4 Start-Up Meetings Summary-------- ----------------- ❑
12.4.5 Equipment Warranties/Plant Acceptance ----------- ❑

13.0 Project Follow-Up (Pastel Orange*) ---------------------- ----------------- ❑
13.1 Site Visit Notes and Memos ------------------------ ----------------- ❑
13.2 Post-Construction Reports -------------------------- ----------------- ❑

MWH Constructors

Design and Constructability
QA/QC Review Comments
(Insert Project Name)

Discipline: ___________________
Reviewer name: ________________

Review date:

Comment No.	Reference Document or Topic	Page or Sheet Number	Paragraph Number	Description of Issue	Possible Resolution of Issue	Comment Response	Resolution Date

INTERNAL DESIGN AUDIT REPORT CARD

9/15/04 VERSION

Project QC Number:	______________________	Client:	______________________
Business Unit:	______________________	Project Name:	______________________
Client Service Manager:	______________________	Date of Audit:	______________________
Project Manager:	______________________	Auditor:	______________________
Project Engineer:	______________________	Original Contract Amount:	$ ______________________
		Current Contract Amount:	$ ______________________

PROJECT SCOPE/FACTS:

A. Project Budget/Schedule/Status

Objectives	Evaluation		Findings/Comments
	Yes	No	
1. Have there been any changes in the project scope of work? If so, explain:			
2. Have the scope changes and costs been documented with the client?			
a. Has the client approved the scope changes and costs? If not, explain:			
3. Project WBS adequate to manage costs?			
a. Schedule have sufficient detail, including key milestones & deliverables?			
b. ISBM developed?			
c. Does the ISBM include earned value?			
d. ISBM up-to-date?			
e. Is the project within budget? If not, provide explanation of the situation:			
4. What is being done to recover from a budget overrun:			
a. Is the project on schedule? If not, provide explanation of the situation:			

Objectives	Evaluation		Findings/Comments
	Yes	No	
5. What is being done to recover the schedule:			
6. Client's attitude towards project schedule slippage? Potential problem?			
a. Is the remaining project budget adequate? If not, what is being done about it?			
7. Is the remaining project schedule adequate? If not, what is being done about it?			
8. Are the project billings and client payments current? If not, explain the problem:			

B. Project Quality

Objectives	Evaluation		Findings/Comments
	Yes	No	
9. Does the Project Notebook exist?			
a. Does the Project Notebook contain required information?			
b. Is the Project Notebook up-to-date?			
c. Has the project filing system been setup?			
d. Is the filing system up-to-date?			
e. Has the project EN-65 form been completed and signed?			
f. Is the EN-65 form up-to-date?			
g. Was a QC budget established for the project? Negotiated or standard 5%?			
Scheduled CCMs:			
10. Were the scheduled CCMs held as planned?			
11. Were the CCMs adequate for the project?			
a. Did the appropriate assigned personnel participate in the CCMs?			
b. Were the results of the CCMs properly documented and followed up?			
12. Design interdiscipline review conducted?			

Objectives	Evaluation		Findings/Comments
	Yes	No	
13. Project deliverables properly reviewed and back checked?			
14. List project subconsultants:	N/A	N/A	1.) 2.) 3.)
15. Has the performance of the subconsultants been satisfactory?			

C. Client Satisfaction

Objectives	Evaluation		Findings/Comments
	Yes	No	
16. How often does the client service manager visit the client?			
17. Need for client service manager/office manager visit?			
18. Is the client's project manager satisfied with our performance?			
19. Is the client's management satisfied with our performance?			

D. Project Audit Rating

	Satisfactory
	Minor irregularities - see action items
	Moderate irregularities - see action items (reaudit may be warranted)
	Major deficiencies - see action items (reaudit required)

E. Action Items

1.
2.
3.
4.
5.
6.

MWH Constructors

PROJECT:____

____

PARTICIPANTS/ROLES:____

____

BUDGET

1. What is the status of the monthly ISBM documentation?

2. How is actual progress estimated? Is the drawing list, specification or report outline used to support the ISBM documentation?

3. Is there enough money to complete the job? If the job is overrun, has a Project Fiscal Problem Report (with supplementary questions) being completed?

4. Did MWH fee-bid the project? Did MWH low ball the fee? Was the PM involved with fee negotiations? Did the design disciplines have input to the fee estimate?

SCHEDULE

6. Is the project on schedule? If not, what corrective action is being taken? Is there enough time to complete the job?

7. Is there a "design freeze" built into the project? Is it enforceable?

8. Did the design disciplines and subconsultants have input to the schedule?

QUALITY

9. What is the status of the Project Quality Control Plan? How is the QA/QC budget doing?

10. Have QA/QC activities been useful to the team? How many CCM's were held on the project? Who were the MWH participants? Was the Owner invited? Were the CCM recommendations incorporated into the design? Is there adequate documentation of QA/QC activities?

11. Do we have the right MWH experience on the project?

12. Is there an organized and active Customer Service plan? Has it been effective?

13 Who is doing calculations? Who is checking calculations? Where are calculations being kept? Who is selecting equipment? Are there data sheets and calculations to support the selections?

14. What is the status of the drawing list? What is the status of the spec outline?

15. Does the team know which PFD/P&ID, basic design criteria, and hydraulic profile governs their work?

16. Was a pre-design cost estimate prepared? Who is doing construction cost estimating? How and to what accuracy is the estimating going to be done?

17. When and how was verification of existing conditions at the proposed construction site done? What is the documentation?

18. By drawing discipline, what has been the percentage of design rework? Has the team been doing it right the first time?

MANAGEMENT

19. How does the Department Manager and/or ROM review the status of the job?

20. Was a Project Control Plan distributed to the team? Kick-off meeting held? Was the Project Control Plan used to control and monitor the project?

21. How are staff assignments and availability?

22. How effective has the invoicing been to date? When do invoices go out to the Owner? Any invoices more than 30 days in arrears?

23. How have scope changes been handled between MWH and Customer? Subconsultant? Status of these contracts?

24. How have in-house scope changes been handled within the MWH discipline team? Status of these contracts?

25. How were job numbers established? List of files? Completeness of files to date?

26. Does the PM/PE meet with the Owner on a regular, preset basis? Is a summary of decisions and follow-up items prepared for each meeting? Is the summary distributed to the Owner and the entire MWH project team?

27. Does the PM/PE meet with the MWH project team on a regular, preset basis? Is a summary of decisions and follow-up items prepared for each meeting. Is this summary distributed to the entire MWH project team?

28. How are subconsultants and in-house disciplines coordinated on a daily basis?

DESIGN PROJECT CERTIFICATION

MWH Constructors

Owner: ______________________________

Project: ______________________________

Job No. ______________________________

		Reviewer Name	Reviewer Signature	Date Reviewed
1.	Criteria Committee Meeting procedures have been completed.			
2.	Red/Yellow checking of engineering scientific calculations has been completed.			
3.	Red/Yellow checking of drawings has been completed.			
4.	Agreement between Specifcations and drawing checked (may be P.E.).			
5.	Constructability check has been completed.			
6.	Construction cost estimates have been reviewed.			
7.	Project Control Notebook completed.			
	Certification: MWH QA/QC Manager			

Instructions:

1. This form must be completed before the project deliverable is printed or submitted to the client. After certification, return completed form to Quality Management Manager for documentation.

2. “Reviewer” is the Project Reviewer listed in the Project Control Plan.

EN-79

DESIGN PROJECT CLOSE-OUT SUMMARY

MWH Constructors

CLIENT: ______________________ JOB NO. ________________ DATE: ______________
PROJECT: ______________________ PROJECT MANAGER ______________________________

DESIGN PERIOD: __________________ TO: ______________ BID DATE: __________________
(MO-YR) (MO-YR)
ENGINEERS ESTIMATE: $__________________ LOW BID: $______________________________
DESCRIPTION OF FACILITIES DESIGNED (INCLUDE FLOWS, UNIT PROCESSES, PIPE SIZE AND LENGTH, ETC., AS APPROPRIATE)

____
____
____
____
____
____
____

PRODUCTION SUMMARY

DRAWINGS	NO. DWGS	TOTAL HRS	TOTAL COST $	COMMENTS
GENERAL/CIVIL				
STRUCTURAL				
MECHANICAL				
ELECTRICAL				
INSTRUMENT.				
PROJECT MANAGEMENT				
TOTAL				

TOTAL DESIGN COST $______________________
LESS SURVEY SUBCONTRACT ($______________________)
LESS GEOTECHNICAL SUBCONTRACT ($______________________)
NET TOTAL DESIGN COST $______________________

Were any of the following costs included in the net total design cost shown above? If so, indicate approximate costs:

PRELIMINARY DESIGN __________ COST $________________
BID PERIOD SERVICES __________ COST $________________
FINAL PRINTING ______________ COST $________________
NET TOTAL DESIGN COST PER SHEET $________________
TOTAL MANHOURS PER SHEET ________________
OTHER (NAME AND GIVE HOURS) INCLUDE SUBCONTRACTOR DESIGN WORK, IF APPLICABLE

Appendix D: Construction Quality Management Project Forms

Contents

1. Submittal Transmittal Form*
2. RFI Form*
3. Lessons Learned*
4. Material Inventory*
5. Project Deficiency Report*
6. Notice of Non Compliance*
7. Stop Work Order*
8. Submittal and RFI Flowchart
9. Inspection Test Plan (ITP)
10. Quality Management Deficiency Process Flowchart
11. Quality Management Trend Log
12. Inspection Test Request
13. Subcontractor Quality Correction Plan
14. Monthly Quality Management Report

* These documents are generated via Prolog.

Submittal Transmittal

Detailed, Grouped by Each Number

Date: 1/27/2006	Reference Number: 0033

RFI_DCN_DCL RFI-MWHCON-101

Detailed, RFI_DCN_DCLs Grouped by RFI_DCN_DCL Number

RFI_DCN_DCL # RFI-MWHCON-101			Date Created: 1/25/2006
Answer Company	Answered By	Author Company	Authored By

Co-Respondent	Author RFI_DCN_DCL Number

Subject	Discipline	Category

Cc: Company Name	Contact Name	Copies Notes

Issue	Date Required: 1/29/2006

Suggested Action

Resolution	Date Answered: 2/10/2006

Material Inventory

Detailed, Grouped by Material Code with PO Items, Delivery, and Installation

Material Code: 001	TEMPLATE			15200
	Quantity	Costs	UOM	Avg Unit Price
Purchased	0	0	EA	0
Delivered	2	0		
Balance For Delivery	0	0		
Installed	0	0		
Balance For Install	0	0		

Delivery:

Ticket #	Shipping Company	Rec'd Date	Time	Qty	Location

Installation:

Date	Company	Crew	Qty	Location	Notes

Project Deficiency Report

Detailed, Grouped by Each Number

Number: TEMPLATE P **Date:**

To: **From:**

Subject **Notice to Comply Type** **Location**

Reference **Due By**

MWH Quality Inspection dated:

Details and Action Required

ITEM DESCRIPTIONS:

SOURCE OF DEFICIENCY:

SPEC/DWG REFERENCE:

DATE DEFICIENCIES CORRECTED BY SUBCONTRACTOR: ____________

NNC No. (if issued): __________

copies: Subcontractor Project Manager, City Construction Representative, MWH Project Site Manager, MWH Construction Manager, MWH Superintendent, MWH QA Engineer

Signature Signed Date

Notice of Noncompliance

Detailed, Grouped by Each Number

Number: TEMPLATE N		Date:
To:	From:	

Subject	Notice to Comply Type	Location

Reference	Due By

Details and Action Required

DEFICIENCIES TO BE CORRECTED (MWH):

ATTACHMENTS/SUBCONTRACT REFERENCES:

PROPOSED REMEDIAL ACTION (Subcontractor):

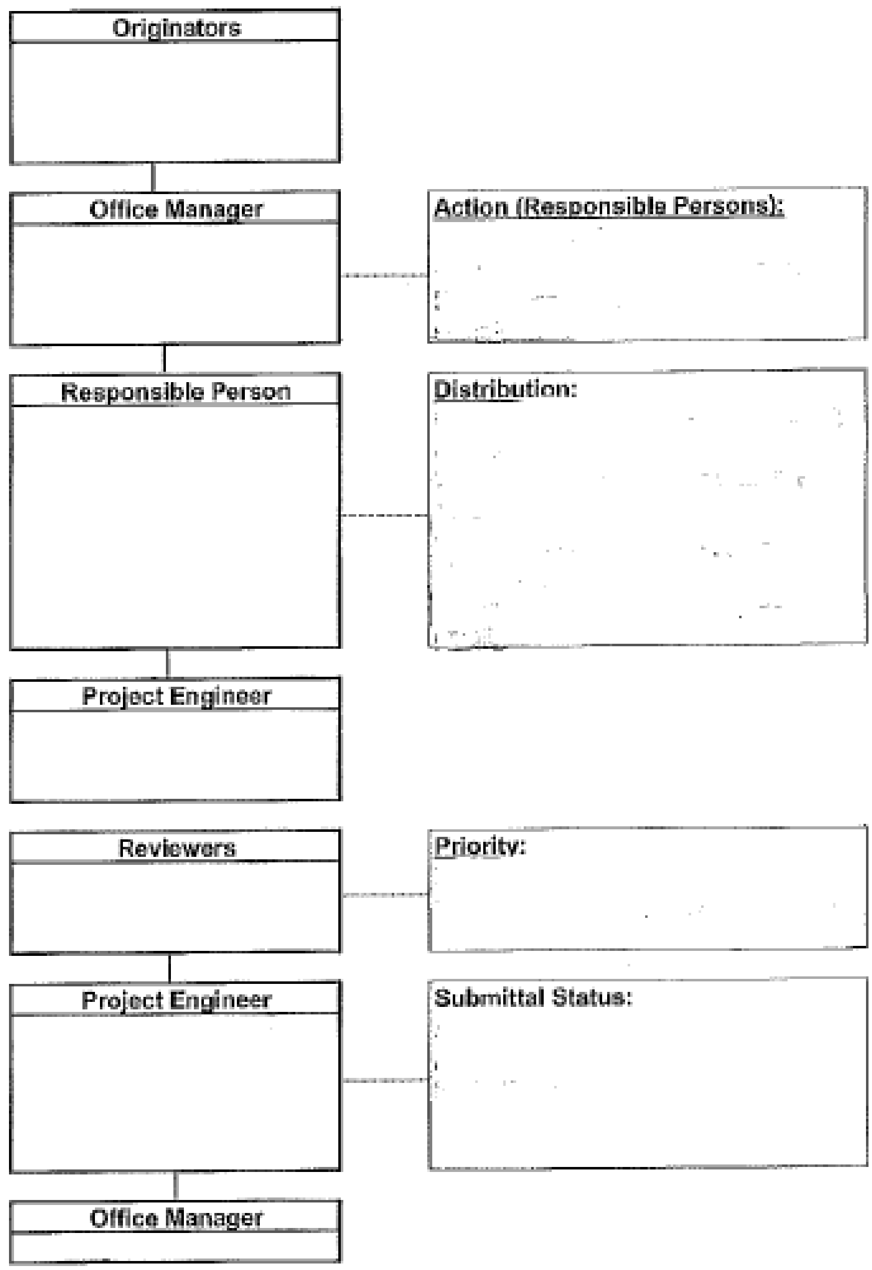
ACTION TAKEN (MWH):

REMEDIAL WORK COMPLETE DATE: ____________
SIGNED BY SUBCONTRACTOR: ________________

NON-CONFORMANCE CLOSED BY (MWH Quality Assurance Engineer): (sign below)

Signature Signed Date

MWH RFI/Submittal Process Flow Chart



CAW Desalination Infrastructure Project Date:

Subcontractor / Supplier Quality Control:

<table>
<tr><td colspan="3">SUBCNTR/PA NO:</td><td colspan="6">ACTIVITY:</td><td colspan="2">ACTIVITY NO.:</td></tr>
<tr><td colspan="3">MWHC SPEC:</td><td colspan="3">COMPANY A:
COMPANY B:</td><td>COMPANY C:
COMPANY D:</td><td colspan="2"></td><td colspan="2">REV:</td></tr>
<tr><td rowspan="2">SPECS ECT.</td><td colspan="2" rowspan="2">ACTIVITY</td><td colspan="2" rowspan="2">ACCEPTANCE CRITERIA</td><td colspan="2" rowspan="2">VERIFYING DOCUMENTS</td><td rowspan="2">CERT REQ?

Y, N</td><td colspan="4">QA/QC FOR PARTICIPANTS</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td></tr>
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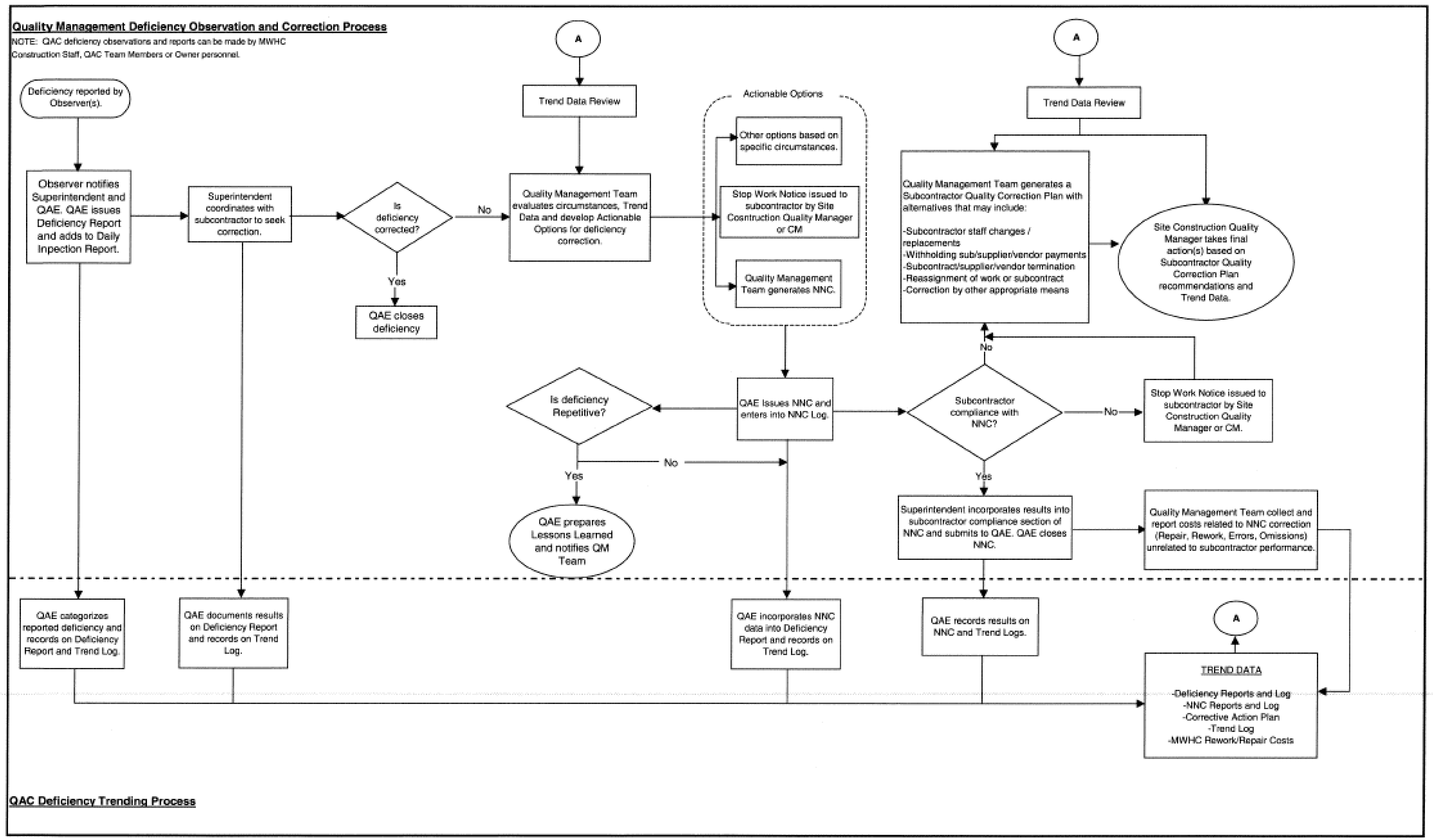
</table>

(i) R – Review, W – Witness, H – Hold Point, S – Sample, T - Testing



Quality Management Deficiency Observation and Correction Process
NOTE: QAC deficiency observations and reports can be made by MWHC Construction Staff, QAC Team Members or Owner personnel.
Deficiency reported by Observer(s).
Observer notifies Superintendent and QAE. QAE issues Deficiency Report and adds to Daily Inpection Report.
Superintendent coordinates with subcontractor to seek correction.
Is deficiency corrected?
No
Yes
QAE closes deficiency
A
Trend Data Review
Quality Management Team evaluates circumstances, Trend Data and develop Actionable Options for deficiency correction.
Actionable Options
Other options based on specific circumstances.
Stop Work Notice issued to subcontractor by Site Contruction Quality Manager or CM
Quality Management Team generates NNC.
A
Trend Data Review
Quality Management Team generates a Subcontractor Quality Correction Plan with alternatives that may include:
-Subcontractor staff changes / replacements
-Withholding sub/supplier/vendor payments
-Subcontract/supplier/vendor termination
-Reassignment of work or subcontract
-Correction by other appropriate means
Site Construction Quality Manager takes final action(s) based on Subcontractor Quality Correction Plan recommendations and Trend Data.
Is deficiency Repetitive?
QAE Issues NNC and enters into NNC Log.
Subcontractor compliance with NNC?
No
Stop Work Notice issued to subcontractor by Site Construction Quality Manager or CM.
No
Yes
No
Yes
QAE prepares Lessons Learned and notifies QM Team
Superintendent incorporates results into subcontractor compliance section of NNC and submits to QAE. QAE closes NNC.
Quality Management Team collect and report costs related to NNC correction (Repair, Rework, Errors, Omissions) unrelated to subcontractor performance.
QAE categorizes reported deficiency and records on Deficiency Report and Trend Log.
QAE documents results on Deficiency Report and records on Trend Log.
QAE incorporates NNC data into Deficiency Report and records on Trend Log.
QAE records results on NNC and Trend Logs.
A
TREND DATA
-Deficiency Reports and Log
-NNC Reports and Log
-Corrective Action Plan
-Trend Log
-MWHC Rework/Repair Costs
QAC Deficiency Trending Process

QUALITY MANAGEMENT
TREND LOG and ANALYSIS

Deficiency Report Data								Corrective Measure Data									Subcontractor Quality Compliance Data					
Deficiency Report Number	Date Opened	Month-Year Opened	Subcontractor	Trend Item	Summary Deficiency Description	Deficiency Source Key	Deficiency Correction Date	Date Stop Work Order Issued	Month-Year Stop Work Order Issued	Date NNC Issued	Month-Year NNC Issued	Date CAR Issued	Root Cause Analysis Results	Date NNC Closed	Date PAR Issued	Month-Year PAR Issued	Personnel Changes (Yes)	Payment Amount Withheld	Subcontract Termination	Subcontract Reassignment	Other Measures	MWHC Direc Constructio Cost for Conformanc
												not used	not used		not used	not used						

DATA TABLE FOR CUMULATIVE QUALITY COST TARGET
VS
ACTUAL CUMULATIVE MONTHLY QUALITY COST

Month	Project Monthly Gross Rev	Project Total Revenue	Project QAC Direct Cost Goal (%)	Target Monthly Direct Quality Cost	Actual Monthly Direct Quality Cost	Target Cumulative Monthly Direct Quality Cost	Actual Cumulative Monthly Direct Quality Cost

DATA TABLE FOR MONTHLY DEFICIENCY BY SOURCE KEY

Month	MWH Design / Build Interface	Inadequate MWH Supervision	Quality Mgmnt System Issue	Inadequate Subcontractor Supervision	Subcontractor Crew Size/Skill	Drwngs / Specs Non-Conformance	Inadequate Tools & Equipt	Insufficient Materials on site	Means & Methods Issues	Weather
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

DATA TABLE FOR MONTHLY AND CUMULATIVE PROJECT DEFICIENCIES

Month	Monthly Deficiencies	Total Project Deficiencies
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
April-06	0	0
May-06	0	0

DATA TABLE: CUMULATIVE DEFICIENCY REPORTS, NCCS ISSUED, LESSONS LEARNED ISSUED, & STOP WORKS ISSUED

Month	Monthly Deficiencies	Monthly NNC's	Mnthly Lessons Learned Issued	Monthly Stop Works Issued	Total Deficiency Reports	Total NCC's Issued	Total Lessons Learned Issued	Total Stop Works Issued
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0

INSPECTION TEST REQUEST

MWH Constructors

Project Name:	
Owner:	
Contractor:	
MWH Contract No.:	
Requested By:	**Date:**

Location: **Plant** ☐ **Pipeline** ☐

Request: **Test** ☐ **Inspection** ☐

- **24-HOUR ADVANCE NOTICE REQUIRED FOR PRODUCTION TESTING**
- **SEVEN DAYS MINIMUM ADVANCE NOTICE REQUIRED FOR FUNCTIONAL/OPERATIONAL TESTING**

Location of Work	Type of Test/Inspection Requested	Date Inspection/ Test Needed	Time	
			A.M.	P.M.

Comments:

Received By: ______________________________

Date: ______________________________

SUBCONTRACTOR QUALITY CORRECTION PLAN

MWH Constructors

Owner: ______________________________	Project Name: __________________________
Date: ________________________________	Project Number: ________________________
	Quality Correction Plan Number: ____________

Summary of Quality Issue Notification (list, each): ____

Deficiency Reports: ____

Notice of Non-Compliance Reports: ____

Corrective Action Reports: ____

Quality Performance Issue(s) Background:

Summary of Subcontractor Efforts at Compliance:

Experienced or Probable Project Impacts (Cost, Schedule, etc.):

Correction Alternatives Considered by Quality Management Team in Development of This Plan:

Quality Management Team Quality Correction Plan Recommendation and Basis:

Prepared By:

____________________	____________________	____________________
QA/QC Manager	Superintendent	CM

Date: _

MWH Constructors

MWH Project Management Action Taken:

CPM Signature

Date

Distribution:
1. QA/QC Manager
2. Superintendent
3. Project Manager
4. File

MWH Constructors

DESALINATION INFRASTRUCTURE DESIGN-BUILD PROJECT

MONTHLY QUALITY MANAGEMENT REPORT

Project Name:	**Project Number:**
MWHC Project Manager:	**MWHC QAR:**
MWHC Contract Number:	**Owner:**
Month Ending:	**Date Prepared:**

Summary of Monthly QAC Activities:

NNC Log Status:

Summary of Corrective Actions:

Summary of Preventive Actions:

Result of Internal Audits:

Significant Project QAC Issues:

Signed: (MWHC Quality Assurance Representative)	**Distribution:** 1. MWHC Project Manager 2. QAC Team 3. Project File

Appendix E: Start-Up / Operations Integration Quality Management Project Forms

This section will be developed as the project gets closer to the start up phase.

Contents

Appendix F: MS Word Features Used in this Document

Contents

1. Introduction

This appendix is included to assist editors of this document. Explanation of how to use these features is left to the Help (press F1), but here, basic explanations and strategies employed have been noted. If you find additional content you believe would make this appendix more useful, please make that known so that it may be added to the Quality Management Template.

2. Style

Style has been used to manage the following elements:

- Body Text – used for most *paragraphs of text* (Not "Normal" and not "Copy."),
- Body Text Bulleted – used for bulleted lists like this one,
- Headers (with autonumbering),
- Appendix Headers,
- Table of Contents (editing the style of TOC1, TOC2), and
- Other styles.

Other styles are also used. To see what style is used somewhere, put the cursor there and either look on the formatting tool bar, or open Format > Styles (the one being used will be highlighted).

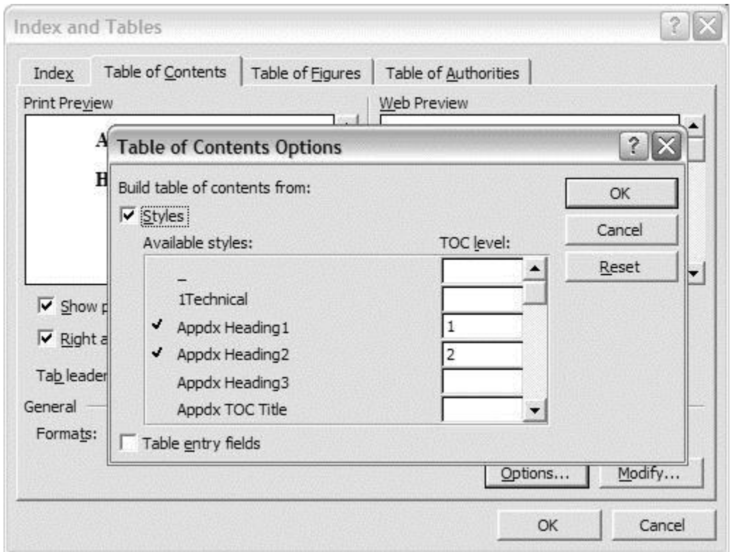
3. Table of Contents

Tables of Contents (TOC): The table of contents is generated using style information, and has custom settings. In case it gets completely messed up or deleted, the settings are noted here to help regenerate it.

As new pages get added, or the text is lengthened, page numbers may become wrong. In this case, ***update the TOC*** by right clicking on it and choosing 'update.'

To generate a new TOC, or to ***rebuild one*** for which the settings have become corrupted, put the cursor where you want the TOC (or highlight part of the current one) and select Insert > Index & Tables > (tab) Table of Contents. Set the Options and "Show Page Numbers" according to the specific info below.

- "Show Right Page Number" is checked by default.
- Click the "Options" button (see image below).



Scrolling down the available styles, ensure the TOC Level numbers are correct for these styles:

Styles Available	TOC Level
Appdx Heading1	1
Appdx Heading2	2
First Five Headers	2
Heading 1	1
Heading 2	2

Note: all other styles should NOT have any TOC Level.
Delete any numbers for other styles.
(Hitting the "Reset" button removes all info except for Heading 1, 2, 3.)

When you hit 'OK,' it may highlight the current TOC and ask, "Replace Current Table of Contents?" Click "OK" and replace the current TOC with the new one.

4. Org Charts, Tables, Inserted Objects

Figures and ***Tables***: ***Excel*** files have been inserted (Insert > Object). Borders and Captions were added (right click). ***Excel tables*** were sometimes sized down to fit (right click, "Object Properties," "Size," adjusting the width until it fits). Double-click to open them in Excel.

Org Charts were created in Excel, and inserted as objects. Double-click to open them in Excel. Turning on 'Snap to Grid' (Drawing Toolbar > Draw > Grid) allows the boxes to be moved and resized, keeping their incremental size and aligned location. Also, note that ***'Connectors'*** were used for lines, not merely drawn lines.

5. Inserted Excel Objects, and Displaying All Desired Columns

Appendices have ***inserted objects (ie, Excel worksheets).*** If, when inserting a worksheet, not all of it fits on the page, it may be necessary to reduce the column widths in Excel, save it, then insert it again. Once it has been inserted with all the columns showing in the word document, the columns can be resized. To reduce the size of the excel object, note that dragging the lower corners up diagonally (in Word mode) works better than right clicking and changing the object's size properties, when the widths of the columns are adjusted.

(Yes, there does seem to be an unaddressed bug in the resize object process, when trying to get additional columns to display. This is supposedly possible by opening the inserted Excel object in Excel (double-click it), then dragging the right handlebars further right. This is supposed to open more of the Excel object up for display, but I have been finding on most Excel objects, they always snap back to the original display setting. I've posted this question at Microsoft's Excel user's forum and my question was conspicuously not responded to. The work-around I found was the narrowing of columns in the original Excel file prior to inserting it as an object, then resizing those columns after inserting. In other words, you're trying to trick it into displaying all the columns you happen to want.)