Final Value Engineering Study Report

Monterey Peninsula Water Supply Project Desalination Plant

August 2014

Prepared By Value Management Strategies, Inc.

In Cooperation with California American Water

Value Management Strategies, Inc.

"Value Leadership"

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Date: August 1, 2014

To: James M. Cullem, Executive Director
Monterey Peninsula Regional Water Authority
735 Pacific Street
Monterey, CA 93940

Subject: Final Value Engineering Study Report
Monterey Peninsula Water Supply Project – Desalination Plant

Dear Mr. Cullem:

Value Management Strategies, Inc. is pleased to transmit this Final Value Engineering Study Report for the referenced project. This report summarizes the results and events of the VE workshop conducted July 7-11, 2014, in Monterey, California.

We enjoyed working with you and look forward to continuing our efforts to assist Monterey Peninsula Regional Water Authority and California American Water in this and future Value Engineering efforts.

If you have any questions or concerns regarding this report, please contact me at (816) 206-0067 or Mark@vms-inc.com.

Sincerely,

VALUE MANAGEMENT STRATEGIES, INC.

Mark Watson, PE, CVS, PMP
VE Team Leader

Copy: (PDF) Addressee
(PDF) Mr. Ian Crooks, P.E., Engineering Manager, CAW

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EXECUTIVE SUMMARY

FINAL REPORT

A Value Engineering (VE) study, sponsored by the Monterey Peninsula Regional Water Authority and facilitated by Value Management Strategies, Inc., was conducted for the Desalination Plant portion of the Monterey Peninsula Water Supply Project. The study was conducted at the offices of California American Water in Monterey, California July 7 through 11, 2014. This *Executive Summary* provides an overview of the subject project, summary results of the VE team's analysis, and the alternatives developed by the VE team.

PROJECT SUMMARY

Led by California American Water Company (CAW), the Monterey Peninsula Water Supply Project (MPWSP) is a complex, multi-component program that is necessary to replace a large percentage of the local drinking water supply that currently originates from the Carmel River. State Water Resources Control Board (SWRCB) Order 95-10 requires CAW to reduce diversions from the Carmel River by approximately 70% no later than December 31, 2016.

In order to meet the cutback requirements and provide adequate water to the Monterey Peninsula communities, CAW plans include three projects to address this regional water crisis:

- Desalination of seawater from wells drawing water from Monterey Bay
- Groundwater Replenishment (GWR) with advanced treatment of wastewater by the Monterey Regional Water Pollution Control Authority Plant
- Aquifer Storage and Recovery (ASR)

This VE study focused solely on the desalination plant portion of the water supply project.

Treatment at the desalination plant will consist of oxidation with sodium hypochlorite, granular media filtration, dechlorination, pH adjustment with sulfuric acid, cartridge filtration, a first pass of seawater reverse osmosis (SWRO), a partial second pass of brackish water reverse osmosis (BWRO), disinfection with ultraviolet light, post-stabilization treatment with carbon dioxide and hydrated lime, pH adjustment with sodium hydroxide, addition of an orthophosphate corrosion inhibitor and post-chlorination with sodium hypochlorite.

CDM Smith was selected as the consultant for the desalination plant design-build project. Their work will include the design, construction and commissioning of the proposed seawater desalination plant. The planned facilities include the treatment plant, treated water storage and pumping, and concentrate storage and disposal facilities.

Construction costs for all elements of the desalination plant are currently estimated at $74,029,943.

PROJECT PURPOSE AND NEED

The primary purpose of the overall MPWSP is to replace existing water supplies that have been constrained by legal decisions affecting the Carmel River and Seaside Groundwater Basin water

resources. The purpose of the desalination plant portion of the MPWSP is to treat the water supplied by the seawater intake wells sufficient to meet the applicable water quality standards.

VE STUDY BASIS

The VE study was based on the 30% Design Submittal documents prepared by the project's design-build contractor, CDM Smith, dated June, 2014.

VE STUDY OBJECTIVES

The VE team was tasked with exploring ideas to improve project value by:

- Reducing project cost without sacrificing functionality
- Identifying opportunities to improve the desalination plant's operations and reliability
- Identifying recommendations for reducing long-term operational costs
- Improving the overall maintainability of the facility

EVALUATION OF BASELINE CONCEPT

The first day of the VE study included meetings with CDM Smith and other project stakeholder representatives. During the VE team's analysis of the baseline concept, a number of analytical tools and techniques were used to develop a thorough understanding of the functional requirements of the project and how well the baseline concept was performing the functions. A major component of this analysis was the use of Value Metrics, which seeks to assess the elements of cost, performance, time, and risk as they relate to project value. These elements required a deeper level of analysis, the results of which are detailed in the *Project Analysis* section of this report. The key performance attributes identified for the project are listed in the table on the right, "Performance Attributes."

Performance Attributes
Maintainability
Plant Operations
Future Flexibility
Environmental Impacts
Sustainability
Aesthetics

Below is a summary of the major observations and conclusions identified during the VE team's initial analysis of the baseline concept which led the VE team to identify the alternatives resulting from this study and presented herein.

- Buildings are located on the area of the site most prone to settlement during a seismic event. The project is assuming deep dynamic soil compaction to address collapsible soils.

- UV treatment appears to be included to address temporary uncertainty regarding treatment process and concerns with obtaining sufficient log removal for pathogen removal.

- The current design includes direct feed from intakes to pressure filters which could result in sand and deposits clogging the system.

- The baseline concept assumes a portion of the intake water must be returned after treatment to agriculture properties.

- The project will use granular pressure filters for pre-treatment of seawater prior to the RO membranes to remove iron and manganese.

- The current design is providing storage tanks for filtered water in order to maintain constant pump head through the RO process.

- The project assumes a brine disposal basin will be necessary when wastewater treatment plant (WWTP) discharge outfall is not available.

- The desalination plant may have an issue removing large equipment for maintenance relative to access and equipment transport.

- The current design shows pumps in chemical storage sumps. It is not fully understood where the pumps discharge.

- The project is currently planning for rigorous acceptance test procedures and requirements.

- The installation of pre-engineered metal buildings will require treatment to prevent corrosion and will require maintenance over the life of the facility.

- The current process design is recapturing 45% of the first pass treatment water and 90% of the second pass treatment water (average of 43% total recovery for the plant).

Additionally, sustainability evaluations were conducted to assess the baseline concept against the sustainability requirements of both the U.S. Green Building Council (LEED) and the Institute for Sustainable Infrastructure (Envision). The resulting sustainability assessment is included in the *Project Analysis* section of this report.

RISK ANALYSIS

A qualitative risk analysis was performed in conjunction with the VE study to identify risks related to project cost, time (schedule), and ability to perform its required functions. The VE team also discussed and identified possible risk mitigation strategies in an effort to reduce the overall risk profile of the project. Risk Registers were developed for the project and are provided in the *Project Analysis* section of this report. These Risk Registers provide all of the information for each risk including descriptions, probabilities, impacts and potential risk response strategies.

The following are the key lessons learned identified as a result of the risk analysis exercise:

- There is currently no raw water quality data available. Water quality may impact the assumptions relative to the plant's treatment processes and capacities.

- Plant capacity requirements are dependent on the implementation and success of the groundwater replenishment project which is currently being developed.

- Approval of the environmental documents and regulatory permits may require revisions to the project design.

A majority of the risks identified are being actively monitored and managed by the project design team and project management teams. Key risk mitigation strategies identified by the VE team included membrane pretreatment to mitigate the risk associated with unknown source water quality, and revising the construction schedule to allow the respective features time to be revised when information becomes available.

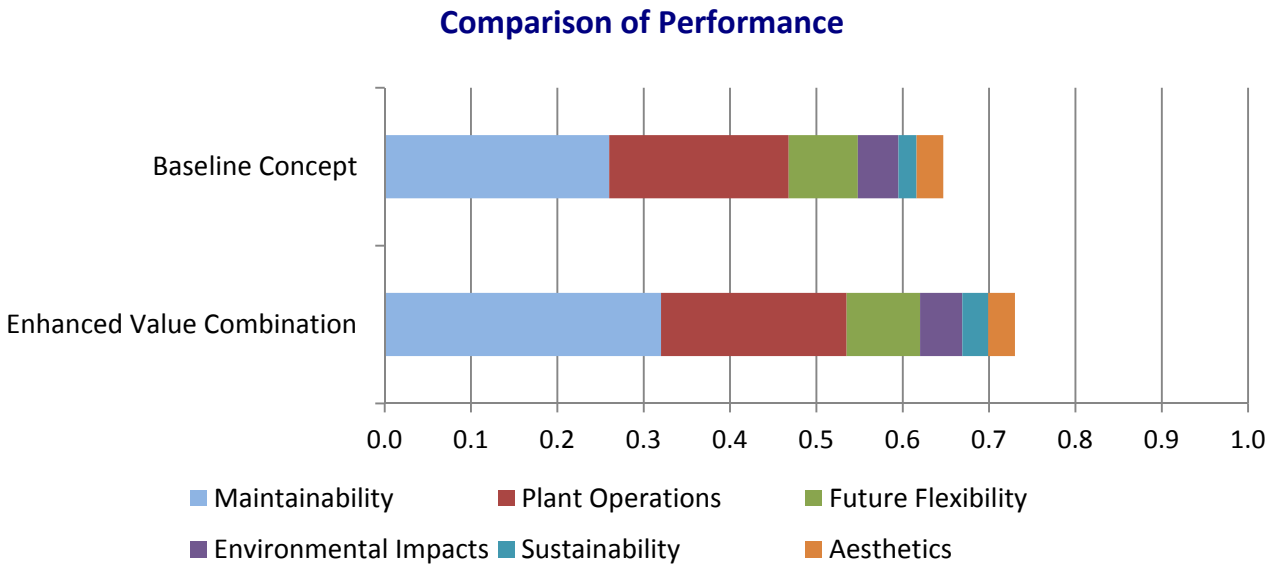
VE STUDY RESULTS

The VE team identified 33 VE Alternatives and 13 Design Comments to support overall project value. The VE Alternatives are organized by the primary topic or project aspect to which they refer:

- Building Design and Site Alternatives
- Water Treatment Equipment and Equipment Layout Alternatives
- Maintainability Alternatives
- Risk Mitigation and Schedule Alternatives
- Treatment Process Alternatives

Of these alternatives, 16 were selected and recommended by the VE team as a cumulatively-implementable alternative strategy focused on enhancing overall value potential for the project. The alternatives have been summarized in the following section of this report. The total net potential cost savings of the VE Strategy is approximately $9 million in initial cost savings and $23 million in life-cycle cost savings. It should be noted that a number of these alternatives would increase the initial project costs; however, they in turn provide benefits to project performance or in the reduction of maintenance and energy usage.

To evaluate the performance of the VE Strategy, the VE team considered the combined effect of all VE alternatives. The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. The following chart compares the total performance scores for the baseline concept and the "Enhanced Value" VE Strategy.



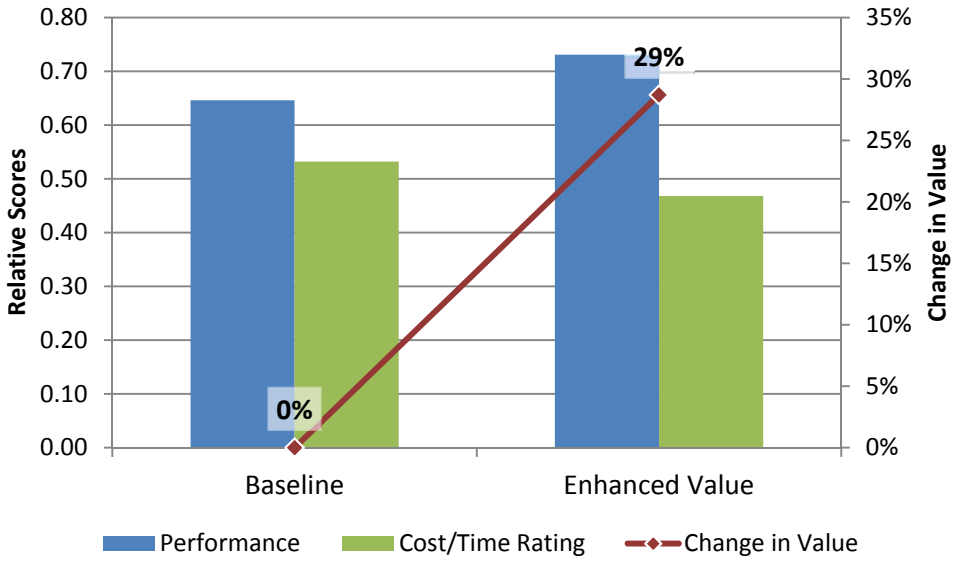
The table below summarizes the savings associated with the Enhanced Value Strategy. The performance scores were divided by the total cost scores for the strategy to derive a value index. The value index for the VE Strategy was then compared against the value index of the baseline concept and the difference is expressed as a percent change.

Summary of VE Strategy

Strategy Description	Initial Cost Savings	LCC Savings	Performance Change	Value Change
Enhanced Value Combination	$9,161,000	$23,204,000	+13 %	+29 %

The Comparison of Value chart below summarizes the total impact to project value resulting from the VE Study. The blue bars represent total project performance and the green bars represent total cost. Details and additional analysis of the baseline concept and VE Strategy performance ratings are included in the *Project Analysis* section of this report.

Comparison of Value – Baseline Concept and VE Strategy



VE ALTERNATIVE IMPLEMENTATION

VE studies are working sessions with the purpose of identifying and developing alternative approaches to a given project, then presenting them to all project stakeholders for consideration. During the VE Study, a Special Joint Meeting of the Monterey Peninsula Water Supply Project Governance Committee and Monterey Peninsula Regional Water Authority was held to present and discuss the preliminary results of the VE Study. The meeting was open to the public and attendees had the opportunity to question and comment on the VE study results.

Detailed feasibility assessment, determination of the VE alternatives' implementation, and final design development will be made following submittal of this Final VE Study Report.

VE TEAM

Participants on the VE team included independent technical experts from HDR Engineering, Inc. and Water Globe representing Architecture, Plant Operations/Maintenance, Sustainability (LEED and Envision), Civil/Structural Engineering, Electrical/Instrumentation & Controls, and Water Treatment Processes. Representatives from California American Water also participated to provide insight into their Plant Operations and Maintenance procedures as well as their engineering standards and requirements for the project. The public interests were represented by Monterey Peninsula Regional Water Authority and Monterey Peninsula Water Management District. A full list of participants in the VE study is included following the *Value Engineering Process* section of this report.

VALUE ENGINEERING ALTERNATIVES

The results of this study are presented as individual alternatives to the baseline concept. Each alternative consists of a summary of the baseline concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost comparison, discussion of schedule and risk impacts (if applicable), and a brief narrative comparing the baseline design with the alternative. Sketches and calculations are also presented where applicable.

Rough order-of-magnitude initial and life-cycle cost estimates were prepared where applicable in order to compare the net cost difference between the baseline concepts and the VE Alternatives. In several cases, the estimates do not include the total feature cost, but only those components that are changed by the alternative. The reader should note that the efforts of the VE team in developing the alternatives in the short time period of the VE study limits their findings to conceptual level analyses and rough order-of-magnitude cost estimates only. Additionally, with the project being delivered via a design-build contractor already under contract, the cost savings or cost increases reported for the VE Alternatives represent their potential cost impacts only and were developed to provide decision makers a sense of the potential significance of the VE Alternatives.

VE STRATEGIES

VE studies result in the development of a number of alternatives. While it is possible for all alternatives to be implemented, typically there are combinations of some alternatives that may provide the best solution for the project. This is due to the fact that some alternatives may be competing ideas or different ways to address the same issue.

As a result of these factors, the VE team developed a strategy that represents one possible combination of alternatives for the project to assist the decision makers in their evaluation of the VE alternatives. This strategy is based on factors that include improved performance, likelihood of implementation, and/or cost savings potential. This information is a guide and is not intended to reject the other alternatives from stakeholder consideration.

VE ALTERNATIVE SUMMARY TABLES

Summary of VE Alternatives

Alternative No. & Description	Initial Cost Savings	Life Cycle Cost Savings	Total Cost Savings Potential
Building and Site Design Alternatives			
BD-1 Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard	($250,000)	$0	($250,000)
BD-2 Eliminate fire protection of the buildings where not required by code	$359,000	$0	$359,000

Alternative No. & Description	Initial Cost Savings	Life Cycle Cost Savings	Total Cost Savings Potential
BD-3 Increase occupancy categories of process structures (category IV for the process-critical facilities)	($475,000)	$0	($475,000)
BD-4 Shift site layouts to avoid collapsible soils	$42,000	$0	$42,000
BD-5 Use a geogrid-reinforced soil mat in lieu of dynamic soil compaction	$34,000	$0	$34,000
BD-6 Connect the 4160 to 480 transformers directly to the 21kV switchgear	($50,000)	$406,000	$356,000
BD-7 Simplify landscaping using xeriscaping principles and eliminate irrigation	$196,000	$0	$196,000
Treatment Equipment and Equipment Layout Alternatives			
E-1 Revise configuration of RO trains to accommodate flat foot foundation	$400,000	$0	$400,000
E-2 Use radially split case pumps in lieu of segmental pumps	$202,000	$4,298,000	$4,500,000
E-3 Install acceptance testing connections as permanent	($200,000)	$0	($200,000)
E-4 Construct the filtered water storage tanks out of concrete and construct as rectangular	$73,000	$0	$73,000
E-5 Use fiberglass for the granular pretreatment filters in lieu of steel	$180,000	$228,000	$408,000
E-6 Relocate VFDs for RO feed water high pressure pumps to filter effluent transfer pumps	$463,000	$0	$463,000
E-7 Use above-ground FRP piping in lieu of below grade HDPE	$62,000	$0	$62,000
Maintainability Alternatives			
M-1 Increase size of the filtered water storage tanks	($480,000)	$0	($480,000)
M-2 Provide lifts to move heavy equipment	($350,000)	$0	($350,000)

Alternative No. & Description	Initial Cost Savings	Life Cycle Cost Savings	Total Cost Savings Potential
M-3 Eliminate pumps in chemical storage sumps	$0	$0	$0
M-4 Split the $C0_2$ tank to share 120-ton requirement between two tanks	$0	$0	$0
Risk Mitigation and Schedule Alternatives			
RS-1 Refine the design to meet test well data water quality information	$5,227,000	$0	$5,227,000
RS-2 Revise construction schedule using multiple crews per discipline to accelerate project completion	($3,701,000)	$0	($3,701,000)
Treatment Process Alternatives			
TP-1 Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)	$6,658,000	$2,935,000	$9,593,000
TP-2 Install a plug on the main permeate line after the second or third membrane and use all of the same elements	($53,000)	$3,341,000	$3,288,000
TP-3 Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use	($300,000)	$5,373,000	$5,073,000
TP-4 Eliminate sulfuric acid addition from process	$326,000	$0	$326,000
TP-5 Provide a spare chemical injection function to Desal Plant	($326,000)	$0	($326,000)
TP-6 Eliminate the UV treatment system	$750,000	$1,961,000	$2,711,000
TP-7 Consider more efficient ways of meeting CT requirements (flocculation chamber, membrane pretreatment, etc.)	$536,000	$0	$536,000
TP-8 Eliminate baffles in the treated water storage tanks; obtain CT points elsewhere	$100,000	$0	$100,000
TP-9 Optimize configuration from intake wells to RO membrane system	$700,000	$147,000	$847,000

Alternative No. & Description	Initial Cost Savings	Life Cycle Cost Savings	Total Cost Savings Potential
TP-10 Consider sand removal process prior to pretreatment	($225,000)	$4,515,000	$4,290,000
TP-11 Eliminate the backwash treatment system and discharge directly to brine basin	$200,000	$0	$200,000
TP-12 Install system to blend the brine with raw water	($150,000)	$0	($150,000)
TP-13 For 6.4 MGD plant option, eliminate brine pit and circulate the permeate and brine until discharge is allowed	($761,000)	$0	($761,000)

Note: Because the cost data depicted above represent savings*, a number in parentheses represents a cost* increase*.*

VE Strategy Summary

Strategy Description	Initial Cost Savings	LCC Savings	Performance Change	Value Change
Enhanced Value Combination Alternatives: BD-6, E-2, E-5, E-6, M-4, TP-1, TP-2, TP-3, TP-4, TP-5, TP-6, TP-7, TP-8, TP-9, TP-10, TP-11	$9,161,000	$23,204,000	+13 %	+29 %

OTHER CONSIDERATIONS

The VE team also identified a number of observations and design comments / suggestions for consideration primarily by the project designers. The suggestions consist of either technical review comments on the design documents themselves or ideas for which VE team could not quantify the performance or cost impacts. Narrative documentation of these design comments is included following the VE Alternatives.

VE ALTERNATIVE BD-1

Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard

Initial Cost Savings: ($250,000)
Change in Schedule: +1 month

Description of Baseline Concept: The plan layout of the SWRO Building and Admin Building indicates two buildings separated by a 50-foot-wide open Garden space.

Description of Alternative Concept: The alternate concept attaches the Admin Building to the SWRO building in order to provide visual and direct physical connectivity from the Control Room, located inside the Admin Building, into the SWRO Building. The Control Room can either be one or two stories depending on whether or not visual connection is desired from a higher vantage point.

Advantages:

- Provides direct visual oversight from the Control Room into the SWRO Building and its operations
- Provides immediate access from the Control Room into the SWRO Building
- Provides quicker response time by controls and maintenance staff

Disadvantages:

- Requires architectural and engineering redesign efforts
- May impact the project schedule since a second 30% submittal will likely be required for review, comment and approval before advancing to the next design phase
- Redesign costs will necessitate an increase to the DB design team's contract
- Construction costs will likely increase, particularly if a 2-story Controls Room is selected
- The current open Garden area would be bisected into two separate areas

Discussion: Comments were voiced during the VE Workshop regarding (1) the possibility of reducing the 50-foot separation between the SWRO and Admin Buildings, and (2) a concern that the operators inside the Control Room will have no direct visual overview of the SWRO operations area. Also, experts on the VE Team reported that similar facilities often include control rooms with windows to allow direct visual overview of the operations plants. If a one story Admin Building plan is desired, the changes to accommodate the alternate plan will not be extensive. Plan changes will be slightly more extensive if a 2-story Control Room is selected.

Discussion of Schedule Impacts: Redesign efforts (excluding review and response time by CAW and other stakeholders) should be achievable within the range of 30 to 45 calendar days.

Discussion of Risk Impacts: There is a risk that occupancy and fire-rated separations between the SWRO and Admin Building will introduce costs and complexities that do not currently exist in the baseline design.

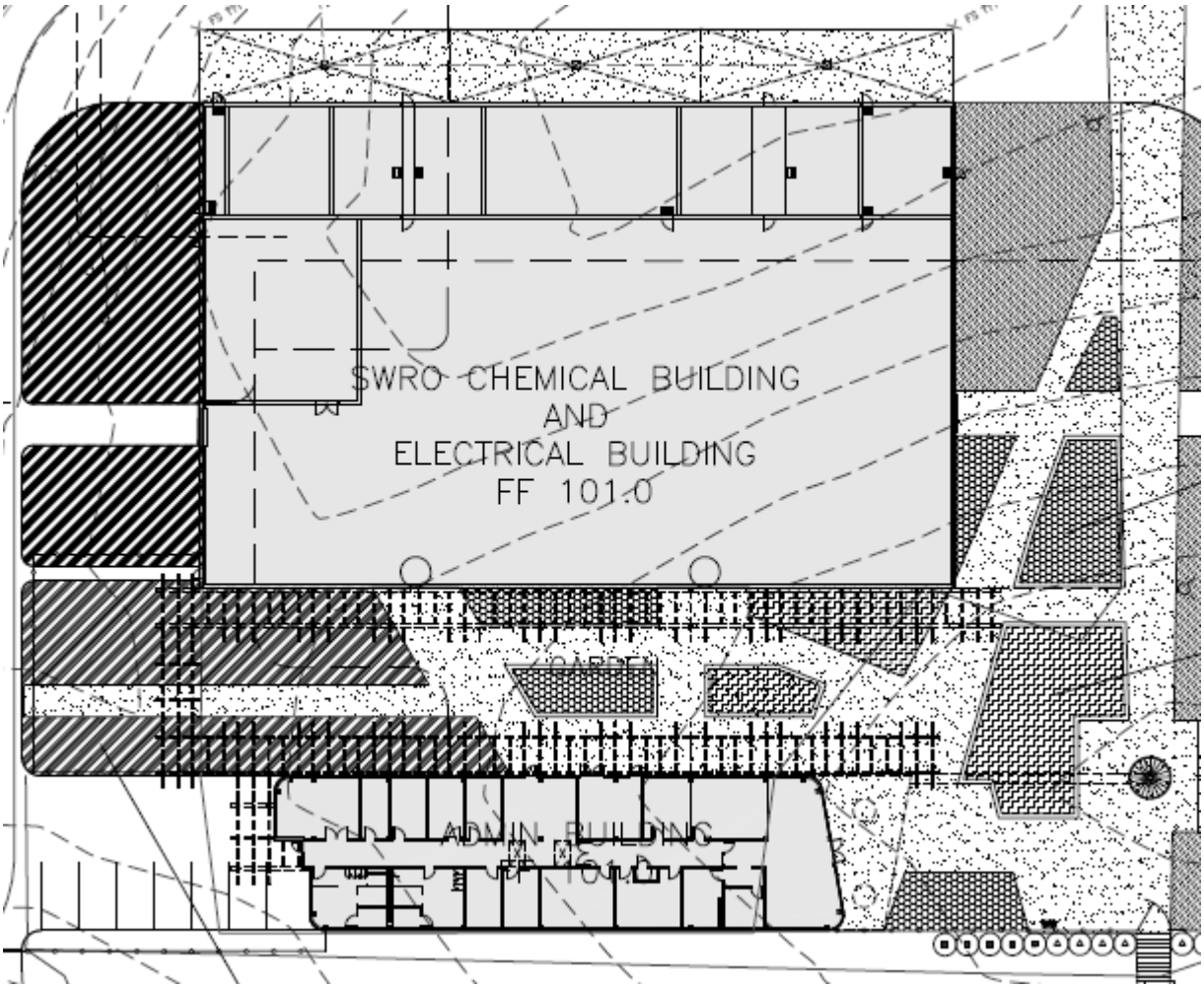
VE ALTERNATIVE BD-1

Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Reduces response time in the event of an emergency or mechanical failure inside the SWRO Building.
Plant Operations	Deemed a more desirable configuration for connectivity of control room operators to the facility.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	Building materials would not change but the building shape would.

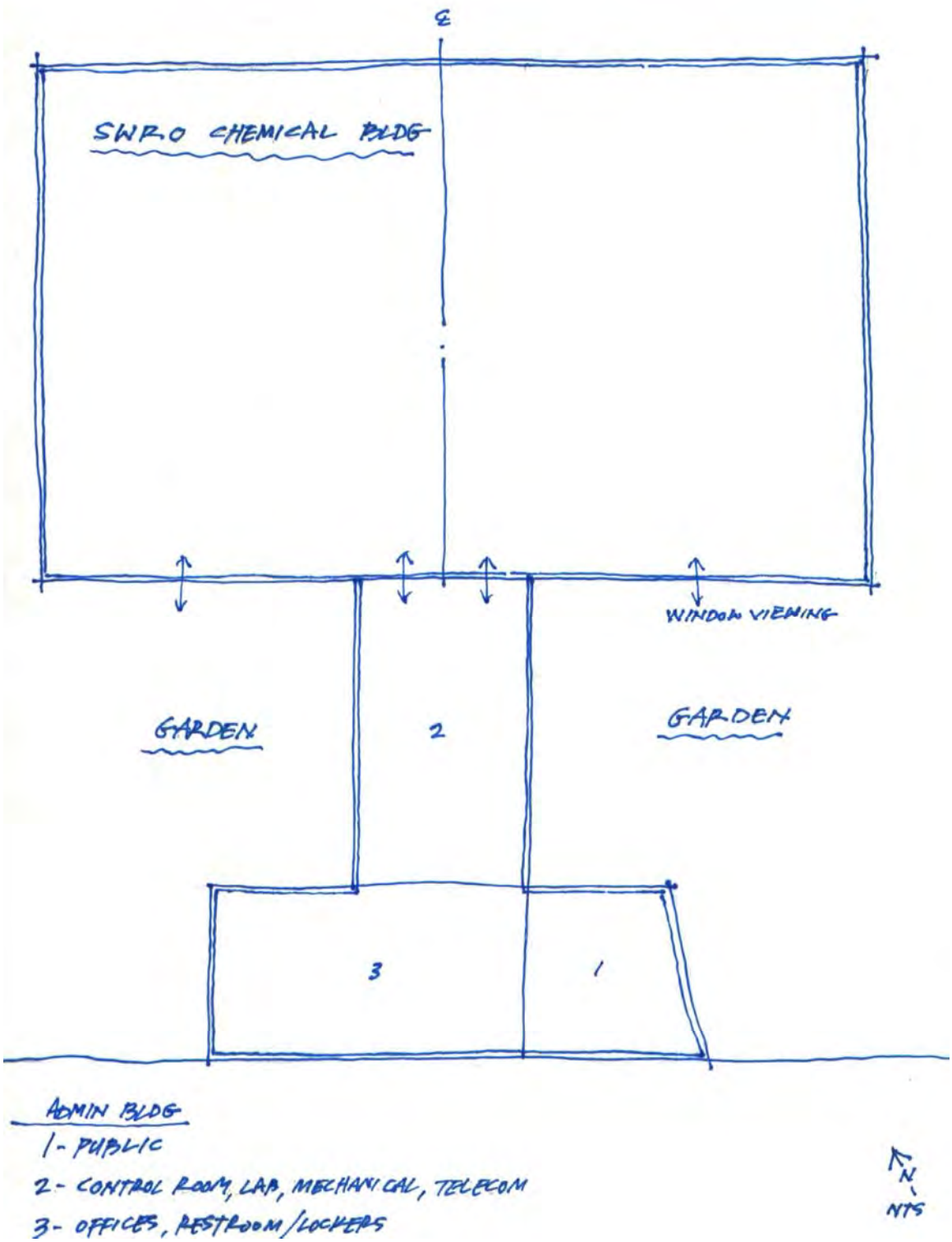
Baseline Concept Sketch



VE ALTERNATIVE BD-1

Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard

VE Alternative Concept Sketch



VE ALTERNATIVE BD-1

Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard

Assumptions and Calculations: The assumption is that the Admin Building floor plan area will remain similar to the current 30% design in the Public and Office areas. The portion connecting to the SWRO Building must be redesigned to accommodate the alternative concept.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Admin Bldg - Const	sf	10,000	$ 250	$ 2,500,000	10,000	$ 275	$ 2,750,000
SUB-TOTAL				$2,500,000			$2,750,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$2,500,000			$2,750,000
						SAVINGS	**($250,000)**

VE ALTERNATIVE BD-2

Eliminate fire protection of the buildings where not required by code

Initial Cost Savings: $359,000

Description of Baseline Concept: The 30% design submittal does not specify areas within the plant receiving fire sprinkler coverage. Per Mike Zafer of CDM Smith on 7/9/14, the SWRO Building, the Admin Building and the Filter Building are all fully sprinklered in the current baseline concept.

Description of Alternative Concept: This recommendation simply proposes the project team should confirm whether fire sprinkler coverage is required in (1) the Filter building, and delete if not, and (2) if the RO room within the SWRO building can change to non-sprinklered.

Advantages:

- Construction costs savings for material and labor costs

Disadvantages:

- Life safety of staff and facility asset protection will be less broad where fire sprinkler coverage is eliminated
- Additional design time and cost to update the 30% drawings and Basis of Design

Discussion: Many other buildings with similar occupancy do not have fire sprinkler coverage. The VE team is not aware of any special conditions that would require certain buildings to trigger code requirements that mandate fire sprinkler coverage. Based on quick code research, the VE team determined:

- The chemical storage rooms in the SWRO building are H4 Occupancy and must be sprinklered.
- The RO area inside the SWRO building does not need to be sprinklered if the walls adjacent to the H4 Occupancy are changed to 3-hour rated walls. The 30% design shows these as 2-hour walls.
- The Filter Building (F2 Occupancy) has an area of 3,900 square feet which is below the code threshold requiring sprinklers.

This alternate must be further explored and confirmed by the CDM Smith design team relative to the applicable code requirements.

Discussion of Schedule Impacts: Negligible schedule benefit is anticipated.

Discussion of Risk Impacts: Life safety of staff and facility asset protection within the Filter Building must be evaluated by CAW.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant change.
Plant Operations	No significant change.
Future Flexibility	The concept has the potential to limit future flexibility only if the fire

VE ALTERNATIVE BD-2

Eliminate fire protection of the buildings where not required by code

Performance Attribute	Rationale for Change in Performance
	sprinklers are eliminated in facilities that may one day be repurposed for other uses that do require a fire suppression system.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

Assumptions and Calculations: Assumption is that CDM Smith's 30% design, particularly in relation to the code analysis, may be adjusted per the discussions above. However, confirmation by CDM Smith's designers is recommended.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Fire Sprinkler Coverage-Filter Building	SF	3,900	$ 15	$ 58,500			
Fire Sprinkler Coverage-R.O. area	SF	20,000	$ 15.0	$ 300,000			
SUB-TOTAL				$358,500			$0
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$359,000			$0
						SAVINGS	**$359,000**

VE ALTERNATIVE BD-3

Increase occupancy categories of process structures (category IV for the process-critical facilities)

Initial Cost Savings: ($475,000)

Description of Baseline Concept: Table 19-7 Risk Categories of the BODR calls for Facility Risk Category of IV for the finished water storage tanks and related equipment, and Facility Risk Category of III for other structure.

Description of Alternative Concept: The VE team recommends that a closer look should be given to the facilities where higher Occupancy Category maybe needed for some structures and a lower one for the rest; for example, SWRO might be IV, and Admin Building might be II.

Advantages:

- Design consistency with IBC 2012 and ASCE 7- 2010 Code
- May result in cost savings

Disadvantages:

- None apparent

Discussion: The VE team suspects that some of the structures within the desalination plant may qualify for lower Risk Category designations that could produce cost savings for the project. However, some other structures may require higher risk designations.

This concept calls for examining the function of each structure within the facility and call for the proper designation based on the function itself, the need, and importance of the structure in relation to entire operation and other elements.

Discussion of Schedule Impacts: None identified.

Discussion of Risk Impacts: None identified.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant change.
Plant Operations	No significant change.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

VE ALTERNATIVE BD-3

Increase occupancy categories of process structures (category IV for the process-critical facilities)

Assumptions and Calculations: The project design is not developed to the point where specific structure costs can be determined. However, generally speaking, increasing the Risk Category of a facility tends to raise the structure costs by approximately 10%. Decreasing the Risk Category tends to reduce costs by approximately 10%.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Admin Building	SF	6,000	$ 250	$ 1,500,000	6,000	$ 225	$ 1,350,000
R.O. Building	SF	25,000	$ 250	$ 6,250,000	25,000	$ 275	$ 6,875,000
SUB-TOTAL				$7,750,000			$8,225,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$7,750,000			$8,225,000
						SAVINGS	**($475,000)**

VE ALTERNATIVE BD-4

Shift site layouts to avoid collapsible soils

Initial Cost Savings: $42,000

Description of Baseline Concept: The baseline concept calls for constructing the facility in an area that is generally comprised of loose to very loose sand, which according to the BODR is considered unsuitable. The project geotechnical engineer estimates 2 to 3 inches of seismically-induced settlement during a design earthquake event, as compared to the 0.5 to 1 inches of seismically-induced settlement reported in the Baseline Geotechnical Report (URS).

The BODR proses to re-densify the soil below the proposed building pads in order to provide uniform and adequate bearing capacity for the foundation systems. The proposed design considers over-excavation and compaction, in addition to one of the following alternatives to address the differential settlement:

- Structures supported by mat foundations
- Geopiers beneath the structures
- Dynamic compaction beneath the structures

Description of Alternative Concept: It was communicated to the VE team that the site area is roughly 43 acres. Therefore, this alternative recommends considering one of the two following options:

- Shift the entire location of the facility within the site to an area where more suitable foundation material is located
- Shift location of facilities in relation to each other within the same area (i.e., interchange the Brine Equalization Basin with Admin and SWOR Treatment Buildings)

Advantages:

- Eliminates or reduces the need for mat foundation, geopiers beneath the structures, or dynamic compaction beneath the structures
- If better foundation materials do not exist on site, the Brine Equalization Basin is more forgiving for differential settlements than the Admin and SWOR Treatment Buildings
- Reduces cost
- Schedule savings depending on the option selected

Disadvantages:

- Requires additional borings and soil investigation
- Additional cost to perform geotechnical investigation

Discussion: The BODR report had mentioned that there are areas on site that have been previously investigated by URS that have seismically-induced settlement of the 0.5 to 1 inches.
Compared to the cost of additional soil treatment proposed, it might be worth it to perform additional soil investigation to look for better location for the facilities.
The entire site might be shifted or structures within the same area placing the more settlement sensitive structures on the better areas.

VE ALTERNATIVE BD-4

Shift site layouts to avoid collapsible soils

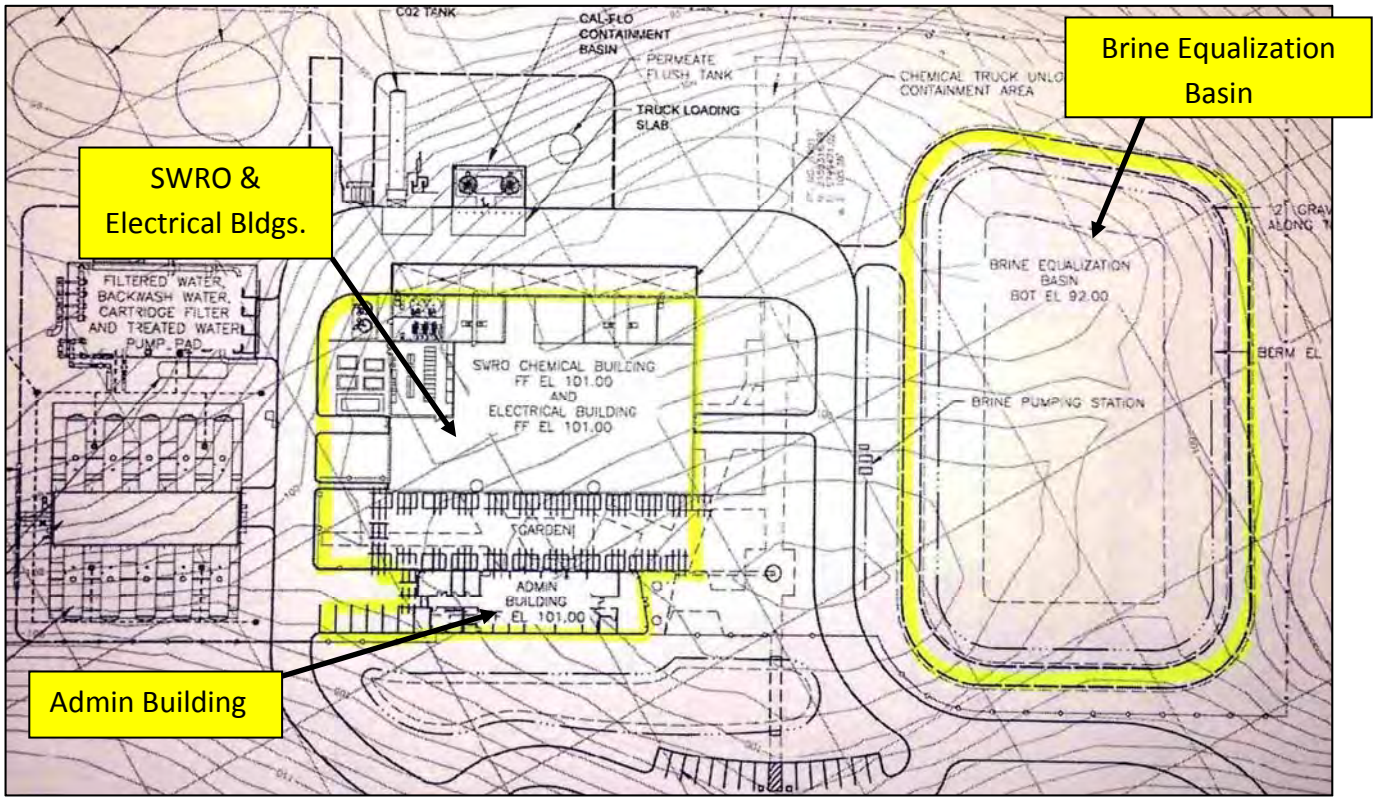
Discussion of Schedule Impacts: No construction schedule impacts are anticipated. Little to no design impact would be expected since the design is currently at 30%.

Discussion of Risk Impacts: Unknown to the VE team at this point.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Minor reduction of maintenance efforts.
Plant Operations	No Significant Impact.
Future Flexibility	No Significant Impact.
Environmental Impacts	No Significant Impact.
Sustainability	No Significant Impact.
Aesthetics	No Significant Impact.

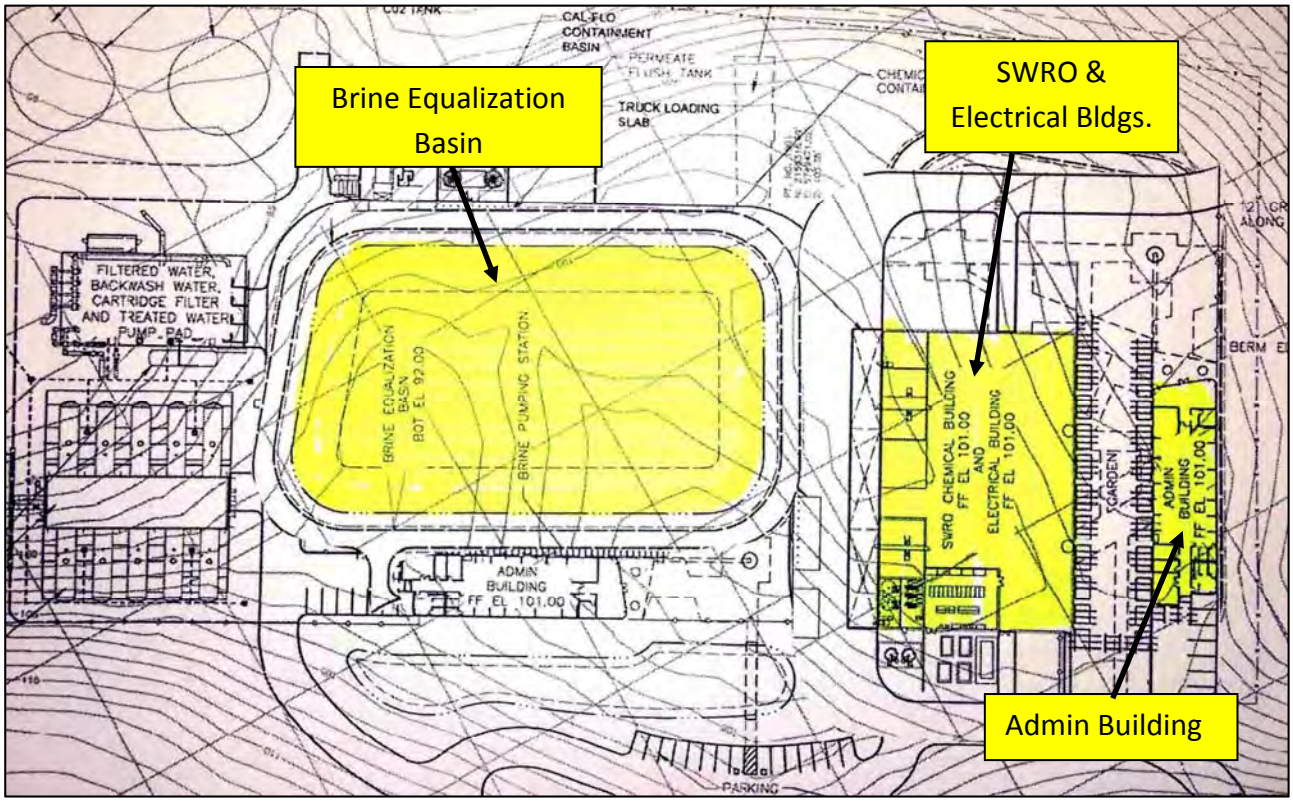
Baseline Concept Sketch



VE ALTERNATIVE BD-4

Shift site layouts to avoid collapsible soils

VE Alternative Concept Sketch



Proposed revised locations of plant facilities

Assumptions and Calculations:

- Other areas on site have better foundation materials
- There are no adverse impacts from shifting the entire facility or portion of it within the site
- The cost of soil treatment/strengthening of localized areas is not offset by longer piping or other impacts

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Dynamic Deep Soil Compaction	SF	60,000	$ 0.70	$ 42,000			
SUB-TOTAL				$42,000			$0
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$42,000			$0
						SAVINGS	**$42,000**

VE ALTERNATIVE BD-5

Use a geogrid-reinforced soil mat in lieu of dynamic soil compaction

Initial Cost Savings: $34,000

Description of Baseline Concept: The Baseline design is considering over- excavation and compaction combined with one of a three alternatives below to address the 2 to 3 inches of estimated differential settlement:

- Structures supported by mat foundations
- Geopiers beneath the structures
- compaction beneath the structures

Description of Alternative Concept: This alternative calls for a geosynthetic-reinforced soil mat to be placed under the SWRO and Admin buildings that have conventional footings. The purpose of the soil mat would be to limit differential settlement across the building footprint in event of seismically induced settlement as opposed to other proposed measure.

Advantages:

- Reduces differential settlements
- Reduces construction cost and maintenance
- Reduces construction schedule

Disadvantages:

- None apparent

Discussion: The BODR states that the "soil near surface soils beneath the proposed development area are generally comprised of loose to very loose sand and are therefore considered unsuitable in their present state for structural support. A zone of re-densified soil below the proposed building pads is recommended in order to provide uniform and adequate bearing capacity for the foundation systems".

The estimated seismically-induced settlement during the design earthquake event is 2 to 3 inches. As a mitigation for this large settlement, the 30% design is considering over-excavation and compaction, combined with one of three alternatives to address the differential settlements: structures supported by mat foundations, geopiers beneath the structures, or dynamic compaction beneath the structures.

Geogrid-reinforced soil mats are biaxial polypropylene geogrids for base course reinforcement and subgrade stabilization. They deliver strength, long-term performance, reliability and quick installation for base reinforcement of foundations on weak soils.

The use of geogrid-reinforced soil mats has become a viable method to mitigate differential settlements caused by deformations in the underlying soils, including those resulting from fault rupture and seismically-induced settlements. This alternative proposes installing a geosynthetic-reinforced soil mat under the SWRO and Admin buildings or other areas of high load, and conventional footings. The purpose of the soil mat would be to limit differential settlement across the building footprint in the event of seismically-induced settlement.

VE ALTERNATIVE BD-5

Use a geogrid-reinforced soil mat in lieu of dynamic soil compaction

Discussion of Schedule Impacts: There should be no adverse impact on schedule resulting from implementing this concept. Rather, it might help save schedule as geo-grids can be placed faster than performing the soil compaction.

Discussion of Risk Impacts: Project risk is not anticipated to be greatly affected by this concept. If the proposed foundations are implemented for the project, there will be improved safety to the desalination plant infrastructure and personnel in the event of an earthquake.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Maintainability is improved due to reduced settlement and cracking, as well as less leakage in piping and valves.
Plant Operations	Enhanced.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	This concept enhances facility aesthetics (lines are all horizontal).

Assumptions and Calculations: Average costs of dynamic soil compaction range for $0.60 to $.0.90 per square foot. Average costs of the geo-grid is approximately $0.25 per square foot.

The quantity of site area that will be subject to the soil compaction was not available. As such, the VE team assumed an area of 60,000 SF to cover the majority of the central area of the plant where the buildings are located.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Dynamic Deep Soil Compaction	SF	60,000	$ 0.70	$ 42,000			$ -
Geo-Grid Reinforced Soil Mat	SF			$ -	31,000	$ 0.25	$ 7,750
				$ -			$ -
SUB-TOTAL				$42,000			$7,750
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$42,000			$8,000
						SAVINGS	**$34,000**

VE ALTERNATIVE BD-6

Connect the 4160 to 480 transformers directly to the 21kV switchgear

Initial Cost Savings: ($50,000)
LCC Savings: $356,000

Description of Baseline Concept: The existing electrical distribution system has the 21kv to 4160 volt (5000 kva) transformer and the 4160 volt to 480 volt (2500 kva) transformer connected in series. The power for the 2500 kva tranformer goes through the 5000 kva transformer. The configuration is typical for two transformers, circuits MDS-2A and MCS-2B. All four transformers are pad mounted, oil filled transformers.

Description of Alternative Concept: Change the 2500 transformers from "4160 volt to 480 volt" to "21kv to 480 volt" and connect to the 21 kv switchgear. The change would require the cables be installed from the 21 kv switchgear instead of the 4160 volt switchgear. Two additional fused switches would be added to the 21 kv switchgear and two circuit breakers would be deleted from the 4160 volt switchgear.

Advantages:

- The power would only have to be transformed once reducing the losses in the system

Disadvantages:

- The system would have to be analyzed to see if the change affected the rating of the downstream equipment

Discussion: The loss through the transformer is dependent on two factors: the size of the transformer (no load losses) and the load through the transformer. The actual loss is dependent on the type and rating of the transformer and will be approximated in this case to be 1 % of the load. The no load losses will not be considered as the size of the transformers are not being changed.

The reconfigured system will eliminated the load loss through the 5000 kva transformer for the load that has to be transformed to 480 volt. In the baseline concept the 480 volt power load is transformed twice resulting in a 2% load loss. With the proposed concept, the power load is transformed once resulting in a 1 % load loss. The load loss change is approximately 26 kva from information submitted as part of the 30% design.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant change.
Plant Operations	No significant change.
Future Flexibility	No significant change.

VE ALTERNATIVE BD-6

Connect the 4160 to 480 transformers directly to the 21kV switchgear

Performance Attribute	Rationale for Change in Performance
Environmental Impacts	No significant change.
Sustainability	Improved through reduction in energy usage.
Aesthetics	No significant change.

Assumptions and Calculations:

- The losses throughout a transformer (neglecting load losses, as size of 5000 kva transformer does not change) are generally approximately 1%.
- The peak demand of MDS-2A is 1243 kva and MDS-2B is 1683 kva (from CDM Smith 30% submittal), for a total 480 volt load of 2926 kva.
- Average load is assumed to be 90% of the peak load (estimate). One percent is 26 kva, so assuming 0.93 power factor (CDM Smith 30% submittal), the result is 24 kw.
- Assume plant operates 95% of the time: 24kw x 24 hours x 365 days x .95 (plant operating 95% of the time) results in 199,728 kwh reduction in one year.
- Energy cost is 8 cents in the winter (6 months) and 10 cents in the summer (6 months), resulting in an average energy cost of 9 cents.
- Resulting energy savings of 18,000 dollars per year.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
4160 circuit breakers	ea	2	$ 25,000	$ 50,000			
21 kv fuse switches sections	ea				2	$ 50,000	$ 100,000
SUB-TOTAL				$50,000			$100,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$50,000			$100,000
						SAVINGS	**($50,000)**

VE ALTERNATIVE BD-6

Connect the 4160 to 480 transformers directly to the 21kV switchgear

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$50,000	$100,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years	**INITIAL COST SAVINGS:**				**($50,000)**
B. SUBSEQUENT ANNUAL COSTS					
Energy				$17,975	$0
			Total Subsequent Annual Costs:	$17,975	$0
			Present Value Factor (P/A):	22.576	22.576
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$406,000**	**$0**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
			1.00000		$0
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$406,000**	**$0**
			TOTAL SUBSEQUENT COSTS SAVINGS:		**$406,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$456,000**	**$100,000**
			TOTAL LIFE CYCLE SAVINGS:		**$356,000**

VE ALTERNATIVE BD-7

Simplify landscaping using xeriscaping principles and eliminate irrigation

Initial Cost Savings: $196,0000

Description of Baseline Concept: The landscape design in the 30% submittal includes indigenous plants that only require irrigation until their roots are established - as reported by Joni Janecki, Landscape Architect on 7/7/14. The 30% design is not yet detailed enough to show how this initial irrigation period concept will be implemented.

The Basis of Design Draft Report (BODR) dated 4/14/14 indicates only "A drip irrigation system will be designed and implemented".

The design also includes vegetables planted in raised beds to create an "agricultural education garden" per the BODR. As reported on 7/8/14, the gardens will be irrigated with rainwater (and possibly water from the desalination facility) that will be captured then stored within an above-ground cistern tank. Ms. Janecki reported that the cistern's capacity can provide up to 50% of the water necessary to irrigate the garden vegetables throughout a given year.

Description of Alternative Concept: Explore and design a means to eliminate the use of potable water entirely for the irrigation of plants. Scale back plant materials and irrigation as much as possible.

Advantages:

- Reduces cost due to less irrigation pipe and bubblers, and future maintenance costs
- Reduces construction associated with installation

Disadvantages:

- The site landscape plants may be less likely to survive with reduced irrigation, particularly during extended drought periods
- Cost savings for less piping and bubblers may be offset by higher costs for a larger or second cistern tank and associated pumping system

Discussion: Implementation of the alternative includes reevaluating the design to confirm that all (non-vegetable plants) are indigenous and/or can survive without potable water and a scaled back irrigation system.

Discussion of Schedule Impacts: Schedule impact will be negligible.

Discussion of Risk Impacts: There is a risk that some plants will not survive over an extended amount of time. If this effect occurs then certain detrimental impacts including erosion, blowing sands and possibly a less attractive installation may exist in the future.

VE ALTERNATIVE BD-7

Simplify landscaping using xeriscaping principles and eliminate irrigation

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Reduced maintenance costs.
Plant Operations	No significant change.
Future Flexibility	No significant change.
Environmental Impacts	Same as Sustainability – see below.
Sustainability	This alternate supports the potential achievement of a LEED credit WE1 related to the use of less potable water within the design.
Aesthetics	Increases the possibility of a less attractive site if all plants do not survive.

Assumptions and Calculations: Assumption is made that CAW has not yet accepted the extent of planting provided by CDM Smith in the 30% design submittal. A 25% cutback in landscape materials and irrigation is the basis for the cost analysis for this alternative.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Landscaping & Irrigation - Construction	sf	70,000	$ 7	$ 490,000			
Landscaping & Irrigation - Baseline design	%	490,000	0.1	$ 49,000			
Landscaping & Irrigation - Redesign	%	490,000	.05	$ 24,500			
Landscaping & Irrigation - Alt. Construction	sf			$ -	70,000	$ 5.25	$ 367,500
				$ -			
SUB-TOTAL				$563,500			$367,500
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$564,000			$368,000
						SAVINGS	**$196,000**

VE ALTERNATIVE E-1

Revise configuration of RO trains to accommodate flat foot foundation

Initial Cost Savings: $400,000

Description of Baseline Concept: Currently the desalination plant building is designed to include a two-level configuration of the foundations. The upper level houses all equipment and the lower level (pipe galleries) house most of the interconnecting piping.

Description of Alternative Concept: This recommendation proposes to reconfigure the interconnecting piping and equipment layout such that the building foundation is simplified to a flat foot foundation. An example is provided in the image on the following page.

Advantages:

- Simplifies constructability
- May eliminate the need for site soil compaction
- Reduces foundation costs by 25 to 30%

Disadvantages:

- Increases building's total footprint (or height) by 10 to 15%.
- Reduces accessibility to the plant equipment for maintenance – a number of bridges/overpasses will need to be installed to go over piping which is laid down on the floor

Discussion: Flat-foot foundations are commonly used in desalination plants where soils are weak and/or groundwater is high (examples: 34 MGD Gold Coast SWRO Plant Australia, 80 MGD Perth II Desalination Plant, Australia, all desalination plants in Israel, 15 MGD desalination plants in Larnaka and Dhekelia, Cyprus).

In order to solve challenges associated with RO system and equipment accessibility for maintenance the building foot print is usually increased to provide additional space for circulation of maintenance equipment and staff.

Discussion of Schedule Impacts: Potential positive impact; not quantified at this point in time.

Discussion of Risk Impacts: No significant risks associated with implementation.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	May have negative impact due to reduced accessibility to key RO equipment; could be mitigated by enlarging the footprint of the building or installing all piping above the RO trains.
Plant Operations	May have negative impact due to reduced accessibility to main equipment (could be mitigated).
Future Flexibility	No significant impact.

VE ALTERNATIVE E-1

Revise configuration of RO trains to accommodate flat foot foundation

Performance Attribute	Rationale for Change in Performance
Environmental Impacts	Positive impact due to less excavation and offsite soil hauling/ disposal (fewer truck trips).
Sustainability	No significant impact.
Aesthetics	Slight degradation: 10 to 15% larger building footprint or taller building.

VE Alternative Concept Sketch

Assumptions and Calculations: The building footprint can be enlarged to accommodate the installation of both equipment and piping on one floor.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
RO Building Foundation		1	$ 2,100,000	$ 2,100,000	1	$ 1,500,000	$ 1,500,000
RO Building Cost - Above Grund Structure		1	$ 4,000,000	$ 4,000,000	1	$ 4,200,000	$ 4,200,000
SUB-TOTAL				$6,100,000			$5,700,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$6,100,000			$5,700,000
						SAVINGS	**$400,000**

VE ALTERNATIVE E-2

Use radially split case pumps in lieu of segmental pumps

Initial Cost Savings: $202,000
LCC Savings: $4,500,000

Description of Baseline Concept: The baseline concept includes the use of segmental-ring high pressure pumps designed to operate at 82% efficiency. Figures are provided on the following page to illustrate the type of pumps.

Description of Alternative Concept: The alternative concept proposes to replace the segmental-ring pumps with radially split case pumps. Further, consider the use of one radially split case pump to feed two RO trains in order to increase the high pressure pump size and obtain pump efficiency of 87% (instead of 82%) and to achieve capital cost savings. This concept proposes the use of 4 radially split case pumps instead of 7 segmental-ring pumps.

Advantages:

- Reduces energy usage and capital cost
- Simplified pump maintenance – radially split case pumps are much easier to maintain because they are water cooled and have less complex assembly
- Space savings – radially split case pumps occupy approximately 50% less space.

Disadvantages:

- Use of fewer pumps could reduce plant reliability because if one pump is taken out of service, two RO trains rather than one RO train will be inoperable

Discussion: Use of radially split case pumps instead of segmental pumps is a common trend in the latest desalination plant designs. This concept can be implemented even if individual pumps are used for each train. This scenario would likely result in a capital cost penalty of $250,000. The energy efficiency of the pumps will be 85% instead of 87%, which will reduce the overall lifecycle cost savings in a half - i.e. from $2.588 million to $1.3 million. Taking the extra cost for the pumps, the total life-cycle benefit will be approximately $1 million.

At present, split case pumps are the norm for facilities with high unit energy costs. Additional savings could be achieved if one energy recovery device is used for two trains using common high-pressure pumps. Additional benefits would be lower capital costs from fewer ERDs and potentially improved energy efficiency.

Discussion of Schedule Impacts: Minor schedule impact only associated with the extra time needed for redesign of the RO system.

Discussion of Risk Impacts: Potential increase in reliability risk because one high pressure pump will feed two RO trains.

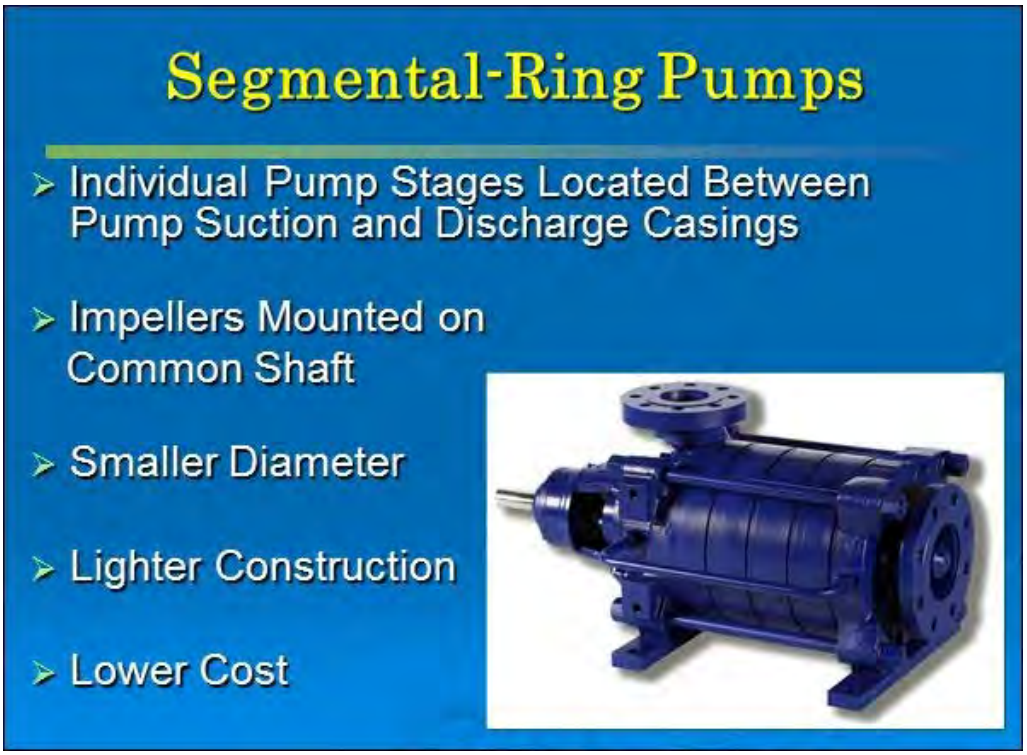
VE ALTERNATIVE E-2

Use radially split case pumps in lieu of segmental pumps

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Significant improvement.
Plant Operations	More complex operation – two RO trains fed by the same pump.
Future Flexibility	No impact.
Environmental Impacts	No impact.
Sustainability	Lower energy usage results in a more sustainable project.
Aesthetics	No impact.

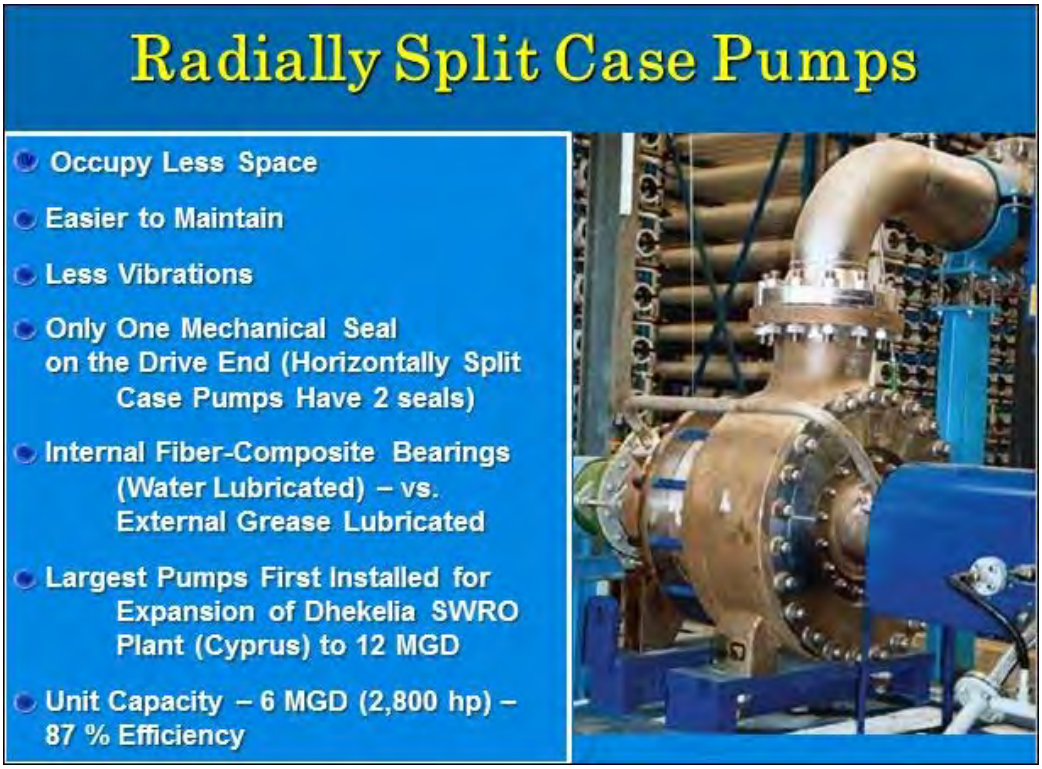
Baseline Concept Sketch



VE ALTERNATIVE E-2

Use radially split case pumps in lieu of segmental pumps

VE Alternative Concept Sketch



Assumptions and Calculations:

- Total plant energy use - 11.6 kWh/1,000 gallons
- Total plant power costs - $4.76 million
- Total plant energy savings of 4% by increasing high pressure pump efficiency from 82 to 87%
- Taking under consideration that 70% of the plant energy (11.6 kwh/1,000 gal) is consumed by the high pressure pumps, the total energy use savings will be 11.6 kWh/1000 gal x 0.7 x (1 - 82/87) = 0.47 kWh/1000 gallons - 4%
- Capital cost reduction of $202,000 as a result of replacing 7 segmental pumps with 4 radially split case pumps
- $2,588,000 from energy savings
- Labor and maintenance cost reduction due to more simple operation (unquantified)

VE ALTERNATIVE E-2

Use radially split case pumps in lieu of segmental pumps

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Seven segmental ring high pressure pumps		7	$ 286,000	$ 2,002,000			
Four radially split case pumps					4	$ 450,000	$ 1,800,000
SUB-TOTAL				$2,002,000			$1,800,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$2,002,000			$1,800,000
						SAVINGS	**$202,000**

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			**BASELINE**	**ALTERNATIVE**
A. INITIAL COST				$2,002,000	$1,800,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years	**INITIAL COST SAVINGS:**				**$202,000**
B. SUBSEQUENT ANNUAL COSTS					
Energy				$4,760,000	$4,569,600
	Total Subsequent Annual Costs:			$4,760,000	$4,569,600
	Present Value Factor (P/A):			22.576	22.576
	PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):			**$107,462,000**	**$103,164,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
	PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):			**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$107,462,000**	**$103,164,000**
	TOTAL SUBSEQUENT COSTS SAVINGS:				**$4,298,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$109,464,000**	**$104,964,000**
	TOTAL LIFE CYCLE SAVINGS:				**$4,500,000**

VE ALTERNATIVE E-3

Install acceptance testing connections as permanent

Initial Cost Savings: ($200,000)

Description of Baseline Concept: The baseline concept at 30% stage does not contemplate any special provisions or connections to recirculate water during the startup and commissioning phase. Also, it does not contain any provisions to recirculate flow to the head of the plant to keep the plant running during short periods, instead of shutting the plant down.

Description of Alternative Concept: Install a permanent connection between the treated water line and the raw water line at the desalination plant during the initial construction. This will assist in startup/commissioning as well as allowing the plant to recycle flow under abnormal condition (instead of having to shut down).

Advantages:

- One simple connection will allow treated water to be recycled back to the head of the plant
- The initial connection will allow the operators to avoid shutting down the facility during many scenarios in the future
- Planning for startup and commissioning connections up front avoids more expensive change orders at the last moment

Disadvantages:

- A slight increase in initial construction cost, but some of this can be offset by the contractor reducing his cost for temporary pumping provisions

Discussion: During the startup and commissioning of the plant, it will be necessary to recycle all flows back to the head of the plant if the brine outfall is not available. This will involve recycling flows from the end of the plant (treated water), backwash recycling basins, and brine equalization basins. No flows will be allowed to go to the distribution system. By doing this, the contractor can complete his functional testing at 100% capacity, and gain approval from DPH to put flow into the distribution system.

There is a benefit to making these recycling connections permanent, in that when the plant is in normal operations the plant can continue to operate without being shut down. Properly shutting down a reverse osmosis process is a very complicated and time consuming activity, especially when one considers the effort ensure membranes are not damaged, and also the process in starting the plant back up and creating potable water. Having the ability to recycle water through the plant during times it would normally be shut down would greatly enhance the plant's operability.

The three recycle components are described below:

1. Treated Water: Water that passes through all of the treatment steps would be returned to the head of the plant. The treated water pumps that would normally pump the water into the distribution system would have enough head to pump the treated water back to the head of the plant. The capacity of these pumps is 9.6 MGD. Since the treated water pipeline (downstream of the treated water pumps) passes nearby the raw water line, this could be

accomplished by connecting the two pipes. This would involve the installation of two tees, two valves, and a short run of 24-inch pipe.

2. Backwash Recycling Basin: The design already has the ability to pump part (1.1 MGD) of the backwash water back to the head of the plant. Any excess backwash water would overflow to the brine equalization basin. No modifications are needed.

3. Brine Equalization basin: Approximately 60% of the total plant influent ends up as brine and will be discharged to the MRWPCA outfall. Under normal circumstances, the brine will flow by gravity but there will be times when a small volume will be pumped from the brine equalization basin to the outfall. The brine equalization pumps do not have enough head to recycle back to the head of the plant.

By making the connection mentioned in item 1 above, the quantity of water that can be recycled to the head of the plant increased from 1.1 MGD to 10.7 MGD. This is a huge improvement in the ability to perform test runs of the facility, and also keep the facility in standby mode instead of shutting it down.

An alternative approach (which would only be beneficial during the initial startup and commissioning) would be to pass all flows down to the MRWPCA outfall. This could be done by a) allowing all treated water to overflow the treated water tanks and into the brine equalization basin (and ensuring there is an overflow at the brine equalization basin that goes to the MRWPCA outfall line), b) allowing all flows to the backwash recycling basin to overflow to the brine equalization basin, and c) allow all brine to go down the pipe to the MRWPCA outfall.

Discussion of Schedule Impacts: No impact.

Discussion of Risk Impacts: This will reduce the risk of potential damage to the membranes during shutdown and startup, as well as excess "off spec water" during abnormal circumstances.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Minimum impact because the initial connection will allow the operators to avoid shutting down the facility during many future scenarios.
Plant Operations	Significant positive impact on stabilizing operations during abnormal conditions.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	During startup and commissioning, using less raw water and discharging less water to the outfall. It could save over 100 million gallons of water being extracted from the slant wells.
Aesthetics	No significant change.

VE ALTERNATIVE E-3

Install acceptance testing connections as permanent

Assumptions and Calculations:

- This concept was verified by checking the hydraulic grade line of all pertinent aspects of the recycling
- The connection between the treated water and raw water lines should be less than $150,000
- If there is currently no overflow line on the brine equalization basin, it should be less than $50,000 to install one

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Interconnect between treated water line and raw water line	1	0		$ -	1	$150,000	$ 150,000
Potential: Overflow line to brine equalization basin	1	0		$ -	1	$ 50,000	$ 50,000
				$ -			$ -
SUB-TOTAL				$0			$200,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$0			$200,000
						SAVINGS	**($200,000)**

VE ALTERNATIVE E-4

Construct the filtered water storage tanks out of concrete and construct as rectangular

Initial Cost Savings: $73,000

Description of Baseline Concept: The baseline concept includes two 750,000 gallon prestressed concrete finished water storage tanks (approximate dimensions: 70' diameter by 27' tall).

Description of Alternative Concept: This alternative proposes replacing two tanks with a single two-cell reinforced concrete storage tank.

Advantages:

- Common wall construction

Disadvantages:

- Exposed concrete surface harder to finish than the base line prestresed concrete tank
- Shorter tank height due to cracking limits on wall thickness
- Differential settlement could be more challenging on the larger combined footing

Discussion: Many times, reinforced concrete tanks can be built less expensively than prestressed concrete tanks. The one advantage that prestressed tanks have over reinforced concrete tanks is the ability to design taller tanks.

Discussion of Schedule Impacts: No change.

Discussion of Risk Impacts: No change.

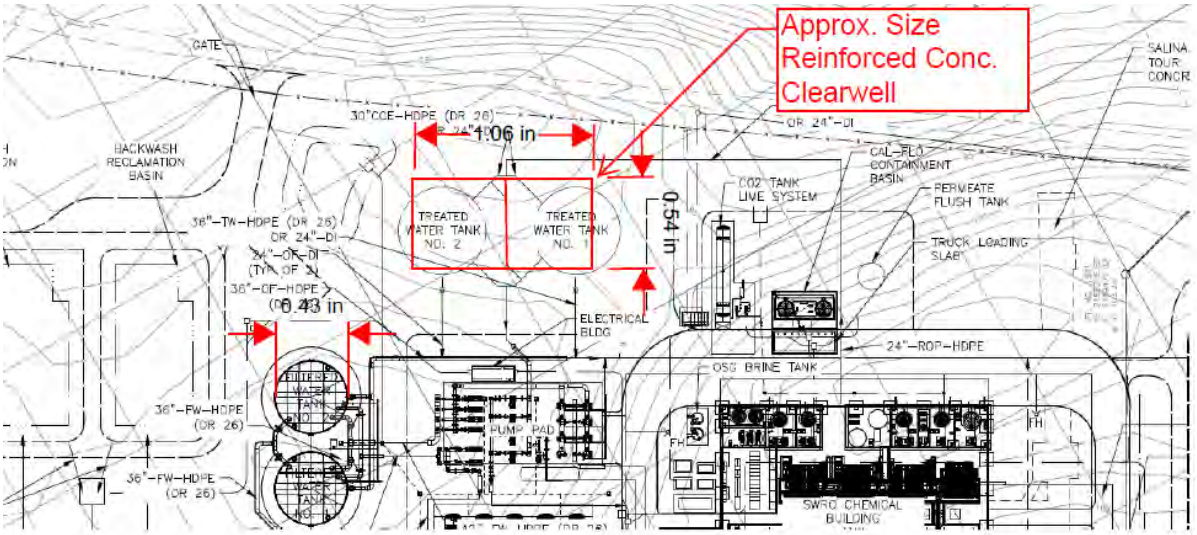
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No change.
Plant Operations	No change.
Future Flexibility	Slight improvement in future in flexibility.
Environmental Impacts	No change.
Sustainability	Slight improvement as more material may be locally sourced.
Aesthetics	Slight decrease.

VE ALTERNATIVE E-4

Construct the filtered water storage tanks out of concrete and construct as rectangular

VE Alternative Concept Sketch



0.43" ~ 50' or 1" = 116'
123' = 1.06"
63' = 0.54"

Assumptions and Calculations:

Description	Quantity	Unit	Comment
Treated Water Flow	9.60	MGD	from BODR pg. 10-1
Raw Water Flow	6,667	gpm	
Base Line Design			
Nominal Tank Volume	750,000	gal	from BODR pg. 10-1
Tank Diameter	69.50	ft	Dwg S-34
Tank Height	26.75	ft	Dwg S-34
Computed Volume	759,075	gal	
Number of Tanks	2	ea	
Total Volume	1,518,151	gal	
Volume per foot	56,753	gal / ft	
Alternative Design			
Wall Height	14.00	feet	Typical max span for 18' thick wall
Length	120	feet	Assume 2:1 Length to width
Width Cell 1	60	feet	
Width Cell 2	60	feet	
Wall Thickness	1.5	feet	
Recomputed Volume	1,507,968.00		
Base Slab	1,190	CY	Assume 2' thick and 1.5' overhang
Top Slab	567	CY	Assume 1' thick
Walls	327	CY	

VE ALTERNATIVE E-4

Construct the filtered water storage tanks out of concrete and construct as rectangular

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Finshed Water Storage Tanks	ea	2	$ 750,000	$ 1,500,000			
Base Slab	CY				1,190	$ 500	$ 595,000
Walls	CY				327	$ 750	$ 245,000
Top Slab	CY				567	$ 1,000	$ 567,167
Hatches	ea				4	$ 5,000	$ 20,000
SUB-TOTAL				$1,500,000			$1,427,167
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$1,500,000			$1,427,000
						SAVINGS	**$73,000**

VE ALTERNATIVE E-5

Use fiberglass for the granular pretreatment filters in lieu of steel

Initial Cost Savings: $180,000
LCC Savings: $408,000

Description of Baseline Concept: The baseline concept includes 10 steel rubber-lined pressure filter tanks that are 10-feet in diameter by 40 feet (~24,000 gallons).

Description of Alternative Concept: This alternative proposes to replace the steel tanks with fiberglass tanks.

Advantages:

- Lighter structural concrete supports required
- No lining required
- Weather resistant, with no corrosion or future painting issues
- Lighter tanks to ship and handle in the field
- Proven strength and use in RO facilities

Disadvantages:

- Any cracks or leaks in the tank shell requires replacement as it is difficult to repair and maintain shell strength (unlike steel that can be patch welded)

Discussion: The alternative proposal is to replace the 10 steel pressure filter tanks with more cost-effective fiberglass tanks, which require less maintenance and are more weather-resistant.

Discussion of Schedule Impacts: No change.

Discussion of Risk Impacts: No change.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	This alternative reduces maintenance relative to steel tanks and potential corrosion issues.
Plant Operations	No change.
Future Flexibility	No change.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	No change.

VE ALTERNATIVE E-5

Use fiberglass for the granular pretreatment filters in lieu of steel

Baseline Concept Sketch

VE Alternative Concept Sketch

Assumptions and Calculations: The following calculation assume $2.50 a gallon for the steel rubber-lined tanks, a 30% discount from that for fiberglass considering less expensive tanks, concrete supports, painting, and shipping costs.

VE ALTERNATIVE E-5

Use fiberglass for the granular pretreatment filters in lieu of steel

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Pressure Filter Tanks - Steel	EA	10	$ 60,000	$ 600,000			
Pressure Filter Tanks - Fiberglass				$ -	10	$ 42,000	$ 420,000
SUB-TOTAL				$600,000			$420,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$600,000			$420,000
						SAVINGS	**$180,000**

Life-Cycle Cost Estimate

Life Cycle Period 30 Years				Real Discount Rate 1.942%		**BASELINE**	**ALTERNATIVE**
A.	**INITIAL COST**					$600,000	$420,000
	Service Life-Baseline		Years	**INITIAL COST SAVINGS:**			**$180,000**
	Service Life-Alternative		Years				
B.	**SUBSEQUENT ANNUAL COSTS**						
				Total Subsequent Annual Costs:		$0	$0
				Present Value Factor (P/A):		22.576	22.576
				PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):		**$0**	**$0**
C.	**SUBSEQUENT SINGLE COSTS**	**Year**	**Amount**	**PV Factor (P/F)**		**Present Value**	**Present Value**
	Replace rubber lining on filters	5	100,000	0.90831		$90,831	
	Replace rubber lining on filters	10	100,000	0.82503		$82,503	
	Replace rubber lining on filters	15	100,000	0.74938		$74,938	
	Replace rubber lining on filters	20	100,000	0.68067		$68,067	
	Replace rubber lining on filters	25	100,000	0.61826		$61,826	
	Replace rubber lining on filters	30	100,000	0.56157		$56,157	
				PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):		**$228,000**	**$0**
D.	**TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)**					**$228,000**	**$0**
				TOTAL SUBSEQUENT COSTS SAVINGS:			**$228,000**
F.	**TOTAL PRESENT VALUE COST (A+D)**					**$828,000**	**$420,000**
					TOTAL LIFE CYCLE SAVINGS:		**$408,000**

VE ALTERNATIVE E-6

Relocate VFDs for RO feed water high pressure pumps to filter effluent transfer pumps

Initial Cost Savings: $463,000

Description of Baseline Concept: In the baseline concept, VFDs are proposed to be installed on both the high pressure pumps and on one of the filter effluent transfer pumps.

Description of Alternative Concept: This concept proposes to install VFDs on all filter effluent transfer pumps and eliminate the VFDs on the high pressure pumps.

Advantages:

- Equipment cost savings from installing smaller VFDs

Disadvantages:

- Potential impact on energy efficiency (1-3% of elevated energy use) if the source water salinity varies in a very wide range - i.e., 15,000 to 35,000 mg/L

Discussion: The existing design is very conservative and would only be suitable for desalination plants with shallow vertical intake wells with heavy influence from fresh groundwater if a large fresh water aquifer is connected to the coastal aquifer.

From prior experience in Spain, slant wells have shown to produce source water in a narrow range of salinity within 10% of average. Usually VFDs on the intake pumps are needed when the TDS of the feed water varies over 30% of the average.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improved due to the use of smaller VFDs and elimination of one set of VFDs.
Plant Operations	Minimal Impacts.
Future Flexibility	No impact.
Environmental Impacts	No Impact.
Sustainability	No Impact.
Aesthetics	No Impact.

VE ALTERNATIVE E-6

Relocate VFDs for RO feed water high pressure pumps to filter effluent transfer pumps

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
VFD of High Pressure Pumps		7	$ 85,000	$ 595,000	6	$ 22,000	$ 132,000
SUB-TOTAL				$595,000			$132,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$595,000			$132,000
						SAVINGS	**$463,000**

VE ALTERNATIVE E-7

Use above-ground FRP piping in lieu of below-grade HDPE

Initial Cost Savings: $62,000

Description of Baseline Concept: Permeate and Raw/Saline Water pipes are specified as below-grade high-density polyethylene (HDPE) and fiber-reinforced plastic (FRP) above-grade pipes in the baseline concept.

Description of Alternative Concept: This alternative proposes to substitute below-grade HDPE piping with above-grade FRP piping.

Advantages:

- Potential cost savings of 30%
- Improves accessibility for maintenance

Disadvantages:

- Redesign for rerouting pipes, and the associated costs may be significant
- Conflicts with above-grade appurtenances and crossings
- Exposes pipes to elements and impacts
- Additional property fencing is needed if pipes outside the fence line are brought above grade
- Aesthetically, above-ground piping is not preferred for this location

Discussion: The baseline concept site design and layout is based on HDPE below-grade pipes. Because of the compact site design, most of the below-grade piping runs parallel to and beneath improved surfaces with limited room in surface shoulders to install above-ground piping. Significant pipeline, site redesign, surface crossing and man walks will be required if the alternative concept is implemented, therefore, offsetting some of the cost savings. This alternative considers only the pipelines in areas outside of improved surfaces and other conflicts. In addition, a site with above-ground FRP will impact overall plant aesthetics.

Discussion of Schedule Impacts: Minimal impact to the design schedule.

Discussion of Risk Impacts: None noted.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improves maintainability on above-grade segments.
Plant Operations	No change.
Future Flexibility	No change.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	Degrades project aesthetics.

VE ALTERNATIVE E-7

Use above-ground FRP piping in lieu of below-grade HDPE

VE Alternative Concept Sketch

Example of above-grade FRP piping

Assumptions and Calculations: This proposal assumes that only pipelines outside the improved areas will be under consideration for this application.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
8" RCW		130	$ 130	$ 16,900	130	$ 98	$ 12,675
30" BWW		225	$ 225	$ 50,625	225	$ 169	$ 37,969
30" BWS		20	$ 225	$ 4,500	20	$ 169	$ 3,375
36" BWS		120	$ 250	$ 30,000	120	$ 188	$ 22,500
30" CCE		160	$ 250	$ 40,000	160	$ 188	$ 30,000
30" BRF		410	$ 250	$ 102,500	410	$ 188	$ 76,875
SUB-TOTAL				$244,525			$183,394
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$245,000			$183,000
						SAVINGS	**$62,000**

VE ALTERNATIVE M-1

Increase size of the filtered water storage tanks

Initial Cost Savings: ($480,000)

Description of Baseline Concept: The baseline concept includes two 300,000-gallon covered, glass-lined tanks, with a total volume of approximately 600,000 gallons. Assuming a 5-foot minimum operating level, the effective volume is approximately 440,000 gallons.

Description of Alternative Concept: This alternative proposes the installation of two 500,000-gallon covered, glass-lined tanks, resulting in a total volume of approximately 1,000,000 gallons. Assuming a 5-foot minimum operating level, effective volume is approximately 770,000 gallons.

Advantages:

- Increases volume available for backwashing pre-treatment pressure filters in case they become inundated with iron, manganese or other foulants
- Increases effective volume detention time from 27 to 47 minutes
- Increases effective volume detention time if one tank is out of service from 13 to 23 minutes

Disadvantages:

- Increases capital costs of the project and will slightly increase the O&M cost of the project due to maintenance requirements of a larger tank

Discussion: This idea was requested by the operation staff to increase detention time and the amount of backwash water available. As part of the initial design concept, CAW considered the larger tanks; however, during the desalination plant procurement process, the design-build entity submitted slightly smaller tanks.

There are generally two schools of thought when it comes to tanks providing detention time. One is to provide enough volume to be able to react in time to changes in water quality. With approximately 27 minutes of reaction time with two units in service, and only 13 minutes of reaction time with one unit in service, it is possible that operations will miss a change in water quality. The second school of though is that if the tanks are too large, and the plant experiences a slug of poor quality water, it takes a much longer time to clear it out. In this case, the request to make tanks slightly larger is reasonable. See the figure on the following page for a conceptual layout.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

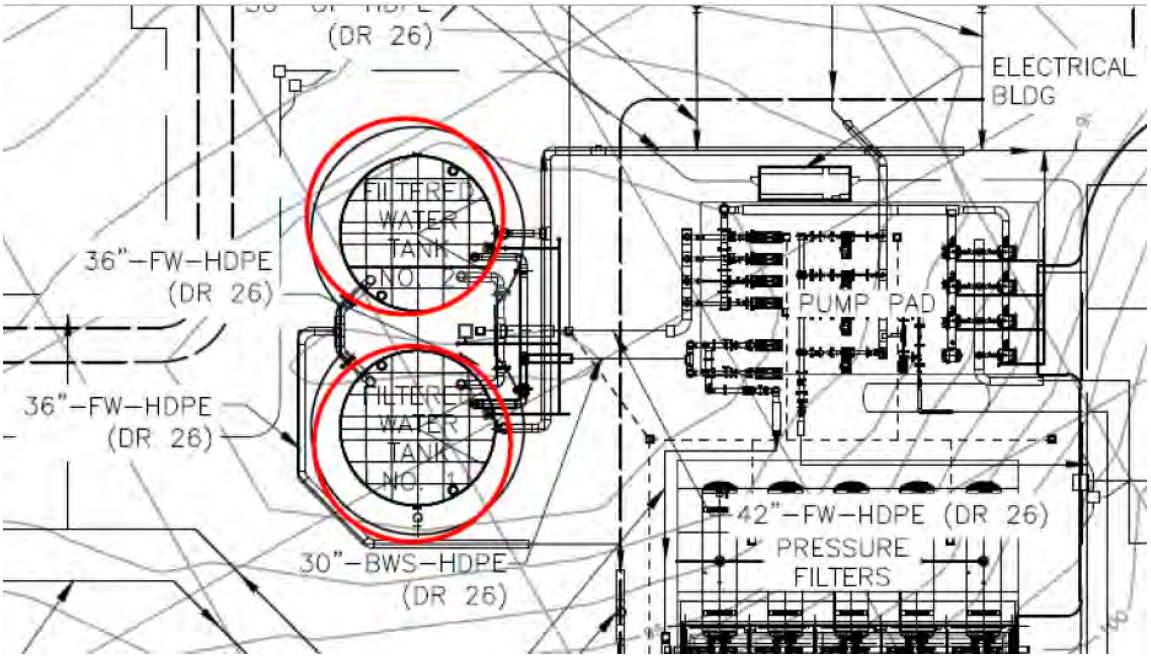
VE ALTERNATIVE M-1

Increase size of the filtered water storage tanks

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Slight increase in overall maintenance as tanks become larger.
Plant Operations	Increases plant operators' reaction time to changing conditions.
Future Flexibility	No change.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	Tanks increase from 50-foot diameter to 66-foot diameter. Height remains the same, so no real change in overall plant aesthetics.

VE Alternative Concept Sketch



VE ALTERNATIVE M-1

Increase size of the filtered water storage tanks

Assumptions and Calculations

Description	Quantity	Unit	Comment
Raw Water Flow	23.60	MGD	from BODR pg. 4-7 reliable capacity of Filterered Water PS (2 @ 11.8, 2@ 5.9 MGD)
Raw Water Flow	16,389	gpm	
			Baseline Design
Nominal Tank Volume	300,000	gal	from BODR pg. 4-2
Tank Diameter	50.00	ft	Dwg S-34
Tank Height	20.00	ft	Dwg S-34
Computed Volume	293,739	gal	
Number of Tanks	2	ea	
Total Volume	587,478	gal	
Volume per foot	29,374	gal / ft	
Max Detention Time: 1 Tank	17.92	min	
Max Detention Time: 2 Tank	35.85	min	
Effective Volume	440,608		assume 5-foot min operating level
Effective Detention Time: 1 Tank	13.44	min	
Effective Detention Time: 2 Tank	26.88	min	
			VE Proposal
Nominal Tank Volume	500,000	gal	
Tank Diameter	66.00	ft	
Tank Height	20.00	ft	
Computed Volume	511,811	gal	
Number of Tanks	2	ea	
Total Volume	1,023,621	gal	
Volume per foot	51,181	gal / ft	
Max Detention Time: 1 Tank	31.23	min	
Max Detention Time: 2 Tank	62.46	min	
Effective Volume	767,716		assume 5-foot min operating level
Effective Detention Time: 1 Tank	23.42	min	
Effective Detention Time: 2 Tank	46.84	min	

VE ALTERNATIVE M-1

Increase size of the filtered water storage tanks

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
2 - 300,000 gallon, covered, glass lined tanks	ea	2	$ 360,000	$ 720,000			$ -
3 - 500,000 gallon, covered, glass lined tanks				$ -	2	$ 600,000	$ 1,200,000
				$ -			$ -
SUB-TOTAL				$720,000			$1,200,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$720,000			$1,200,000
						SAVINGS	**($480,000)**

VE ALTERNATIVE M-2

Provide lifts to move heavy equipment

Initial Cost Savings: ($350,000)

Description of Baseline Concept: The baseline 30% design does not include provision for moving or removing the large equipment in the RO building. It is assumed that the equipment would be removed using a portable crane.

Description of Alternative Concept: In the RO Building, the installation of a permanent overhead bridge crane is recommended to be able to move, remove and install large pieces of equipment (pumps, motors) and new membrane skids. This crane would have a 5-ton capacity.

Advantages:

- Ease of moving large equipment when needed
- Could be used to install equipment
- Avoids having to roll heavy equipment over grating on trenches

Disadvantages:

- Existing building cannot support the bridge crane, so a separate framing structure would have to be installed
- Increases cost

Discussion: In the RO Building, there are numerous pieces of large, heavy equipment. These include large pumps and motors, as well as membrane skids and long pieces of pipe. During construction these are normally installed using a crane, and must be completed before the roof is installed on the building.

During the life of the project, all equipment will have to be repaired and/or replaced. The VE team recommends there should be a provision for moving the equipment in and out of the building without damaging surrounding equipment or risking injury of employees. For example, there will be seven 800-horsepower motors inside the building, which each weigh roughly 7,500 pounds.

Due to the piping and equipment configuration, the use of a portable gantry crane may not be possible. It would have to fit over the equipment, then it would have to be wheeled out of the building. While it is wheeled, it would have to pass over grating which protects trenches in the building floor.

In order to minimize installation cost of the proposed concept, the length of the crane span should be evaluated. The bridge crane does not necessarily have to span the entire width of the building. It only has to be above the heavy equipment. The independent support frame structure that has to be built could be constructed only partly across the building.

VE ALTERNATIVE M-2

Provide lifts to move heavy equipment

Discussion of Schedule Impacts: This alternative should have little to no impact on the project's construction schedule.

Discussion of Risk Impacts: This should reduce project risk during operations:

- Use of the bridge crane will reduce the chance of equipment damage during equipment repair and replacement.
- Installation at the project onset should include a thorough maximum load evaluation. This will avoid unqualified personnel assuming loads later in the project and incorrectly using an insufficient portable crane.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	The use of a permanent bridge crane will greatly improve the maintainability of the facility. It will make the moving of the large equipment significantly easier and safer than using a portable crane.
Plant Operations	This should not impact operation, but will greatly assist the plant maintenance personnel.
Future Flexibility	The use of a permanent bridge crane will allow much easier installation of pumps, motors, membrane skids, and chemical tanks into the RO building if capacity is ever increased. Remember that the original equipment will probably be installed using a crane before the roof is installed. Not having a bridge crane will make the installation of future equipment much riskier, and probably more expensive.
Environmental Impacts	No significant impact.
Sustainability	No significant impact.
Aesthetics	No significant impact.

Assumptions and Calculations:

- The installation of a permanent bridge crane in the RO building will probably cost in the order of $250,000 to $400,000.

- This assumes that the heaviest piece of equipment inside the building is the 800 hp motor which is roughly 7500 pounds. If the 800hp motor is skid mounted with the pump attached it could approach 10,000 pounds.

- This assumes that the RO building does not support the bridge crane and that a separate supporting frame structure must be built.

VE ALTERNATIVE M-2

Provide lifts to move heavy equipment

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Bridge Crane and supporting frame structure	1	0		$ -	1	$ 350,000	$ 350,000
				$ -			$ -
SUB-TOTAL				$0			$350,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$0			$350,000
						SAVINGS	**($350,000)**

VE ALTERNATIVE M-3

Eliminate pumps in chemical storage sumps

Initial Cost Savings: $0

Description of Baseline Concept: The existing design shows sump pumps in chemical storage sumps. The pumps would operate on a manual-enable switch and shut off by float switch activation. At present, pumps are connected to the sanitary sewer.

Description of Alternative Concept: This concept proposes to provide portable sump pumps and receptacles for power connection. The operators would put the sump pumps in the sumps when sumps are full. Pumps would be connected to receptacles on the outside of the building such that chemicals could be loaded into a truck or container for disposal.

Advantages:

- Provides positive confirmation that sump does not contain chemical spillage
- Operation of the pump can be limited to qualified operators

Disadvantages:

- Operator must physically carry a sump pump from an equipment storage area to the chemical sump

Discussion: The permanent installation of sump pumps reduces the amount of time required to pump out a chemical sump. The chemical sump pumps cannot be automated due to the fact that if a chemical spill occurs, the sump pump might pump chemicals into the sanitary sewer system. If the pump is permanently installed, a local on/off switch is installed allowing an operator to operate the pump by a local switch with an overriding float switch to shut the pump off when the sump is empty. One issue with this method is that anyone (qualified or not) can operate the pump.

If portable pumps are used as proposed in this alternative, when the sumps are full, a float switch can generate an alarm in SCADA and an operator will take a pump to the sump, lower it into the sump and pump out the wash down water, storm water or chemical to the appropriate vessel for disposal.

In either installation, normal operation would be to check the sump to ensure that no chemical is present before operating the sump pump.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

VE ALTERNATIVE M-3

Eliminate pumps in chemical storage sumps

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant change.
Plant Operations	Slightly increases work load for Plant operations.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

Assumptions and Calculations: Assume the same number of pumps for both alternatives, so no significant cost impacts are estimated for the alternative concept at this point in time.

VE ALTERNATIVE M-4

Split the $C0_2$ tank to share 120-ton requirement between two tanks

Initial Cost Savings: $0

Description of Baseline Concept: One CO_2 120-ton storage tank is provided in the baseline concept. (Drawing sheet M45 and M46).

Description of Alternative Concept: To provide for redundancy during tank maintenance, this alternative recommends utilize two storage tanks to provide the same amount of storage.

Advantages:

- Allows maintenance of tanks without losing CO_2 capability

Disadvantages:

- Minor cost increase

Discussion: To provide adequate redundancy it is recommended that two tanks be provided for critical product water stabilization. Instead of installing a redundant 120-ton CO_2 tank, it is advised to split the volume requirement between the two tanks at some ratio, i.e. 50/50, 60/40, or 70/30. This allows one tank to be removed for maintenance while maintaining operations.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improves maintainability due to increased redundancy of the tanks.
Plant Operations	Improves plant reliability by allowing one CO_2 to operate while the other is maintained.
Future Flexibility	No change.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	No change.

Assumptions and Calculations: Although two tanks may cost slightly more than the single tank of the baseline concept, given the total capacity of the CO_2 has not changed, assume the alternative is a no cost change.

VE ALTERNATIVE RS-1

Refine the design to meet test well data water quality information

Initial Cost Savings: $5,227,000

Description of Baseline Concept: The project has been designed around many assumptions relative to the quality and quantity of raw water that will be delivered to the plant from the intake wells. Key assumptions include equipment sizing, chemical treatment processes, and storage quantities. The reported intent is to not significantly revise the design when the information from the test well is available. The assumption is that the design will be robust enough to account for any water quality or quantity issues. Currently, the design team has been contractually limited relative to their engineering design fees. The full amount of engineering design fees will not be authorized until the project receives certain regulatory approvals in order to proceed.

Description of Alternative Concept: Perform a design analysis of the treatment processes, equipment sizing, and storage capacities once water quality and quantity information is available from the seawater intake test well. If the information indicates that the plant is overdesigned for certain aspects, entertain revisions to the design sufficient to "right size" and optimize the design per the test information.

Advantages:

- Potential reductions in water treatment equipment and sizes
- Potential reduction in pretreatment chemicals
- Potential reduction in features that will require maintenance throughout the life of the facility
- Increases ability for project to adjust to regulatory requirements or other future changes currently unknown

Disadvantages:

- Given the Design-Build delivery of the project, changes in the design concept that differ from what was originally proposed will be subject to renegotiation of the D-B contract
- Potential schedule impacts relative to redesign efforts

Discussion: The slant intake wells are proposed to be 100 feet deep. This depth, combined with the water quality in the area, may result in getting raw water low in iron and manganese. As such, the plant may have much less need for the granular pre-treatment filters and chemical pre-treatment of the water before it gets to the RO membranes.

Discussion of Schedule Impacts: Current models indicate that it will take 18 months from the time the intake test well is started to reach equilibrium relative to the water being provided to the plant (96% ocean water and 4% groundwater). Admittedly, this does not leave much time to make design changes per the current project delivery schedule.

One option the project could consider is to revise the construction schedule to build the project elements not subject to unknowns first (i.e., service pumps, treated water storage, Admin Building) and leave the elements subject to water quality tests and regulatory requirements to the later stages.

Discussion of Risk Impacts: This alternative suggests a means of mitigating the risk associated with the lack of raw water data at this stage of design development. The water quality data could result in

less need for pre-treatment processes or it could result in needing more pre-treatment. Either way, the project should proceed with an assumption that modifications to the design may be needed when the information is available, and build the time for the modifications into the project schedule.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	There is potential that the water quality information will result in reductions in pre-treatment filters and chemical pre-treatment requirements. This will improve the maintainability of the system by reducing O&M efforts associated with this equipment.
Plant Operations	Alternative provides greater flexibility in the design development to adjust the design per the information received. As such, the plant will be "right sized" and optimized to treat the raw water most likely to be provided to the plant. As such, plant operations will be more efficient and adapted to precisely what is needed instead of robustly designed to accommodate unknowns.
Future Flexibility	If pre-treatment processes are simplified due to the raw water data, the ability of the plant to adjust to changes in future water quality may be reduced.
Environmental Impacts	No significant change.
Sustainability	No significant change. Slight reductions in energy consumption relative to pre-treatment operations that could be simplified.
Aesthetics	No significant change.

Assumptions and Calculations: The potential cost impacts for this alternative are difficult to quantify at this time due to the lack of information from the future intake test well. However, there is potential for cost reductions based on reductions in pre-treatment filtration and chemical pre-treatment systems. These reductions would result in initial cost savings as well as life-cycle cost savings through reduced maintenance and reduced chemical costs. Conversely, the water quality data could result in needing much more pre-treatment processes as well.

To illustrate the potential of this alternative, assume that the water quality will result in a 75% reduction of pre-treatment process equipment and chemical pre-treatment.

VE ALTERNATIVE RS-1

Refine the design to meet test well data water quality information

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Granular Media Pressure Filters	LS	1		$4,600,000	1		$ 1,150,000
Filter Backwash System	LS	1		$ 800,000	1		$ 200,000
Chemical Storage and Feed Equip	LS	1		$ 400,000	1		$ 100,000
Pretreatment Piping	LS	1		$ 200,000	1		$ 50,000
Filter Building	LS	3,875	$ 250	$ 968,750	969	$ 250	$ 242,188
TOTAL				$6,968,750			$1,742,188
TOTAL (Rounded)				$6,969,000			$1,742,000
						SAVINGS	**$5,227,000**

VE ALTERNATIVE RS-2

Revise construction schedule using multiple crews per discipline to accelerate project completion

Initial Cost Savings: ($3,701,000)
Change in Schedule: -6 months

Description of Baseline Concept: The CDM Smith proposed schedule indicates a sequentially phased construction schedule, likely using one crew per discipline type that moves around the project site.

Description of Alternative Concept: This alternative proposes to start construction of all facilities as soon as possible after underground infrastructure is complete, and consider multiple crews per discipline to accelerate the schedule and complete construction sooner.

Advantages:

- Reduces overall project schedule
- Earlier occupancy, operations start-up and clean water supply

Disadvantages:

- Accelerating the schedule could cause site sequence challenges
- May result in additional work crews and labor costs
- Potential savings due to shortened schedule could be negated by project acceleration and staff increase costs

Discussion: The RFP allowed the DB bidders to prepare and submit a proposed project schedule along with their bids. The CDM Smith schedule presents a logical sequence of activities that allows crews to move around the site as each segment of work is performed. By doubling certain crews, like concrete forming and pouring, the overall project schedule could be shortened.

Discussion of Schedule Impacts: Schedule impacts could include shifting the burden of schedule liability to CAW since CDM Smith has provided a schedule that they feel is achievable for the price they bid. Shortening the schedule will require a new cost and work crew analysis that may not save any costs for CAW. The benefit derived from this alternative is the ability to occupy and operate the facility sooner, and ultimately provide clean water sooner. Based on a review of CDM Smith's proposed schedule, the acceleration could range from 3 to 6 months.

Discussion of Risk Impacts: Accelerating schedules after award introduces the need for an analysis of work crews versus the current contract amount that may not pay off from a cost perspective.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant change.
Plant Operations	No significant change.
Future Flexibility	No significant change.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

VE ALTERNATIVE RS-2

Revise construction schedule using multiple crews per discipline to accelerate project completion

Assumptions and Calculations: The potential cost impacts for this alternative are difficult to quantify at this time due to the lack of information relative to the construction schedule and costs assumed by the DB contractor. However, crashing the project construction schedule to use multiple construction crews can add as much as 5% to the total construction contract.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Revise Construction Schedule	LS	1	$ 74,029,943	$ 74,029,943	1	$ 77,731,440	$ 77,731,440
				$ -			$ -
SUB-TOTAL				$74,029,943			$77,731,440
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$74,030,000			$77,731,000
						SAVINGS	**($3,701,000)**

VE ALTERNATIVE TP-1

Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)

Initial Cost Savings: $6,658,000
LCC Savings: $9,593,000

Description of Baseline Concept: The existing design is based on 45% recovery rate of the first pass SWRO system and 90% recovery rate of the second pass. The total plant recovery rate is approximately 43%.

Description of Alternative Concept: This alternative proposes to design the desalination plant such that the recovery of the first (SWRO) pass is 50% instead of 45%. By definition, recovery is the percentage of raw (source) water converted into desalinated water. The higher the design RO system recovery, the less source water is needed to be collected, pretreated and desalinated to produce the same volume of fresh water. Increase of the SWRO system recovery from 45% to 50% will result in 11% (50% / 45 % = 1.11) lower intake, pretreatment system, and SWRO system. A figure widely used for plants with intake wells is 50% recovery.

Advantages:

- Reduces the size of intake system, pretreatment filtration system, chemical feed systems for sodium hypochlorite and sodium bisulfite, filtered water tanks and pumps
- Fewer cartridge filter vessels and cartridges
- Eliminates one RO train (including high pressure pump, RO rack, energy recovery unit and pumps)
- Reduces the size of the brine pond and discharge system
- Product water be of slightly higher quality - TDS, boron, chloride, sodium and bromide concentrations will be 5- 8% lower

Disadvantages:

- Potentially higher RO membrane fouling rate and more frequent RO membrane cleaning
- Potentially shorter RO membrane useful life if the source water quality is poor
- Increases energy use
- Increases salinity concentration because the same mass of salt will be contained in 11% lower volume
- Additional engineering costs to redesign the plant

Discussion: Use of 50% vs. 45% recovery is very common for desalination plants with well intakes because wells usually provide very high water quality. Carlsbad and Huntington Beach desalination plants are both designed for 50% recovery. Since the slant wells are expected to produce very high quality water in Monterey as well, designing the plant around 50% recovery is prudent.

Redesigning the plant for 50% recovery will result in changes to a majority of the 30% design drawings and specifications; however, at this stage of design, such modifications are prudent and desirable taking under consideration the high potential for capital cost savings.

VE ALTERNATIVE TP-1

Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)

Project management, construction and commissioning will be impacted positively because of the fewer equipment and systems that will need to be constructed and commissioned.

Discussion of Schedule Impacts: Design schedule will not be impacted significantly. Construction schedule will be reduced because fewer pieces of equipment and membranes will need to be installed.

Discussion of Risk Impacts: The main risk is that the source water quality will contain high level of organics, oil and grease, or other compounds that will increase the fouling impacts on the plant – high recovery design will result in potential for elevated RO fouling and the need for more frequent cleaning.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improved maintainability – fewer and smaller facilities to maintain.
Plant Operations	No significant impact unless the source water quality produced by the slant wells is very poor (has very high fouling potential).
Future Flexibility	No significant impact.
Environmental Impacts	Higher brine salinity may cause elevated impact if not blended properly – more blending water may be needed.
Sustainability	This concept would result in 2-3% higher plant energy use and carbon footprint, slightly degrading the project's sustainability profile.
Aesthetics	No significant impact.

Assumptions and Calculations:

- 11% smaller intake system - the 8 intake wells in the original design can be reduced to 0.89 x 8 = 7 wells ($2.5 million savings)
- 11% smaller pretreatment filtration system (use of 10 vs. 11 filters – $0.52 million savings from elimination of one filter)
- 11% smaller chemical feed systems for sodium hypochlorite and sodium bisulfite – $60,000 savings from smaller size chemical feed and storage facilities)
- 11% smaller filtered water tanks and pumps – savings of $100,000
- 11% fewer cartridge filter vessels and cartridges – $55,000 capital cost savings – by eliminating one of the 6 cartridge vessels (additional O&M savings of $33,000/year – @ 0.11 X 4200 cfs x $12/cf x 6 replacements per year = $33,000/yr)

VE ALTERNATIVE TP-1

Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)

- Elimination of one RO train (including high pressure pump, RO rack, energy recovery unit and pumps) - total savings – $3 million in capital costs and annual O&M replacement costs of 0.143 x 532 elements x $400/element = $30,000
- 11% Smaller brine pond and discharge system – $100,000
- Product water be of slightly higher quality – TDS, boron, chloride, sodium and bromide concentrations will be 5- 8% lower
- Potentially higher RO membrane fouling rate and more frequent RO membrane cleaning if source water quality is poor (to be confirmed by slant well pilot test) – maximum cost penalty of US $140,000/year of CIP cleaning
- Potentially shorter RO membrane useful life if the source water quality is poor – reduction from 7 to 5 years of useful life if source water quality is poor – $15,000/year
- 5% higher energy use – $190,000/year of additional energy costs
- 11% higher salinity concentration because the same mass of salt will be contained in 11% lower volume

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Intake Wells		8	$ 2,500,000	$ 20,000,000	7	$ 2,500,000	$ 17,500,000
Granular media pretreatment filters		11	$ 500,000	$ 5,500,000	10	$ 500,000	$ 5,000,000
Chemical Feed System	1	1	$ 600,000	$ 600,000	1	$ 540,000	$ 540,000
Filtered Water Treatment Tanks and Pumps		1	$ 1,000,000	$ 1,000,000	1	$ 900,000	$ 900,000
Cartridge Filters		7	$ 72,000	$ 504,000	6	$ 72,000	$ 432,000
HP Pumps		7	$ 290,000	$ 2,030,000	6	$ 290,000	$ 1,740,000
ERD Booster Pumps		7	$ 86,000	$ 602,000	6	$ 86,000	$ 516,000
ERD PX System		7	$ 960,000	$ 6,720,000	6	$ 960,000	$ 5,760,000
First Pass RO		7	$ 1,630,000	$ 11,410,000	6	$ 1,630,000	$ 9,780,000
Miscelanous Piping, Valves, Etc.	1	1	$ 2,900,000	$ 2,900,000	1	$ 2,600,000	$ 2,600,000
Discharge Ponds and Pumps		1	$ 1,000,000	$ 1,000,000	1	$ 900,000	$ 900,000
Backwash Treatment System		1	$ 600,000	$ 600,000	1	$ 540,000	$ 540,000
SUB-TOTAL				$52,866,000			$46,208,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$52,866,000			$46,208,000
						SAVINGS	**$6,658,000**

VE ALTERNATIVE TP-1

Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$52,866,000	$46,208,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years	**INITIAL COST SAVINGS:**				**$6,658,000**
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and Inspection				$1,960,000	$1,700,000
2. Labor & Misc				$3,090,000	$2,950,000
3. RO membrnae Replacement Cost Decrease Due to Fewer RO Membranes				$550,000	$490,000
4. Energy - RO increase due to higher recovery				$4,760,000	$5,200,000
5. Cartridge Filter Replacment Due to Fewer Cartridges				$500,000	$440,000
6. Chemicals				$770,000	$720,000
Total Subsequent Annual Costs:				$11,630,000	$11,500,000
Present Value Factor (P/A):				22.576	22.576
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):				**$262,560,000**	**$259,625,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):				**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$262,560,000**	**$259,625,000**
TOTAL SUBSEQUENT COSTS SAVINGS:					**$2,935,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$315,426,000**	**$305,833,000**
TOTAL LIFE CYCLE SAVINGS:					**$9,593,000**

VE ALTERNATIVE TP-2

Install a plug on the main permeate line after the second or third membrane and use all of the same elements

Initial Cost Savings: ($53,000)
LCC Savings: $3,288,000

Description of Baseline Concept: At present, the SWRO system vessel configuration has an internally staged design where two different types of membranes (SWC5-LD and SWC6-LD) elements are used. See the baseline concept figure on the following page.

The design includes a split-permeate configuration where a portion of the permeate produced from the front 3 elements is removed from the front of the vessels rather than allowed to mix with the permeate from the remainder of the elements within the vessel. Two different types of elements are used in order to maximize the benefit of collecting high quality water from the front end of the vessels. If the same elements are used, the permeate collected from the front of the vessels will not be of as high of quality because permeate from the back and front membranes in the vessel will mix and back elements always produce worse quality permeate than front elements. SWC5-LD is a higher salt rejection, lower productivity element than SWC6-LD.

Description of Alternative Concept: This alternative proposes to use the same RO elements for the entire vessel – for example SWC5 or SWC5+ elements (or other non-Hydranautics elements with the same or higher productivity) and install a plug in the permeate tube between the 3rd and 4th elements in the vessels. Use of the same RO elements within the vessels will simplify plant operation (i.e., membrane rotation and procurement) and lower membrane replacement costs.

Advantages:

- Reduces the frequency of CIP membrane cleaning from 4 times to 3 times per year because the RO membranes can be rotated and thereby cleaned at no additional costs (use of different membranes does not allow rotation)
- Increases the useful life of the membrane elements from 5 to 6 years because the rotation allows to maintain the membranes in a better condition
- Eliminates the need to procure, store and handle different SWRO membrane elements
- Allows RO membrane elements to be rotated, which prolongs their useful life
- Cost effectively uses 8 elements vs. 7 elements per vessel
- Improves water quality from the front of the RO vessels and ultimately to reduce the size of the second pass by preventing mixing of front and back-end permeate

Disadvantages:

- Requires installation of permeate plugs in the vessels which will increase the capital costs with $53,000 for purchase and installation of permeate plugs

Discussion: Practical experience shows that the use of internally staged SWRO systems where internal staging utility is achieved by using different elements increases plant operation and maintenance efforts and decreases the useful life and cleaning frequency of the RO elements because it does not allow for the RO elements to be rotated. The proposed method has been adopted in recent designs of many plants worldwide because it simplifies maintenance.

VE ALTERNATIVE TP-2

Install a plug on the main permeate line after the second or third membrane and use all of the same elements

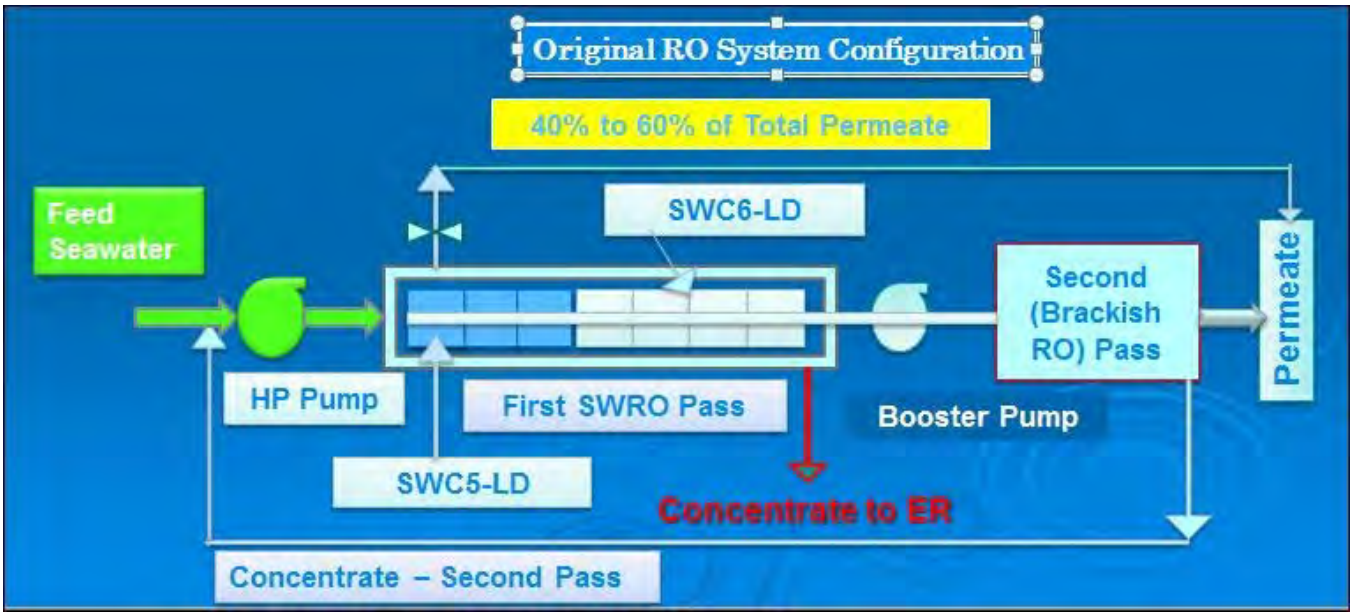
Discussion of Schedule Impacts: No impacts to the project schedule.

Discussion of Risk Impacts: No risk related to system performance with this proven approach.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improves maintainability by reducing the frequency and costs for membrane cleaning because it allows the membranes to be rotated.
Plant Operations	Improves plant operations by reducing fouling and cleaning frequency.
Future Flexibility	No negative impacts.
Environmental Impacts	No measurable impacts.
Sustainability	No measurable impacts.
Aesthetics	No impact – plugs are inside the vessels and have no visual impact.

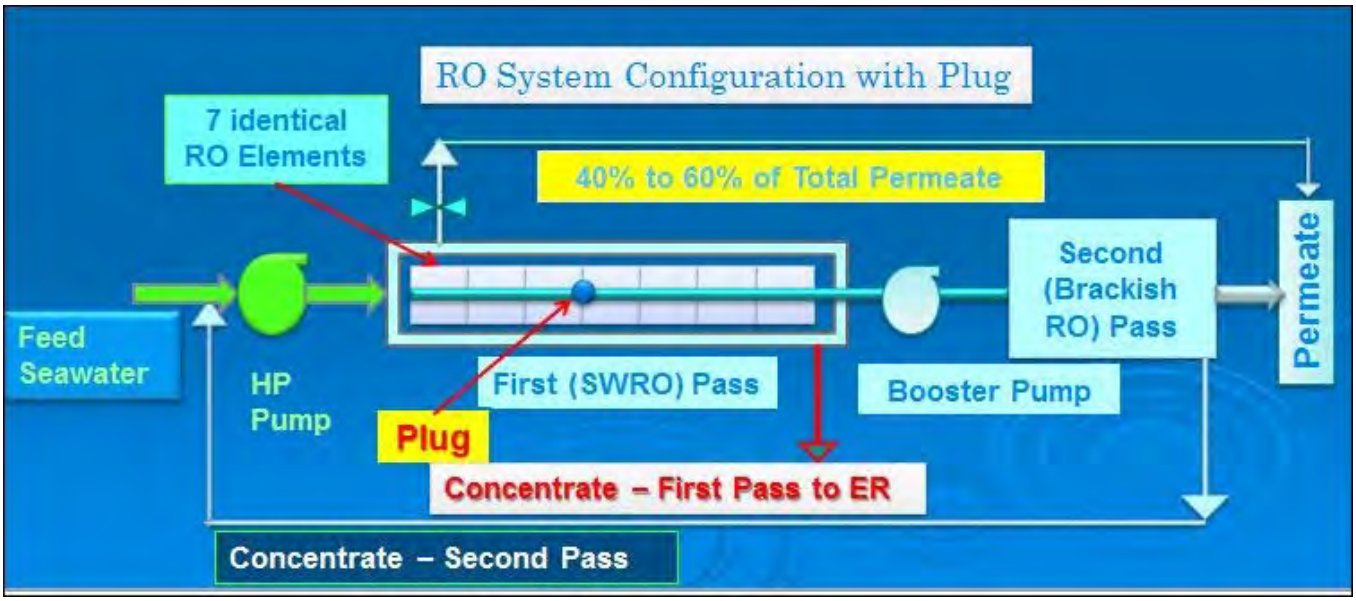
Baseline Concept Sketch



VE ALTERNATIVE TP-2

Install a plug on the main permeate line after the second or third membrane and use all of the same elements

VE Alternative Concept Sketch



Assumptions and Calculations: CIP cleaning frequency reduced from 4 times per RO train per year to 3 times per RO train per year.

- Cost of RO train CIP – $10,000 per RO train per cleaning
- Useful life of the membranes increased from 5 years to 6 years
- The calculations of cost benefits consider 7-element vessels
- Use of 8 elements per vessel will yield additional savings

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Installation of Plugs for RO permeate		0	$ 100		532	$ 100	$ 53,200
SUB-TOTAL				$0			$53,200
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$0			$53,000
						SAVINGS	**($53,000)**

VE ALTERNATIVE TP-2

Install a plug on the main permeate line after the second or third membrane and use all of the same elements

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$0	$53,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years	**INITIAL COST SAVINGS:**				**($53,000)**
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and Inspection - CIP reduced from 4 to 3 times per year.				$224,000	$168,000
2. Membrane replacement reduced becasue useful Life increased from 5 to 6 years				$550,000	$458,000
			Total Subsequent Annual Costs:	$774,000	$626,000
			Present Value Factor (P/A):	22.576	22.576
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$17,474,000**	**$14,133,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$17,474,000**	**$14,133,000**
			TOTAL SUBSEQUENT COSTS SAVINGS:		**$3,341,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$17,474,000**	**$14,186,000**
			TOTAL LIFE CYCLE SAVINGS:		**$3,288,000**

VE ALTERNATIVE TP-3

Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use

Initial Cost Savings: ($300,000)
LCC Savings: $5,073,000

Description of Baseline Concept: At present, the permeate collected from the front end of the SWRO vessels is directly conveyed for post-treatment. This is represented in the Baseline Concept Sketch on the following page.

Description of Alternative Concept: The alternative concept proposes to install a brackish water RO treatment system for the permeate collected from the front of the SWRO vessels in order to use the energy in this stream to produce better quality front permeate water and reduce the size of the second pass. Because the permeate carries energy adequate to retreat it through a second pass, no additional pumping will be needed. The recovery of the front-end permeate will be 95% and the water quality will be of 20 mg/L TDS or less, as compared to the TDS of the front end permeate which will be 80 to 120 mg/L.

Advantages:

- Reduces SWRO system energy use with 4 to 6% (average of 5% – 0.6 kWh/1000 gallons)
- Reduces the size and costs of the second pass by 10 to 15% because the first pass produces significantly higher quality water; less back-end permeate needs to be treated in second pass

Disadvantages:

- Requires the installation of brackish water membranes for retreatment of front-end permeate

Discussion: Use of this configuration was introduced for the first time by Acciona Agua in 2011 in the design of the Adelaide SWRO plant in Australia. The brackish RO system is designed at very high flux, usually 35 gfd, which results in a relatively small number of BWRO elements needed for the second pass. A detailed schematic of the Adelaide SWRO plant is shown in the figure on the following page. As shown on the alternative concept sketch, the plant uses one high pressure SWRO pump to feed two RO trains, which results in further capital and energy cost reduction.

Based on past experience, the size and cost of the front permeate BWRO system is approximately 50% smaller than that of that of the secondary pass. The actual size and costs will need to be determined based on a more detailed membrane modelling and engineering analysis. This improvement option can be combined with VE alternative 36.

Discussion of Schedule Impacts: No negative impacts; installation of the front second pass would require roughly one additional week of work.

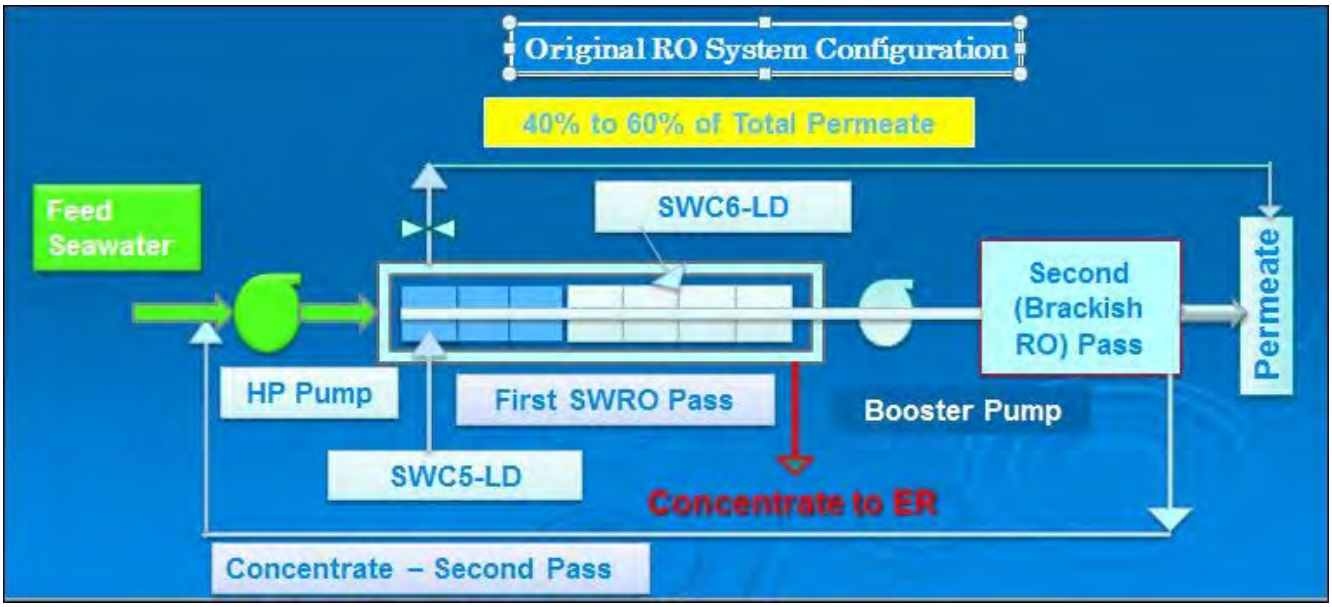
VE ALTERNATIVE TP-3

Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No significant impacts.
Plant Operations	Slightly more complex operations - additional membrane vessels added – additional efforts needed for monitoring of their performance.
Future Flexibility	No significant impacts.
Environmental Impacts	No significant impacts.
Sustainability	No significant impacts.
Aesthetics	No significant impacts.

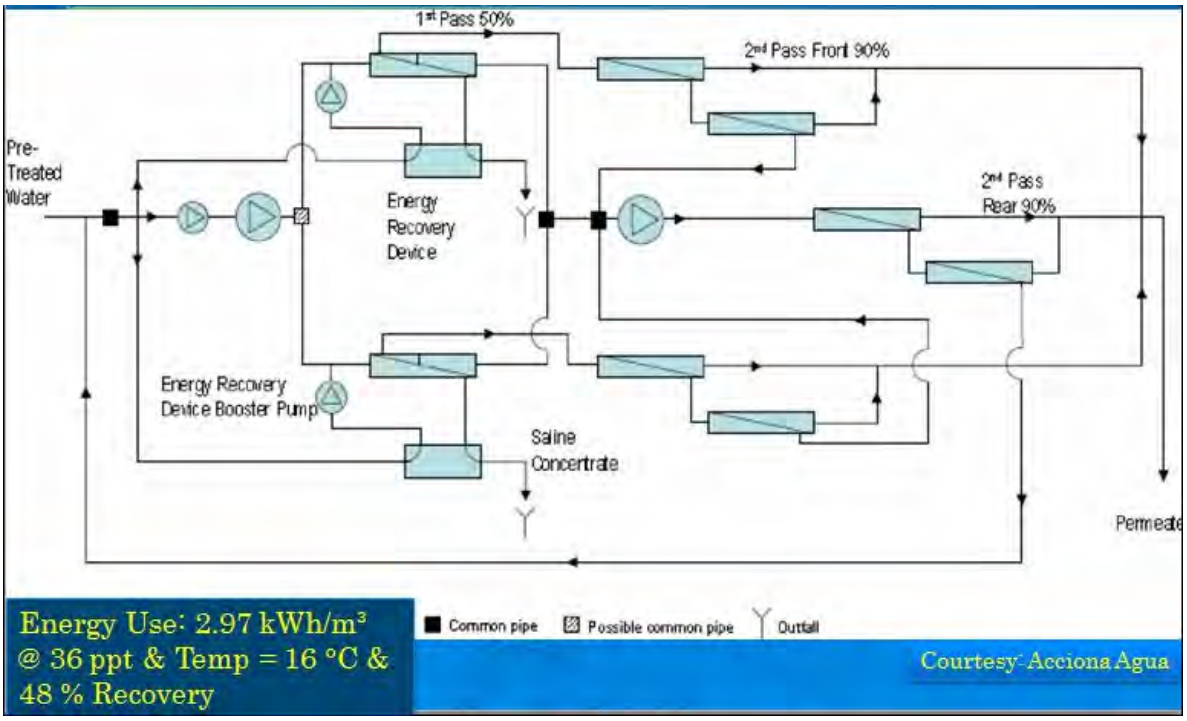
Baseline Concept Sketch



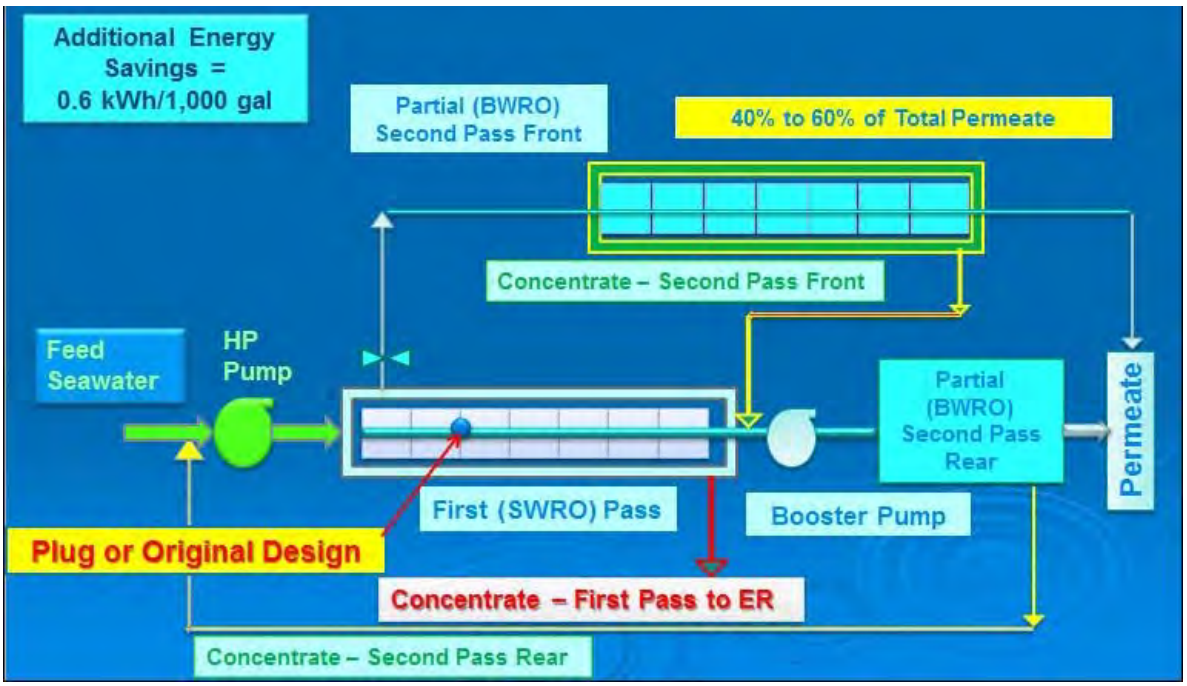
VE ALTERNATIVE TP-3

Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use

VE Alternative Concept Sketches



Adelaide example



Proposed configuration

VE ALTERNATIVE TP-3

Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use

Assumptions and Calculations:

- Second front permeate pass is designed for 60 % of the flow at flux which is two times higher than the flux of the second pass for treatment of back stage permeate.
- The cost of the second front pass is estimated at approximately 30 % of the back second pass = 0.3 x 3.6 million = US$1.2 million.
- The size of the second pass is expected to be reduced with 10 % - i.e., to decrease down from 40 % to 30 % - US$0.9 million savings.
- Energy savings are estimated at 0.6 kWh/1,000 gallons - 5 % of average plant use of 11.6 kWh/1000 gallons. These numbers are to be confirmed by CDM.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Installation of Front Pass Permeate System		0			1	$ 1,200,000	$ 1,200,000
Existing Second Pass RO system		1	$ 3,600,000	$ 3,600,000	1	$ 2,700,000	$ 2,700,000
SUB-TOTAL				$3,600,000			$3,900,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$3,600,000			$3,900,000
						SAVINGS	**($300,000)**

VE ALTERNATIVE TP-3

Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$3,600,000	$3,900,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years			**INITIAL COST SAVINGS:**		**($300,000)**
B. SUBSEQUENT ANNUAL COSTS					
Energy				$4,760,000	$4,522,000
			Total Subsequent Annual Costs:	$4,760,000	$4,522,000
			Present Value Factor (P/A):	22.576	22.576
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$107,462,000**	**$102,089,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$107,462,000**	**$102,089,000**
			TOTAL SUBSEQUENT COSTS SAVINGS:		**$5,373,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$111,062,000**	**$105,989,000**
			TOTAL LIFE CYCLE SAVINGS:		**$5,073,000**

VE ALTERNATIVE TP-4

Eliminate sulfuric acid addition from process

Initial Cost Savings: $326,000

Description of Baseline Concept: Sulfuric acid is included in the baseline concept as a tool for controlling the formation of calcium carbonate on the membranes.

Description of Alternative Concept: The alternative concept proposes to eliminate sulfuric acid equipment based on the fact that the production water is anticipated to be nearly 100% seawater, where magnesium carbonate is the driver.

Advantages:

- Capital cost savings
- Potentially reduces O&M
- Improves plant performance

Disadvantages:

- None apparent

Discussion: Sulfuric acid is included in the baseline as one more tool for controlling the formation of calcium carbonate on the membranes in the first pass. Calcium carbonate is the first scale to form when seawater is concentrated. Three things can typically be done to control it: a) keep the recovery low, b) add anti-scalant, and c) add sulfuric acid to lower the pH.

Based on the fact that the production water is anticipated to be nearly 100% seawater and not brackish water, the calcium carbonate is relatively minor (5%-10% of hardness) in comparison to magnesium and calcium sulfate, which sulfuric acid does not effect. In addition, sulfuric acid lowers the pH which reduces boron rejection significantly and increases use of Sodium Hydroxide (Caustic Soda) to increase pH back-up post filters.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: No significant impacts.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improved because of less equipment.
Plant Operations	Improved boron rejection and reduced use of Sodium Hydroxide.
Future Flexibility	Improved plant flexibility by providing a spare chemical room for future chemical addition.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

VE ALTERNATIVE TP-4

Eliminate sulfuric acid addition from process

Assumptions and Calculations: The content of this recommendation is based on consultation with the VE team RO process expert Nikolay Voutchkov, and the fact that production wells will produce 96% or more of seawater.

The cost savings for this alternative are based upon the assumption that the space and equipment allocated for the sulfuric acid treatment is eliminated. However, this alternative complements VE Alternative TP-5 by providing a spare chemical area for future chemical additions as needed. The combination of these two alternatives would result in a zero net cost savings.

Given the VE team's assumption that the water quality provided by the intake wells will not require the sulfuric acid treatment, the assumption is the additional treatment would not be utilized and thus there would be no life-cycle cost savings. It should be noted however, that if sulfuric acid treatment was utilized, there would need to be high dosage of sodium hydroxide to raise the pH.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Sulfuric Acid Room	SF	625	$ 250	$ 156,250			
Process Equipment	LS	1	$ 120,000	$ 120,000			
Miscellaneous Piping	LS	1	$ 50,000	$ 50,000			
TOTAL				$326,250			$0
TOTAL (Rounded)				$326,000			$0
						SAVINGS	**$326,000**

VE ALTERNATIVE TP-5

Provide a spare chemical injection function to Desal Plant

Initial Cost Savings: ($326,000)

Description of Baseline Concept: The baseline concept project does not include additional space or equipment to accommodate chemical injection beyond the currently assumed water treatment process requirements.

Description of Alternative Concept: This alternative proposes to construct an outbuilding separate from the RO building sufficient to house enough chemical storage tanks and equipment to support future chemical injection into the water after the RO membranes.

Advantages:

- Simplifies addition of chemical treatments to the process that are not currently being included
- Increases facility's flexibility to adjust treatment processes per regulatory or other requirements
- Spare chemical injection system could serve as a temporary replacement of other systems for maintenance purposes

Disadvantages:

- Additional costs to the project

Discussion: While theoretically the additional chemical treatment functionality could serve multiple future treatment requirements, a likely potential would be the introduction of fluoride treatment to the water supply. Should this requirement be added to the region's water supply, the cost to add the equipment to the plant will be much larger than if it is accommodated at the time of construction. The project stakeholders need to weigh the likelihood of the future treatment process changes against the cost of providing the flexibility to the plant to accommodate the changes at this time.

Note: One option for this alternative is to use the area currently designated for the sulfuric acid treatment equipment for future chemical treatment instead of eliminating that space as suggested by VE Alternative TP-4.

Discussion of Schedule Impacts: No significant change.

Discussion of Risk Impacts: None noted.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	If additional equipment and outbuilding are provided, they may require periodic inspection and maintenance, but this is assumed to be minor. There is some benefit to using the additional chemical treatment equipment to replace other chemical treatment equipment temporarily to accommodate maintenance of the equipment.

VE ALTERNATIVE TP-5

Provide a spare chemical injection function to Desal Plant

Performance Attribute	Rationale for Change in Performance
Plant Operations	No significant change.
Future Flexibility	Significant improvement if the treatment processes are modified in the future per regulatory or program requirement changes.
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

Assumptions and Calculations: Assuming the sulfuric acid treatment is still required, the additional chemical treatment equipment should be provided in a stand-alone building near the RO Building.

Assume a 25' x 25' Pre-Engineered Metal Building @ $250 per SF.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Chemical Treatment Building	SF			$ -	625	$ 250	$ 156,250
Process Equipment	LS			$ -	1	$ 120,000	$ 120,000
Miscellaneous Piping	LS			$ -	1	$ 50,000	$ 50,000
				$ -			$ -
TOTAL				$0			$326,250
TOTAL (Rounded)				$0			$326,000
						SAVINGS	**($326,000)**

VE ALTERNATIVE TP-6

Eliminate the UV treatment system

Initial Cost Savings: $750,000
LCC Savings: $2,711,000

Description of Baseline Concept: In the baseline concept, the UV system is installed downstream of the RO membranes and upstream of the post-stabilization system. The purpose of the system is to provide a minimum 4-log inactivation of Giardia and Cryptoaporidium. The system consists of 3 trains of reactors in a 2 + 1 configuration. The train consists of a flow meter (for flow documentation), reactor, and a flow valve. Each train will have a UPS to provide 10 minutes of ride through time upon power failure.

Description of Alternative Concept: This concept proposes to remove the UV system from the project. Different methods of obtaining the 4-log removal could be installed. These methods are described in VE Alternative TP-7 which suggests the use of either a coagulant chamber with flocculation or another type of pretreatment. The exact method is undefined and a rough cost estimate is given.

Advantages:

- Less equipment resulting in reduced O&M effort

Disadvantages:

- None apparent

Discussion: Depending on water quality and type of pretreatment, disinfection in the process following the RO units may not be required. The requirement will be determined after the test well is installed and the actual process water is obtained for testing. In addition, the type of pretreatment was not determined. The VE team recommends that the design should be flexible and provide options to delete the UV system at minimal cost to the project.

Discussion of Schedule Impacts: If it is discovered during start-up that disinfection is required, the plant start-up could be delayed.

Discussion of Risk Impacts: None apparent.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Slight improvement, due to less equipment to maintain and operate.
Plant Operations	No significant change.
Future Flexibility	Slight reduction in future flexibility.
Environmental Impacts	No significant change.
Sustainability	Slight improvement through reduction in energy use.
Aesthetics	No significant change.

VE ALTERNATIVE TP-6

Eliminate the UV treatment system

Assumptions and Calculations: Assume disinfection will not be required after the RO units.

Energy savings: Energy usage - 48 KVA per unit, 2 units, summer 10c/KW, winter 8c/KW ave 9c/k=KW; 96 kva x .93 (pf) x 24 (hours) x 365 (days) x .95 (percentage plant online) x .09 (dollars per kilowatt) = $66,868 per year energy cost.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
UV Train	ea	3	$ 250,000	$ 750,000			$ -
				$ -			$ -
				$ -			$ -
SUB-TOTAL				$750,000			$0
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$750,000			$0
						SAVINGS	**$750,000**

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%	**BASELINE**	**ALTERNATIVE**
A. INITIAL COST		$750,000	$0
Service Life-Baseline _____ Years Service Life-Alternative _____ Years	**INITIAL COST SAVINGS:**		**$750,000**
B. SUBSEQUENT ANNUAL COSTS			
Maintenance and Inspection		$20,000	
Energy		$66,868	
	Total Subsequent Annual Costs:	$86,868	$0
	Present Value Factor (P/A):	22.576	22.576
	PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$1,961,000**	**$0**

C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$1,961,000**	**$0**
			TOTAL SUBSEQUENT COSTS SAVINGS:		**$1,961,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$2,711,000**	**$0**
			TOTAL LIFE CYCLE SAVINGS:		**$2,711,000**

VE ALTERNATIVE TP-7

Consider more efficient ways of meeting CT requirements (flocculation chamber, membrane pretreatment, etc.)

Initial Cost Savings: $536,000
Change in Schedule: +1 month

Description of Baseline Concept: Existing granular media pretreatment filters do not have flocculation/mixing chamber and coagulant addition, which does not allow them to be given pathogen removal credit by the California Department of Public Health (CDPH).

Description of Alternative Concept: This alternative would install a flocculation/mixing chamber upstream of the existing filters to receive 2-log pathogen removal credit from the CDPH. Installing a mixing chamber will improve the oxidation of iron and manganese (if they are found in the water) and result in improved removal of these compounds as well. Install membrane pretreatment filters instead of granular media pretreatment filters to receive 4-log removal credit from the CDPH, and eliminate the need for cartridge filters and the UV disinfection system.

Advantages:

- Eliminates UV disinfection system and associated construction, energy, maintenance and UV lamp replacement costs
- Installing mixing chamber will improve the oxidation of iron and manganese (if they are found in the water) and result in improved removal of these compounds
- Membrane pretreatment can remove two times more pathogens than conventional filters and is less sensitive to changes in source water quality
- Taking under consideration the risks associated with the unknown source water quality, membrane filtration provides more flexibility to also accommodate future regulatory requirements and creates approximately 50% less backwash volume
- Improves reliability and operability

Disadvantages:

- Installation of membrane filters will require construction of micro-screens upstream of the filters and may be more costly (the elevated construction costs for membrane filters will be compensated by the elimination of the cartridge filters and the UV disinfection system)
- Installation of flocculation/mixing chamber will increase capital costs

Discussion: The cost competitiveness of the use of membrane pretreatment instead of granular media filters will depend on the source water quality. Therefore, it is recommended to pilot test side by side granular media and membrane pretreatment systems to verify design criteria. Based on past experience the membrane pretreatment filters could be designed at 50 to 70 gfd which will result in pre-treatment costs of $4.5-5.0 million. The current pretreatment system is $4.6 million. With elimination of the cartridge filters and UV system, the overall plant costs will be reduced. If membrane pretreatment is used, there is no need to install a flocculation chamber.

Cost effectiveness of the use of membrane pretreatment is recommended to be verified by pilot testing. Alternatively, membrane manufacturers with extensive pretreatment of similar water –

VE ALTERNATIVE TP-7

Consider more efficient ways of meeting CT requirements (flocculation chamber, membrane pretreatment, etc.)

PALL, Norit/Pentair, Dow Filmtec, GE – can be contacted to verify the cost competitiveness of membrane pre-treatment.

Discussion of Schedule Impacts: Commissioning of membrane pretreatment would increase commissioning time by one month.

Discussion of Risk Impacts: Risk of unknown/varying source water quality will be reduced significantly if membrane pretreatment is used.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Overall maintenance efforts will be reduced. Maintenance efforts could increase for pretreatment – membrane pre-treatment requires more maintenance. Elimination of cartridge filters and UV system will reduce significantly maintenance activities.
Plant Operations	Simplified operation due to membrane pretreatment being easier to operate, elimination of cartridge filters and UV system will reduce significantly operations activities.
Future Flexibility	Significant improvement to accommodate future regulations and changes in source water quality.
Environmental Impacts	Volume of filter backwash will be reduced by 50%.
Sustainability	No impact.
Aesthetics	No impacts - smaller footprint

Assumptions and Calculations:

- Membrane pre-treatment loading rate of 50 gfd – $4.6 million
- Flocculation/mixing chamber designed for 15-minutes contact time and includes mechanical mixers
- $536,000 savings if membrane pre-treatment is used instead of conventional system, cartridge filers and UV to get the same pathogen log removal credit
- $112,000 of savings if flocculation/mixing chamber is used instead of UV system
- O&M savings are difficult to quantify at this time

VE ALTERNATIVE TP-7

Consider more efficient ways of meeting CT requirements (flocculation chamber, membrane pretreatment, etc.)

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Gravity Filters vs. Membrane pretreatment filters		7	$ 772,000	$ 5,404,000	7	$ 700,000	$ 4,900,000
Microscreens					16	$30,000	$ 480,000
Cartridge Filters				$ 200,000	0		
UV System				$ 312,000	0		
SUB-TOTAL				$5,916,000			$5,380,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$5,916,000			$5,380,000
						SAVINGS	**$536,000**

VE ALTERNATIVE TP-8

Eliminate baffles in the treated water storage tanks; obtain CT points elsewhere

Initial Cost Savings: $100,000

Description of Baseline Concept: The baseline concept includes two Hypalon baffle curtains per treated water storage tank to achieve a 0.5 baffling factor and provide 1 log inactivation of giardia.

Description of Alternative Concept: The baseline concept recommends deleting the baffles in treated water storage tanks. Required Contact Time (CT) points will be achieved elsewhere in the system.

Advantages:

- Capital cost savings
- Reduces maintenance
- Eliminates the need to replace

Disadvantages:

- Lower baffling factor
- Inability to operate treated water storage tanks at a lower level while maintaining a 1 log inactivation

Discussion: The project currently has the option to include UV disinfection for virus and giardia inactivation. If UV is installed then these baffles can be removed from the project scope because they would not be needed (unless the UV is down for maintenance). Per the Basis of Design Report, the tanks are designed to provide approximately 50 minutes of detention time assuming 11.75-feet-deep and a baffling factor of 0.5. Using a Baffling factor of 0.2 which can be done by installing nozzles on the pipe inlet, the same detention time can be maintained without baffles and a minimum operating level of 15 feet.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None in addition to the above-mentioned disadvantages

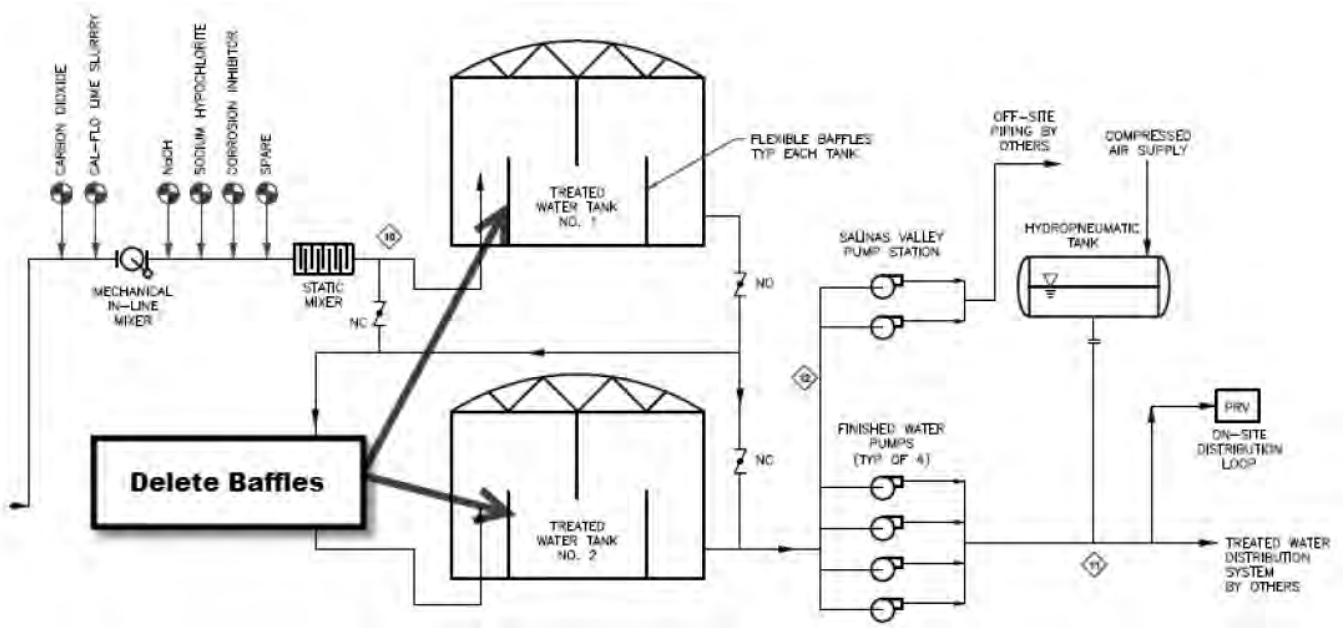
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Improved.
Plant Operations	Slight decrease in ability to handle lower treated water storage tank levels while maintaining Chlorine contact time.
Future Flexibility	No Change.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	No change.

VE ALTERNATIVE TP-8

Eliminate baffles in the treated water storage tanks; obtain CT points elsewhere

VE Alternative Concept Sketch



Assumptions and Calculations:

Description	Quantity	Unit	Comment
Treated Water Flow	9.60	MGD	from BODR pg. 10-1
Raw Water Flow	6,667	gpm	
Base Line Design			
Nominal Tank Volume	750,000	gal	from BODR pg. 10-1
Tank Diameter	69.50	ft	Dwg S-34
Tank Height	26.75	ft	Dwg S-34
Computed Volume	759,075	gal	
Number of Tanks	2	ea	
Total Volume	1,518,151	gal	
Volume per foot	56,753	gal / ft	
Max Detention Time: 1 Tank	114	min	Assumes 1.0 Baffling factor at full tank. (not possible)
Max Detention Time: 2 Tank	228	min	Assumes 1.0 Baffling factor at full tank. (not possible)
Base Design based on this volume	666,851	gal	Per BODR pg 10-1. (approx. 11.75 feet deep)
Effective Detention Time: 1 Tank	25	min	Assumes 0.5 Baffling Factor
Effective Detention Time: 2 Tank	50	min	Assumes 0.5 Baffling Factor
Volume required to match base	851,299	gal	Assumes 15-foot min operating level
Effective Detention Time: 1 Tank	26	min	Assumes 0.2 Baffling Factor by use of nozzle entrance
Effective Detention Time: 2 Tank	51	min	Assumes 0.2 Baffling Factor by use of nozzle entrance

VE ALTERNATIVE TP-8

Eliminate baffles in the treated water storage tanks; obtain CT points elsewhere

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Flexible Baffles in Treated Water Tanks	ea	4	$ 25,000	$ 100,000	0	$ 30,000	
SUB-TOTAL				$100,000			$0
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$100,000			$0
						SAVINGS	**$100,000**

VE ALTERNATIVE TP-9

Optimize configuration from intake wells to RO membrane system

Initial Cost Savings: $700,000
LCC Savings: $847,000

Description of Baseline Concept: The baseline concept includes the following steps for pumping water from the bay to the inlet of the RO high pressure pumps:

1. Slant wells with submersible pumps and motors pump water through the pressure filters and discharge to the filtered water tanks.
2. Filtered Water Pumps pump water through the cartridge filters and to the suction side of the RO high pressure pumps.

Description of Alternative Concept: Several items are presented in this VE alternative that may result in a savings in construction cost or operational costs. This may be even more necessary if the pre-treatment process is changed in order to obtain more CT disinfection credit (See VE Alternative TP-7). The alternative concepts would include (as a minimum):

1. Changing the configuration of the filtered water tanks. For example, using concrete with common wall construction by making it rectangular
2. Using vertical turbine pumps as the filtered water pumps. This may result in more efficient pumps and more cost-effective construction
3. If it is feasible to have less than 600,000 gallons of filtered water tank storage, this would allow the project to reduce tank size and associated costs
4. If flocculation is used to increase the CT disinfection credits, then the entire pumping layout will have to be re-evaluated

Advantages:

- May result in reduced construction and ongoing electrical costs
- If certain items in VE Alternative TP-7 are implemented (i.e. flocculation), it may provide an opportunity to evaluate the options listed above

Disadvantages:

- It is uncertain if the costs to re-engineer will outweigh the benefits gained by these improvements

Discussion: The baseline concept 30% design includes a good methodology for pumping water from the slant wells to the suction of the RO high pressure pumps. There may be additional construction and annual electrical savings with some modifications. This may be even more necessary if the pre-treatment process is changed in order to obtain more CT disinfection credit (See VE Alternative TP-7).

Discussion of Schedule Impacts: None identified.

Discussion of Risk Impacts: None identified.

VE ALTERNATIVE TP-9

Optimize configuration from intake wells to RO membrane system

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Minimum impact.
Plant Operations	Potential reduction of annual electric costs.
Future Flexibility	Minimum impact
Environmental Impacts	No significant impacts.
Sustainability	No significant impacts.
Aesthetics	This could result in a smaller footprint for the plant, especially if the vertical turbine pumps are placed on top of the filtered water tanks.

Assumptions and Calculations: There are numerous options to evaluate with this idea, especially if VE Alternative TP-7 results in changes in pretreatment techniques. It is recommended that CDM Smith evaluate the cost impacts of these options. If vertical turbine pumps at the filtered water pump station could save 2% in energy costs, potentially saving roughly $6,500 per year.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Filtered Water Storage Tanks	Ea	2	$ 600,000	$ 1,200,000			
Vertical turbine pumps in wet wells	Ea				4	$ 100,000	$ 400,000
Backwash Storage Tanks	Ea				1	$ 100,000	$ 100,000
SUB-TOTAL				$1,200,000			$500,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$1,200,000			$500,000
						SAVINGS	**$700,000**

VE ALTERNATIVE TP-9

Optimize configuration from intake wells to RO membrane system

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$1,200,000	$500,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years			**INITIAL COST SAVINGS:**		**$700,000**
B. SUBSEQUENT ANNUAL COSTS					
Energy				$6,500	$0
			Total Subsequent Annual Costs:	$6,500	$0
			Present Value Factor (P/A):	22.576	22.576
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$147,000**	**$0**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
			1.00000		$0
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$147,000**	**$0**
			TOTAL SUBSEQUENT COSTS SAVINGS:		**$147,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$1,347,000**	**$500,000**
			TOTAL LIFE CYCLE SAVINGS:		**$847,000**

VE ALTERNATIVE TP-10

Consider sand removal process prior to pretreatment

Initial Cost Savings: ($225,000)
LCC Savings: $4,290,000

Description of Baseline Concept: The baseline design anticipates production wells without a run-to-waste, and pumping directly to pressure filters at the desalination plant to capture sand/silt and particulate.

Description of Alternative Concept: This alternative proposes to install a run-to-waste ability either at the desalination plant or at well heads when wells are first cycled.

Advantages:

- Prolongs life of pressure filters and cartridge filters

Disadvantages:

- Additional cost to install infrastructure
- Not practical because of common feedwater pipeline from production wells
- Additional disturbance if installed at production well site
- Additional infrastructure at each well pod to run each well to the waste vault

Discussion: Upon cycling of wells there is potential for sand/silt and other particulate in the initial water pumped, which under the baseline condition is captured by pressure filters or cartridge filters. The ability for a well to run-to-waste on initial start-up/cycling is common practice, particularly for groundwater wells. If a run-to-waste option is included, the options are to install additional pipeline and valves at the plant to waste, to backwash ponds, or locate at well production site.

Locating a run-to-waste option at the desalination plant is not practical because all the production wells feed the desalination plant through a common pipeline. Therefore, if one well requires a run-to-waste cycle, then all the well production must be wasted until the volume of common pipeline is turned over. Installing a dedicated pipe is not practical because of the considerable expense of running another two miles of pipeline. The most practical application of run-to-waste is at the well production site, either with a common underground waste vault or a vault at each well pod cluster. However, installing additional waste vaults at well production requires additional disturbance area, valves, controls, piping headers, and future maintenance.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: Minimal risk if pressure filters are determined not to be needed at desalination plant based on water quality and run-to-waste vaults are installed at the well production site.

VE ALTERNATIVE TP-10

Consider sand removal process prior to pretreatment

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	The run-to-waste vaults do provide some flexibility with maintenance of wells for discharge of initial well water after bringing well back in-service.
Plant Operations	No significant change except slightly less pressure filter backwashes and longer media life.
Future Flexibility	The run-to-waste vaults do provide some flexibility during well development and testing of future wells.
Environmental Impacts	No significant change.
Sustainability	No change.
Aesthetics	No change.

Assumptions and Calculations: Assumption is that the production wells will produce sand/silt and no production water quality data is available at this time.

For cost estimating purposes, assume 500 feet of pipeline at $250 per LF. This assumes a common pipeline will connect all 10 slant wells and be used to discharge the water at or near the intake sites.

If the run-to-waste system is not provided, assume the granular filters will require maintenance every 3 months to remove the fines from the top layer. Assume $5,000 per procedure for each of the 10 granular filters.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Run-to-Waste Discharge Pipeline	LF				500	$ 250	$ 125,000
Valves, Controls, Piping Headers	LS				1	$ 100,000	$ 100,000
							$ -
SUB-TOTAL				$0			$225,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$0			$225,000
						SAVINGS	**($225,000)**

VE ALTERNATIVE TP-10

Consider sand removal process prior to pretreatment

Life-Cycle Cost Estimate

Life Cycle Period 30 Years	Real Discount Rate 1.942%			BASELINE	ALTERNATIVE
A. INITIAL COST				$0	$225,000
Service Life-Baseline _____ Years Service Life-Alternative _____ Years		**INITIAL COST SAVINGS:**			**($225,000)**
B. SUBSEQUENT ANNUAL COSTS					
Maintenance and Inspection of Pressure Filters to remove Sand/Silt				$200,000	
		Total Subsequent Annual Costs:		$200,000	$0
		Present Value Factor (P/A):		22.576	22.576
		PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):		**$4,515,000**	**$0**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
			1.00000	$0	
		PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):		**$0**	**$0**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$4,515,000**	**$0**
		TOTAL SUBSEQUENT COSTS SAVINGS:			**$4,515,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$4,515,000**	**$225,000**
			TOTAL LIFE CYCLE SAVINGS:		**$4,290,000**

VE ALTERNATIVE TP-11

Eliminate the backwash treatment system and discharge directly to brine basin

Initial Cost Savings: $200,000

Description of Baseline Concept: The existing configuration has the backwash waste going to two backwash ponds. The water is then settled and sent either to the front of the plant or to the outfall. The solids settle out and need to be removed periodically by plant staff, who dewater and dispose of the solids. The baseline concept also contains one large brine storage pond which is used to store brine before it is disposed of by pumping it to the outfall.

Description of Alternative Concept: The alternative concept proposes to eliminate the backwash ponds. The backwash waste and brine would be sent to the same ponds. The brine ponds would be reconfigured and enlarged into two separate ponds. The combination backwash waste/brine would be disposed of by pumping it to the outfall. The ponds would be configured to be dewatered and the sludge removed, dewatered, and disposed of off-site.

Advantages:

- The brine would be diluted, allowing for easier disposal at certain ocean conditions
- The larger ponds would allow for longer periods between sludge dewatering
- Site layout is more consolidated due to the two-pond footprint being smaller than a three-pond footprint (same overall capacity)

Disadvantages:

- The sludge may be more difficult to dispose of due to containing additional salt

Discussion: The backwash ponds would be eliminated and the backwash waste and brine would be sent to the same ponds in this alternative. The backwash waste and the brine would be combined at the ponds. The discharge of the ponds will be sent to the plant outfall, and the same brine effluent pumps will be used as in the baseline concept. The backwash reclamation station will be eliminated, which includes the backwash reclamation sump, backwash reclamation pumps, VFDs, instrumentation, and floating decanters.

Discussion of Schedule Impacts: None identified.

Discussion of Risk Impacts: There is slight risk related to the unknown cost of disposing a different type sludge than originally planned.

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Maintainability is slightly improved due to the presence of one less pond.
Plant Operations	This concept will result in slightly improved plant operations through the ability to discharge during constrictive ocean conditions.
Future Flexibility	The alternative results in slightly less flexibility because the only option is to combine the two types of waste streams.

VE ALTERNATIVE TP-11

Eliminate the backwash treatment system and discharge directly to brine basin

Performance Attribute	Rationale for Change in Performance
Environmental Impacts	No significant change.
Sustainability	No significant change.
Aesthetics	No significant change.

Assumptions and Calculations: The capacity of the alternative concept ponds would be the same as the baseline concept ponds.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Brine Pond	ls	1	$ 300,000	$ 300,000			
Backwash pond (2 ponds) and Pump station	ls	1	$ 550,000	$ 550,000			
Combination Brine and Backwash Ponds (2 ponds)	ls				1	$ 650,000	$ 650,000
SUB-TOTAL				$850,000			$650,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$850,000			$650,000
						SAVINGS	**$200,000**

VE ALTERNATIVE TP-12

Install system to blend the brine with raw water

Initial Cost Savings: ($150,000)

Description of Baseline Concept: The baseline concept does not address how brine will be disposed of when there is no flow in the outfall from the MRWPCA wastewater plant. Modeling is still being performed to evaluate whether the outfall diffusers can provide sufficient dilution into the seawater when the brine is not combined with any treated wastewater effluent.

Description of Alternative Concept: If additional dilution is required during periods of no treated wastewater effluent availability, this solution could possibly provide sufficient dilution. The proposed alternative solution would use raw water from the slant wells to augment the brine flow to the outfall.

Advantages:

- This approach provides a solution to an issue that occurs every summer when all wastewater effluent is used for irrigation purposes instead of going to the outfall
- Allows the desalination plant to continue operating in summer at a lower output instead of having to shut down when brine cannot be disposed of

Disadvantages:

- Uses well water to bypass the plant instead of being desalinated
- Production capacity may be reduced during this time period

Discussion: The current plan for brine disposal is to have it flow to the MRWPCA wastewater outfall pipe, where it combines with treated wastewater effluent and is discharged through an outfall pipe in the bay (through diffusers). It is worth evaluating whether ocean dilution requirements are met under worse case scenarios when zero wastewater effluent mixes with the brine. If modeling shows that requirements are not met, then one potential solution would be to mix unprocessed seawater at the desalination plant with the brine to obtain the required dilution during these periods.

To do this, it would be necessary to install approximately 300 feet of water line at the desalination plant to connect the raw water pipeline to the brine line. It would also require at least two valves, a flow meter, and instrumentation.

Discussion of Schedule Impacts: No impact.

Discussion of Risk Impacts: If modeling shows that dilution is an issue during periods of no wastewater effluent, then this solution could allow the plant to continue operating, albeit at a reduced rate. If this solution (or another alternate solution) is not implemented, the plant runs the risk of being unable to operate during these periods.

VE ALTERNATIVE TP-12

Install system to blend the brine with raw water

Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	No impact.
Plant Operations	This concept would have a positive impact on operations since it would allow continued operations, and avoid plant shutdowns.
Future Flexibility	No impact.
Environmental Impacts	This would allow a better seawater dilution at the outfall diffusers, improving environmental impacts.
Sustainability	No impact.
Aesthetics	No impact.

Assumptions and Calculations: The cost assessment assumes an installed cost of about $250 per foot for pipeline.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Connection between raw water line and brine line.		0		$ -	1	$ 150,000	$ 150,000
SUB-TOTAL				$0			$150,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$0			$150,000
						SAVINGS	**($150,000)**

VE ALTERNATIVE TP-13

For 6.4 MGD plant option, eliminate brine pit and circulate the permeate and brine until discharge is allowed

Initial Cost Savings: ($761,000)

Description of Baseline Concept: Brine concentrate flows from RO system to Brine discharge at MRWPCA outfall using excess pressure from RO process. When outfall capacity is exceeded, brine is directed to a 3 million gallon brine storage pond. A 6 MGD brine pump station is used to drawdown the brine storage pond when the outfall capacity is restored. Plant feedwater overflow, as well as several other overflow sources, are also sent to the brine storage pond.

Description of Alternative Concept: This concept proposes to delete the Brine Storage Pond and Brine Pump Station and recirculate plant flow to head of plant when the MRWPCA outfall capacity is not available. The slant wells would need to be shut off when outfall capacity is not available. In order to recirculate the flow and keep the plant in ready standby, a 16 MGD recirculation pump station would be needed.

Advantages:

- Additional land freed up by deleting brine storage pond

Disadvantages:

- No central location for plant overflows
- Slightly more complicated operations

Discussion: During discussion with the VE team, it was believed that at the smaller 6.4 MGD plant, the loss of outfall capacity would be enough less than at the full size plant due to the brine concentrate amounts (i.e. approx. 8.8 MGD vs 13.2 MGD). It was also discussed that with the smaller desalination plant, the brine from the 6.4 MGD plant would be mixed with the lower strength concentrate from the GWR project, and that this combined flow stream would likely satisfy all ocean discharge conditions, thereby further reducing the need for the brine storage pond to be used to pulse higher flows to meet all ocean conditions. Upon further review and evaluation of this alternative, this option is likely to cost more and may not yield the initially desired benefits.

Discussion of Schedule Impacts: None noted.

Discussion of Risk Impacts: None noted.

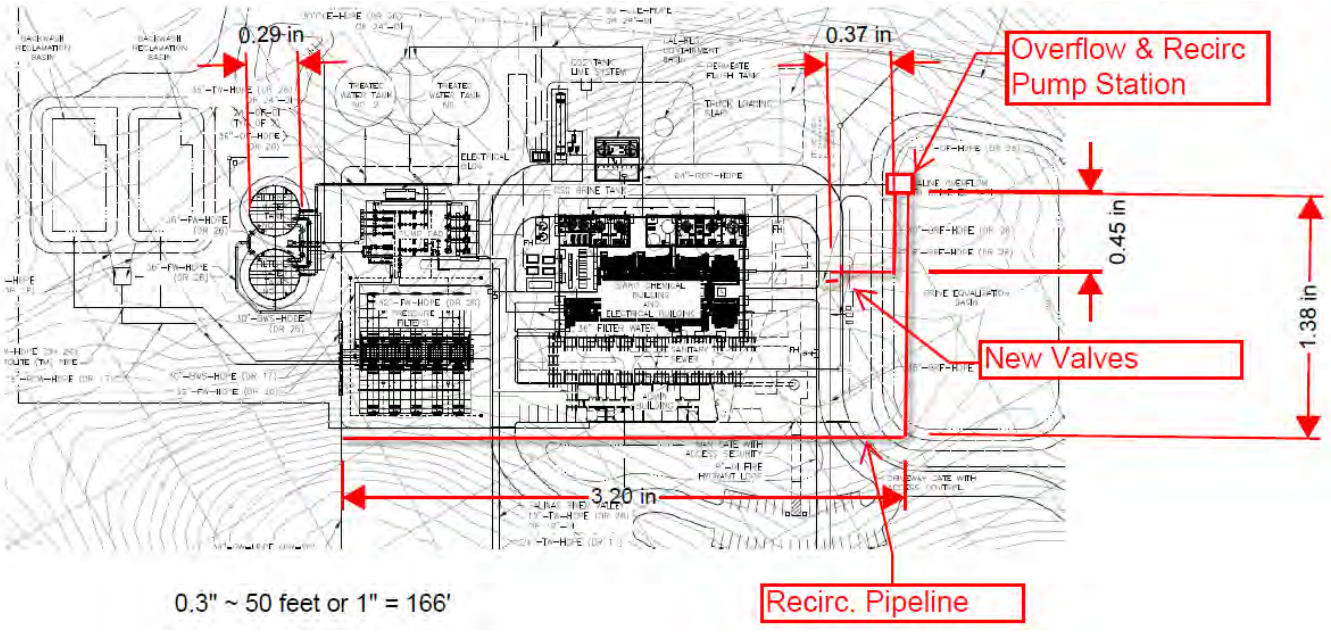
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Maintainability	Higher due to large Pump Station and additional valves.
Plant Operations	Decreased due to additional complexity.
Future Flexibility	This concept results in slightly less future flexibility.
Environmental Impacts	No change.
Sustainability	No change.
Aesthetics	Improvement due to loss of pond.

VE ALTERNATIVE TP-13

For 6.4 MGD plant option, eliminate brine pit and circulate the permeate and brine until discharge is allowed

VE Alternative Concept Sketch



Assumptions and Calculations:

Item	Value	Unit	Comment
Elevation at Brine Storage	101	MSL	
Elevation at Outfall	103	MSL	from Google Earth
Static Lift	2		
Diameter Brine Pipeline	24	inch	
Length Brine Pipeline	5000	LF	
Friction Factor	130		
Flow	16	MGD	
	11111	GPM	
	25	CFS	
Pipeline Headloss	38	Feet	
Total Head	40		
Pump HP	141	HP	
PS Cost	$ 1,393,000		$2000/ HP + $100 per GPM
Existing Brine PS Cost	$ 496,600		Per BODR, 40 HP at 4166 GPM

VE ALTERNATIVE TP-13

For 6.4 MGD plant option, eliminate brine pit and circulate the permeate and brine until discharge is allowed

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Brine Storage Pond	ea	1	$ 400,000	$ 400,000			
Brine Pump Station	ea	1	$ 496,600	$ 496,600			
16 MGD Overflow & Recirc Pump Station	ea	1			1	$ 1,393,000	$ 1,393,000
Recirc Pipelines	LF				900	$ 250	$ 225,000
36-inch Recirc Valves	ea				2	$ 20,000	$ 40,000
SUB-TOTAL				$896,600			$1,658,000
PROJECT MARK-UPS				$0			$0
TOTAL (Rounded)				$897,000			$1,658,000
						SAVINGS	**($761,000)**

DESIGN COMMENTS

The following design comments and suggestions are relatively general in nature, and were identified by the VE team as concepts that should be considered as the Desalination Plant design progresses. At this point in time specific cost or time savings could not be calculated; nonetheless, there are concepts contained in the following list that have strong potential to enhance the performance and functionality of the project features.

Idea Number and Description

7: Consider injection points above grade for maintenance purposes

On this project, there are approximately 15 points in the process where chemicals are injected into water pipelines. At the 30% design stage, the details of these chemical injection points are not shown. This is normal for the 30% design stage. It is highly desirable to have all chemical injection points above ground, where they are easily accessible for operators and maintenance personnel. In doing so, the owner will maximize employee safety and minimize the possibility of worker's compensation costs. In addition, the routine maintenance and repairs on the equipment can be performed more cost effectively because heavy equipment and confined space entry equipment are not required.

26: Eliminate the mixer between the scalant addition point and cartridge filters

The Basis of Design Report shows a static mixer after the chemical application point located between the Filtered Water Storage Tank and the Cartridge Filters. The 30% design drawings do not show this static mixer. This design comment proposes to delete the static mixer located between the Filtered Water Storage Tank and the Cartridge Filters. The concept is expected to result in both capital cost and O&M cost reductions for the facility, and has no apparent disadvantages. Need to clarify if this mixer is actually proposed as part of the baseline or not. If it is, the VE team believes that it could be deleted, because sufficient mixing will occur through the cartridge filter.

40: Use DrinTec Calcite Contactors in lieu of Cal Flo

During the VE study, the VE team identified a calcite contactor product (DrinTec) that had not been previously identified or considered by the Owner or the DB team for this project. The product offers some distinct advantages over traditional calcite contactors. This design comment recommends that the DB team should consider the application of DrinTec calcite contactors in lieu of Cal Flo before finalizing the project's post-treatment stabilization approach. A statement from Nikolay Voutchkov, Water Globe, from 2012 regarding DrinTec is below:

> *The DrinTec calcite contactor technology is well accepted and proven, and has a number of advantages comparted to conventional calcite contactors. The key advantage is that the feed of calcite granules to the calcite contact bed is designed to occur continuously through a special set of funnels delivering the granules gently to the bed. This allows to (1) eliminate the turbidity spikes of the product water associated with the intermittent reload of calcite in conventional systems; (2) avoid the need to backwash the calcite bed after a reload of media, which reduces the volume of product water wasted for operational purposes; (3) reduces the total volume (and associated costs) of the calcite bed significantly because the continuous load of calcite allows to maintain the same depth of the calcite bed at all times, while the intermittent load (typically weekly) of conventional*

Idea Number and Description
calcite contactors requires the bed (and therefore the entire calcite structure) to be oversized to provide adequate filter bed depth at the end of the filtration cycle before bed reloading. The DrinTec calcite contactors have been used at the largest SWRO plant in Europe – the 200,000 m3/day Barcelona plant and at a number of other large and medium size facilities worldwide and has well-proven track record.
41: Coordinate with wastewater treatment plant to handle backwash basin maintenance This idea recommends the MPWSP leverage the wastewater treatment plant's ability to dispose of the sludge. This could be included with a list of other items currently being negotiated between the two parties. The sludge from the backwash treatment system would enhance the dewatering of the wastewater treatment plant's solution, also reducing the volume of their sludge, and therefore reducing their sludge disposal costs.
48: Ensure project is considering removal and maintenance of large equipment This comment recommends installing cranes to handle heavy equipment (primarily the pumps) that cannot be installed, maintained or moved manually. A-frames, multiple jib cranes or other options would be effective and may be considered. The baseline concept does not currently indicate any type of crane for this purpose.
49: Consider installing skylights and other applications of natural lighting There are two skylights shown in the Admin building plans and zero in the RO building on the 30% drawings. Increasing the amount of natural lighting in areas where personnel regularly work would improve the sustainability of the facility. A majority of the work is performed at the plant during the day time and natural lighting would effectively minimize the plant's electric lighting demands.
50: Ensure ease of access for valve operations, membrane removal, and energy recovery devices removal This comment is a reminder that the design must leave adequate space for personnel to remove the membrane elements. Plant operators who participated in the VE study noted that a lack of appropriate planning in previous designs have made maintenance of the equipment in those locations challenging. In addition to adequate spacing, the valves that are operated manually must also be placed at a height that can be safely and easily reached by the operators.
60: Eliminate the physical connection from the landfill and have PG&E wheel the power to the Desalination plant The VE team recommends the desalination plant owner negotiate with PG&E to determine whether it is possible for them to transmit power from the landfill to the plant over their (PG&E's) transmission lines. This would eliminate the pole line from the landfill to the treatment plant as well as the reverse power control in the switchgear. This concept would require some additional cost to implement, but results in easier operation.

Idea Number and Description
64: Install secure Wi-Fi network interfaced with a SCADA system for plant controls This idea would result in a cost increase to the project for Wi-Fi network installation, and additional licenses for the tablet control stations. Tablets should have full capability to control all systems in the same manner as from the control room. This is a standard feature that can be supplied by the SCADA system provider, and would improve flexibility and efficiency of plant operations.
67: Use test well data to confirm feasibility of higher recovery rate in time to incorporate into the project This recommendation involves collection of source water quality data systematically on a weekly basis to confirm compounds that would foul the membranes such as iron and manganese, organic silt content and turbidity. This concept has already been considered by the owner and design team; the cost presented by CDM Smith will be a factor in the ultimate decision regarding application of the test well data.
69: Pre-purchase the minimum equipment based upon test well data and PUC approval If this idea is determined to reduce the project schedule, it may be worth considering. It also may be combined with the VE Alternative (RS-1) which suggests constructing known elements that would not change with the results of the water quality test results (RO system, post treatment, brine disposal system and service facilities) at the beginning of the project. Leave the facilities for which sizing depends on water quality to the very end (intake and pre-treatment).
72: Confirm site layout can accommodate delivery truck turning radii and confirm paving design at turns are concrete The turning radius and paving design must accommodate 40-ton trucks. CDM Smith should prepare and submit truck turning radius models with their next design submittal to verify that the site layout provides adequate space for the vehicles that will regularly access the facility. Encasement of all the piping must also be considered for any location where trucks will cross over.
79: Install sound attenuation measures around energy recovery equipment This concept was grouped with similar ideas that proposed the project should verify local requirements for noise levels and have designated decibel noise level limits for all spaces. The design should provide adequate sound attenuation to meet all applicable standards, including county ordinances and OSHA. This will likely be a condition of the EIR. The project can comply with these standards by providing attenuation within the RO building. Some examples of common sound attenuation features include acoustic panels on walls or noise curtains around high-pressure pumps and energy recovery devices.

PROJECT INFORMATION

PROJECT INFORMATION

BACKGROUND

Led by California American Water Company (CAW), the Monterey Peninsula Water Supply Project is a complex, multi-component program that is necessary to replace a large percentage of the local drinking water supply that currently originates from the Carmel River. State Water Resources Control Board (SWRCB) Order 95-10 requires CAW to reduce diversions from the Carmel River by approximately 70% no later than December 31, 2016.

SWRCB Order 95-10 requires CAW to reduce surface water diversions from the Carmel River in excess of its legal entitlement of 3,376 acre-feet per year (afy), and SWRCB Order 2009-0060 ("Cease and Desist Order") requires CAW to develop replacement supplies for the Monterey District service area by December 2016. In 2006, the Monterey County Superior Court adjudicated the Seaside Groundwater Basin, effectively reducing CAW's yield from the Seaside Groundwater Basin from approximately 4,000 afy to 1,474 afy.

In order to meet the cutback requirements and provide adequate water to the Monterey Peninsula community, California American Water plans include three projects to address this regional water crisis:

- Desalination of seawater from beach wells drawing water from Monterey Bay
- Groundwater Replenishment (GWR) with advanced treatment of wastewater by the Monterey Regional Water Pollution Control Authority Plant
- Aquifer Storage and Recovery (ASR)

This Value Engineering Study was focused solely on the Desalination Plant portion of the water supply project.

PROJECT DESCRIPTION

Dependent upon on the capacities of the planned GWR project, the desalination system will be designed and constructed to initially produce between 6.4 and 9.6 million gallons per day (MGD) of drinking water, and will consist of four major sub-systems:

- Raw water supply wells, pumping and conveyance
- Treatment plant
- Concentrate (or brine) conveyance and disposal
- Treated water distribution and storage

CDM Smith was selected as the consultant for the desalination plant Design-Build project. Their work will include the design, construction and commissioning of the proposed seawater desalination plant to produce drinking water for Monterey and surrounding communities. The

planned facilities include the treatment plant, treated water storage and pumping, and concentrate storage and disposal facilities.

CAW owns an approximately 46-acre parcel of land located just to the northwest of the PCA's wastewater treatment plant on Charles Benson Road as the site for the proposed desalination plant. The desalination plant will be staffed 24 hours per day, seven days per week. However, it is a goal that operation of the plant would be sufficiently reliable to allow partially attended operation.

Water from the Pacific Ocean will be delivered to the desalination plant by pipeline from slant wells on the nearby coast. The slant wells will be designed and constructed by others as a separate project, also led by CAW. Treatment at the desalination will consist of oxidation with sodium hypochlorite, granular media filtration, dechlorination, pH adjustment with sulfuric acid, cartridge filtration, a first pass of seawater reverse osmosis (SWRO), a partial second pass of brackish water reverse osmosis (BWRO), disinfection with ultraviolet light, post-stabilization treatment with carbon dioxide and hydrated lime, pH adjustment with sodium hydroxide, addition of an orthophosphate corrosion inhibitor and post-chlorination with sodium hypochlorite. Fresh water leaving the desalination plant will supply Monterey's local potable water needs.

INFORMATION PROVIDED TO THE VE TEAM

The following project documents were provided to the VE team for their use during the study:

- Basis of Design Report, CDM Smith, April 14, 2014
- Preliminary Drawings, 30% Design Submittal, June 2014
- MPWSP Desalination Infrastructure Request for Proposal, CAW, June 17, 2013
- CDM Smith Technical Proposal, undated
- Technical Specifications for 30% Submittal, June 2014
- Notice of Preparation, PUC, Environmental Impact Report for the CalAm MPWSP, October 2012
- Preliminary Power System Analysis, Short-Circuit Study, June 2014

Note: The information presented in this report may have been excerpted either in part or in full from the documents/information provided to the VE team listed above.

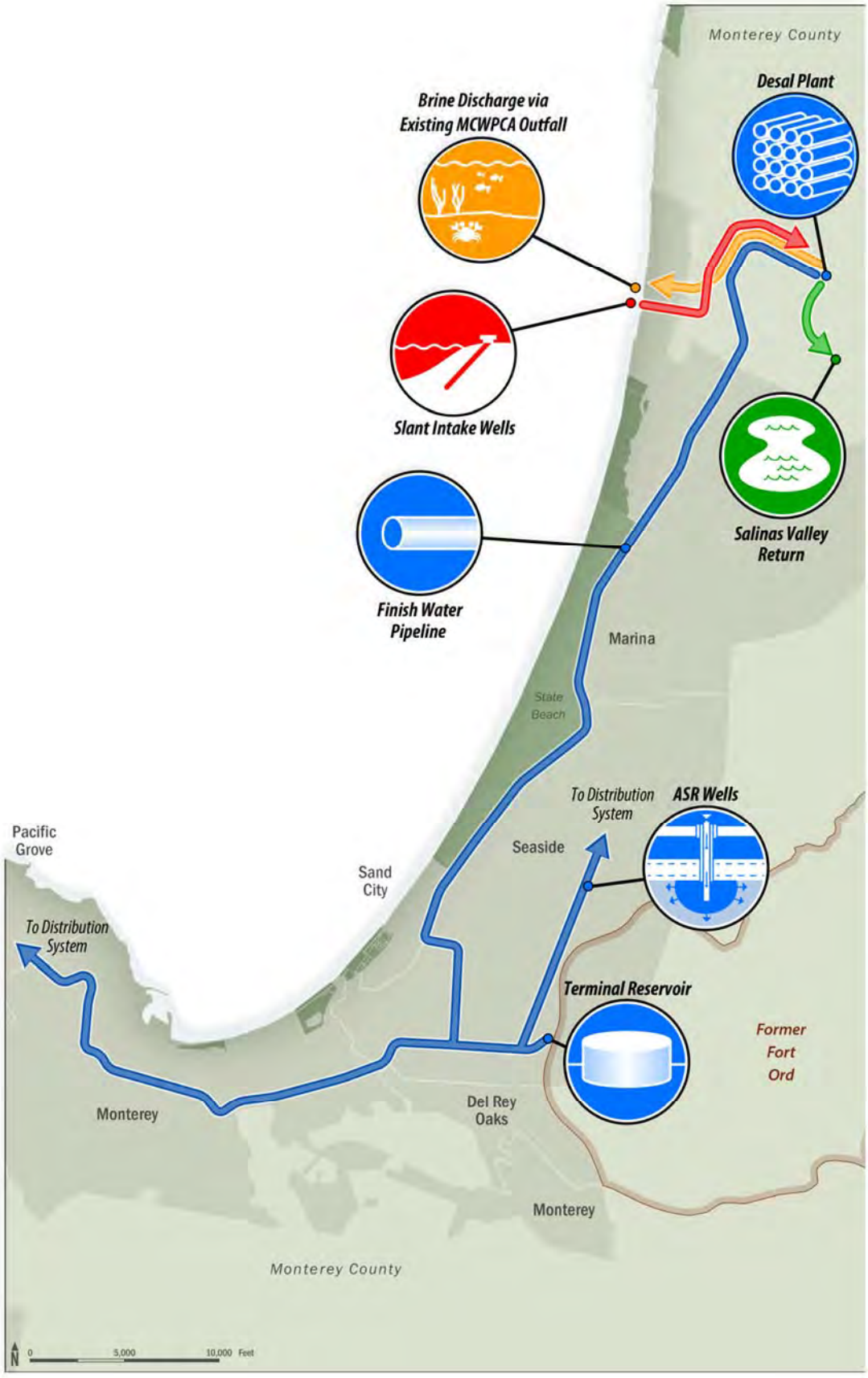
PROJECT DRAWINGS

Selected sheets from the project drawings are included on the following pages.

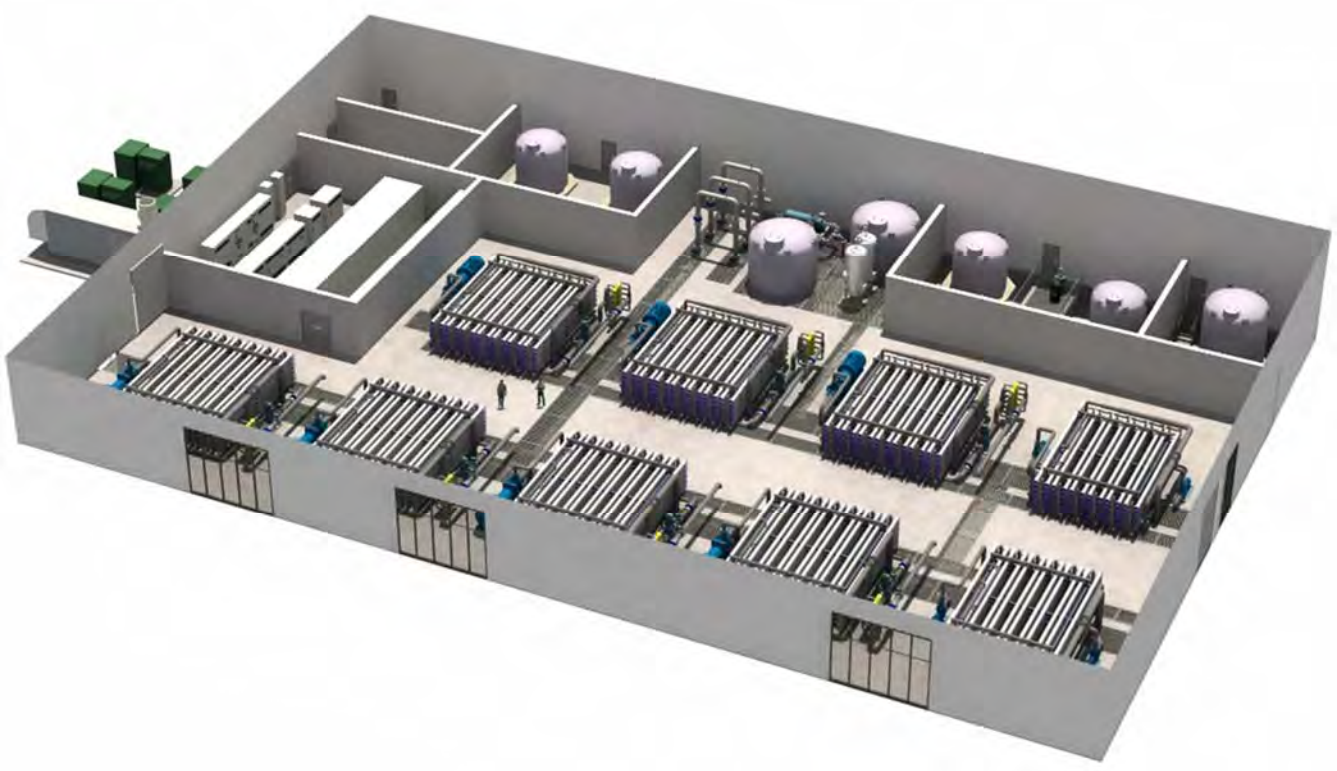
PROJECT COST ESTIMATE

The project cost estimate that was used as the baseline for the VE study is included at the end of this section.

Project Area Map



Birdseye view rendering of desalination plant



Desalination building schematic showing first pass and second pass R.O. membrane layout

Cost Estimate

COST INFORMATION FROM CDM SMITH PROPOSAL FORM 13 FIXED DESIGN-BUILD PRICE
CONSTRUCTION - Provide breakdown by CSI Format, Divisions 1-16

Division 1 - General Requirements	$	6,017,686
Division 2 - Site Construction, Including Yard Piping and Valves	$	2,036,508
Division 3 - Concrete Division 4 -Masonry Division 5 - Metals	$	3,580,836
Division 4 - Masonry	$	195,387
Division 5 - Metals	$	5,697,517
Division 6 - Wood and Plastic	$	260,583
Division 7 - Thermal and Moisture Protection Division 8 - Doors and Windows	$	326,180
Division 8 - Doors and Windows	$	474,316
Division 9 - Finishes	$	531,041
Division 10 - Specialties	$	154,129
Division 11 - Equipment	$	20,196,478
Division 12 -Furnishings	$	68,889
Division 13 - Special Construction (Including Instrumentation and Control and RO System)	$	7,733,459
Division 14 - Conveying Systems	$	25,000
Division 15 - Mechanical	$	17,054,710
Division 16 -Electrical	$	9,677,224
Subtotal Construction Costs	$	74,029,943

Note

1. Costs per CSI Division are for 9.6 MGD Desalination Plant as developed for Proposal (OCT 2013).
2. Costs per CSI Division do not include:
    a. Modifications, Allowances and Alternatives per the DEC 2013 Agreement
    b. Project Development and Design
    c. Startup and Acceptance Testing
    d. Other Direct and Indirect Costs (e.g., Insurance, Bonds, etc.)

PROJECT ANALYSIS

PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

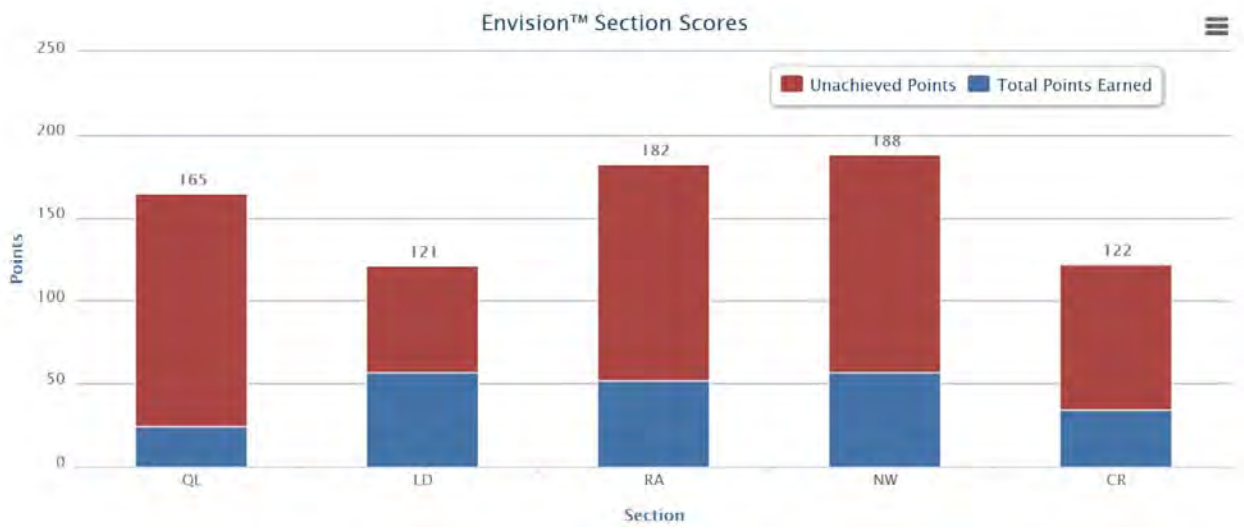
- Sustainability Certification Evaluations
- VE Focus Points
- Cost Model
- Function Analysis
- Value Metrics
- Risk Analysis

ENVISION EVALUATION

Based on the preliminary ratings defined by the Institute for Sustainable Infrastructure (ISI), this project provides for an overall Enhanced level of sustainability. The total number of points achieved (224 out of 778) makes the Monterey Peninsula Water Supply Project – Desalination Plant eligible for the **Bronze** recognition level under the ISI Envision rating system. In order to achieve the Bronze level of recognition, a minimum of 20% of the available credits must be captured. The project would need 10 more points in any category in order to achieve the next rating, Silver, which requires 30% of the available points (233 or more). The VE team believes it is possible for these points to be achieved as the design develops, as the current rating is relatively conservative. The project team should note that recognition at even the Bronze level requires extensive documentation to justify the point values achieved. If there is any intent to certify the project, a commitment should be made now in order to facilitate project team alignment in terms of documentation capture and storage for accreditation purposes. The following tables summarize the scores for each section.

Section Totals Summary

Section	Maximum Possible Score	Section Points	Innovation Points	Total Points Earned
Quality of Life (QL)	165	24	0	24
Leadership (LD)	121	57	0	57
Resource Allocation (RA)	182	52	0	52
Natural World (NW)	188	57	0	57
Climate and Risk (CR)	122	34	0	34
Total Project Points	**778**	**224**	**0**	**224**



For further information on ISI and the rating index, please see: http://sustainableinfrastructure.org

If MPRWA, CAW and the design team agree to pursue a higher level of Envision certification – Silver in lieu of Bronze, for example – several of the VE alternatives presented previously in this report provide the opportunity to attain additional credits for little or no additional cost to the project. The concepts have strong potential to enhance not only the project's sustainability, but other performance attributes such as maintainability, operations, future flexibility, and aesthetics.

The current preliminary ISI Envision Sustainability rating sheet is provided for reference following the LEED discussion below.

LEED EVALUATION

At the time of the VE study, the project is anticipated to qualify for formal **LEED Certified** status as defined by the US Green Building Council (USGBC). LEED Certified status is awarded to projects that achieve 40-49 points. The next level in the rating system, LEED Silver, requires a minimum of 50 points.

During a sustainability workshop held on July 7th, 2014, a preliminary LEED score sheet for the project was prepared. The score sheet, which is based on the design details and information presented in CDM Smith's 30% design submittal (BODR), indicates a total of 32 "Yes" points, 28 "Maybe" points, and 50 points that are believed to be out of range for the project based on cost or practicality reasons. During the July 7th workshop CDM Smith's designers expressed optimism that at least 8 "Maybe" credits could be revised to "Yes" credits, pending further collaboration with CAW to implement design upgrades that support achieving these credits.

As noted above for the Envision assessment and goals, the VE team identified opportunities that would enhance overall project value, and have the potential to support attaining a higher LEED certification status as well. The preliminary LEED score sheet reviewed with the project team during the VE study is presented in the pages following the ISI Envision rating sheets. Below, a list of opportunities for LEED items documented during the July 7th sustainability meeting is presented for reference and consideration.

Sustainable Design Opportunities Identified

- Capture more rainwater from the roofs for the demonstration gardens. There is 26,000 SF of roof area on the RO building, and this could generate 8,000 gallons of water for each ½-inch rainstorm.
- Connect to the MRWPCA reclaimed water line (purple pipe) for additional irrigation supply.
- Install solar panels for some of the electrical supply. Installing PVs on the 26,000 SF roof of the RO building could produce approximately 260 kW if it is sunny assuming a typical 10 watts per SF of solar panel.
- Use of reclaimed or salvaged lumber for the pedestrian walkway from the parking lot to the tour staging areas. There are also opportunities to use salvaged material for the trellis in the demonstration garden, reclaimed stone blocks from demolition of any old buildings in old town Monterey could be used for walls and benches in the demonstration gardens. CDM Smith salvaged marble slabs for decorative signs in the Denver office lobby.
- Need to verify we have an ADA compliant parking spot inside the secure area of the plant site
- Recycle or reclaim the water from the continuous flowing instruments taps such as the turbidimeters. If there are in segregated process drains and not discharged to floor drains then the flow can be discharged to the backwash reclamation basin and returned to the plant inlet. Another option is to discharge the water to the cisterns used for landscaping irrigation. The 14 SWRO turbidimeters would provide 10,000 gallons per day assuming 0.25 gpm sample per turbidimeter. 100 mL/min (0.025) is required for the instrument but will need a higher flow rate to maintain a representative sample
- Use of a "living machine" to treat grey water and wastewater for reclaimed water use around the site. California may require NPDES permit for the on-site treatment system although the County may consider a type of individual on-site treatment system.
- Operation of a composting facility to process plant residue from the demonstration garden and food waste from the employee break room.
- Design the lighting system to minimize light pollution from the site.

General Notes

- American Water Issues a corporate sustainability report, and has some internal sustainability / conservation guidelines for the American Water facilities.
- State of California has adopted a green building code called Cal Green which will apply to this project in addition to the Title 24 energy requirements. Complying with these should result in LEED credits without additional cost to the project.
- Cal Green requires installation of clips to support solar panels on 20% of the total building roof area, which is approximately 7,300 SF Most significant impact is the designing the pre-engineered building for the additional weight.
- There is a new Monterey Bay Friendly Landscaping guideline that CAW or governance committee may want to follow. It has long term maintenance requirements such as integrated pest management.
- The state of California has stormwater regulations as part of WQCD that will impact the control of stormwater. Stormwater will be designed to infiltrate into the sandy soils and no off-site storm water discharge is anticipated.
- $75K included in the contract for landscaping and architectural enhancements

- If CAW wants to consider LEED certification in the future it will be necessary to define the LEED boundary around the Admin Building
- Vic Duran, HDR architect on the VE team, estimated $50K - $100K for the documentation needed for LEED certification based on a recent proposal.
- Jessica with EHDD, said they pursue LEED certification on many of the projects they design, and she thought costs was significantly less than $50K; she recommended developing a proposal to CAW for preparing the LEED documentation
- There were several items in the LEED and Envision check lists that require coordination with the HVAC and Plumbing Building Mechanical groups. These include potential credit for the elimination of supplemental gas or electric heat for the RO process areas and the use of waste heat from the VFDs and large pump motor cooling fans.
- We may end up with low energy 0.5 watts per SF lighting design which may result in LEED credit
- Use of electricity generated from landfill methane gas may quality as an alternative membrane source.

ENVISION EVALUATION

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
QUALITY OF LIFE						
QL1	QL1.1	**Improve community quality of life.** Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities.	INCLUDE	Enhanced	5	25
			Notes: There is community linkages for the project as demonstrated through the internal project focus, linkages to the community and efforts made to locate, review, assess, and incorporate the needs, goals, and plans of the community.			
	QL1.2	**Stimulate sustainable growth and development.** Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness and livability.	INCLUDE	Superior	5	16
			Notes: The project creates local jobs during design and construction. In addition, the constructed facility seeks to create a more sustainable, reliable source of water for the region. This will contribute significantly to local community growth.			
	QL1.3	**Develop local skills and capabilities.** Expand the knowledge, skills and capacity of the community workforce to improve their ability to grow and develop.	INCLUDE	Enhanced	2	15
			Notes: The operations of the facility will largely be local personnel. The project proposes to hire and train local workers (as needed).			
QL2	QL2.1	**Enhance public health and safety.** Take into account the health and safety implications of using new materials, technologies or methodologies above and beyond meeting regulatory requirements.	INCLUDE	Improved	2	16
			Notes: The owner and the project team are working to identify, assess and institute standards, methods and procedures to address any additional risks and exposures created by the application of new technologies, materials, equipment and methodologies. Requirements will be developed by the CDM Smith Design-Build team in the form of construction specifications			
	QL2.2	**Minimize noise and vibration.** Minimize noise and vibration generated during construction and in the operation of the constructed works to maintain and improve community livability.	INCLUDE	Improved	1	11
			Notes: The project will identify the noise and vibration levels that will occur during construction; however, it will seek to be substantially below locally permissible levels. This is largely due to the project location that is away from commercial and residential areas.			
	QL2.3	**Minimize light pollution.** Prevent excessive glare, light at night, and light directed skyward to conserve energy and reduce obtrusive lighting and excessive glare.	INCLUDE	Improved	1	11
			Notes: The project is seeking to integrate sustainable principles in lighting. The facility will be operational during nights, but will employ low emitting fixtures and cut-offs to minimize light spillage. The fixtures will not create obtrusive and disruptive glare.			
	QL2.4	**Improve community mobility and access.** Locate, design and construct the project in a way that eases traffic congestion, improves mobility and access, does not promote urban sprawl, and otherwise improves community livability.	INCLUDE	Improved	1	14
			Notes: There are no infrastructure assets nearby that require coordination. There is also no current plans for future amenities and transportation hubs in proximity to the project. The facility will take into account expected traffic flows and volumes in and around the site while seeking to maximize mobility efficiencies.			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
	QL2.5	**Encourage alternative modes of transportation.** Improve accessibility to non-motorized transportation and public transit. Promote alternative transportation and reduce congestion.	INCLUDE	No Added Value	0	15
			Notes: There is no access to multi-modal facilities nearby. In addition, no parking restrictions for motorized vehicles is being proposed nor is the facility encouraging pedestrian access in proximity to the transportation network.			
	QL2.6	**Improve site accessibility, safety and wayfinding.** Improve user accessibility, safety, and wayfinding of the site and surrounding areas.	INCLUDE	Superior	6	15
			Notes: The project will incorporate sufficient and safe wayfinding measures through appropriate signage. In addition, the project will take into account the safety and accessibility of the operators and publice around the constructed works. The project will do its best to integrate well with the local community in a safe and effective manner. Nearby sensitive areas will also receive consideration and appropriate demarcation through signage.			
QL3	QL3.1	**Preserve historic and cultural resources.** Preserve or restore significant historical and cultural sites and related resources to preserve and enhance community cultural	EXCLUDE	------	--	--
			Notes: There are no historic or cultural resources on or near the project site.			
	QL3.2	**Preserve views and local character.** Design the project in a way that maintains the local character of the community and does not have negative impacts on community views.	INCLUDE	Improved	1	14
			Notes: The project is being designed to minimize visual impacts and seeks to include preservation of the local character. The plans, drawings and documents include consideration of views, natural landscape, and the local character.			
	QL3.3	**Enhance public space.** Improve existing public space including parks, plazas, recreational facilities, or wildlife refuges to enhance community livability.	INCLUDE	No Added Value	0	13
			Notes: The project is not being constructed in a space that is generally used for public access and recreation. No meaningful enhancements or restoration efforts, including parks, plazas, recreational facilities, or wildlife refuges are being included in the project.			
QL0	QL0.0	**INNOVATE OR EXCEED CREDIT REQUIREMENTS.** To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure.	EXCLUDE	NONE	--	--
			Notes:			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
LEADERSHIP						
LD1	LD1.1	**Provide effective leadership and commitment.** Provide effective leadership and commitment to achieve project sustainability goals.	INCLUDE	Enhanced	4	17
			Notes: There are public statements by leadership regarding sustainable practices and principles. There is commitment to address economic , environmental, social aspects through for the project.			
	LD1.2	**Establish a sustainability management system.** Create a project management system that can manage the scope, scale and complexity of a project seeking to improve sustainable performance.	INCLUDE	Enhanced	4	14
			Notes: The project is working to develop a workable sustainability management system. The project has sufficient sustainability personnel identified, management policies relevant to the scope, and the project has prioritized the environmental, economic and societal aspects of the project.			
	LD1.3	**Foster collaboration and teamwork.** Eliminate conflicting design elements, and optimize system by using integrated design and delivery methodologies and collaborative processes.	INCLUDE	Superior	8	15
			Notes: The project is taking a holistic systems view of the project and considering the relationship of performance relative to the long term community economic incentives. The project will seek to balance the levels of sustainability for the ultimate project performance that maximizes sustainability to the extent possible. Team sustainability sessions are being conducted. A systems view of the project is being implemented.			
	LD1.4	**Provide for stakeholder involvement.** Establish sound and meaningful programs for stakeholder identification, engagement and involvement in project decision making.	INCLUDE	Enhanced	5	14
			Notes: The project is involving active communication and feedback with key stakeholders and the affected public. The stakeholder groups are known and their feedback is actively being considered in the design development of the project.			
LD2	LD2.1	**Pursue by-product synergy opportunities.** Reduce waste, improve project performance and reduce project costs by identifying and pursuing opportunities to use unwanted by-products or discarded materials and resources from nearby operations.	INCLUDE	Conserving	12	15
			Notes: The project is leveraging nearby resources of by-products for energy production at the facility. Methane gas from a disposal site is being integrated into the facility design for powering of the project. The aggressive application of this energy strategy demonstrates the understanding of industrial ecology.			
	LD2.2	**Improve infrastructure integration.** Design the project to take into account the operational relationships among other elements of community infrastructure which results in an overall improvement in infrastructure efficiency and effectiveness.	INCLUDE	Superior	7	16
			Notes: The project is optimize sustainability at the component level and seeks to develop the design as an integrated system. In addition, the project is planned and designed so that its operations and functions are fully integrated with other infrastructure elements in the community. There is reasonable infrastructure bundling and synergies being afforded considering the project design and relation to the community considering the deficit for reliable, affordable water resources.			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
LD3	LD3.1	**Plan for long-term monitoring and maintenance.** Put in place plans and sufficient resources to ensure as far as practical that ecological protection, mitigation and enhancement measures are incorporated in the project and can be carried out.	INCLUDE	Conserving	10	10
			Notes: The project will institute plans for long term maintenance and operations as it is a critical infrastructure element to the community. The plan will be comprehensive and include consideration of design parameters and long-term viability. The plan will ensure sufficient operations for the planned project lifecycle.			
	LD3.2	**Address conflicting regulations and policies.** Work with officials to Identify and address laws, standards, regulations or policies that may unintentionally create barriers to implementing sustainable infrastructure.	INCLUDE	Superior	4	8
			Notes: The project is completing a comprehensive EIS that will include a complete assessment of the laws, regulations, policies and standards. Resolution of conflicts that run counter to the sustainability goals will be resolved by the project team and implemented in a manner that preserves the intent of the infrastructure asset. All meeting minutes, letters, and supporting documentation will be widely available.			
	LD3.3	**Extend useful life.** Extend a project's useful life by designing the project in a way that results in a completed works that is more durable, flexible and resilient.	INCLUDE	Enhanced	3	12
			Notes: The project is addressing future flexibility, durability, and resilience in the design of the project through the applied materials and taking into consideration the coastal location and its impacts. Considerations for expansion or reconfigurations in the future are being made; however, the facilities general design allows for flexibility in meeting the demand for water resources.			
LD0	LD0.0	**INNOVATE OR EXCEED CREDIT REQUIREMENTS.** To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure.	EXCLUDE	NONE	--	--
			Notes:			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
RESOURCE ALLOCATION						
RA1	RA1.1	**Reduce net embodied energy.** Conserve energy by reducing the net embodied energy of project materials over the project life.	INCLUDE	No Added Value	0	18
			Notes: The project team is not planning to conduct an assessment of the embodied energy and therefore cannot identify any reductions from base conditions.			
	RA1.2	**Support sustainable procurement practices.** Obtain materials and equipment from manufacturers and suppliers who implement sustainable practices.	INCLUDE	No Added Value	0	9
			Notes: The project team is not explicitly selecting suppliers based on sustainable practices. The project is not applying a sustainable supplier program and has no intent to source materials to sustainable suppliers.			
	RA1.3	**Use recycled materials.** Reduce the use of virgin materials and avoid sending useful materials to landfills by specifying reused materials, including structures, and material with recycled content.	INCLUDE	No Added Value	0	14
			Notes: The project team is not considering the application of recycled materials and structures. There is no explicit percentage of recycled materials to be used.			
	RA1.4	**Use regional materials.** Minimize transportation costs and impacts and retain regional benefits through specifying local sources.	INCLUDE	Improved	3	10
			Notes: The project will maximize the amount of local/regional materials and sources. Applications of local materials and sources will help to optimize construction of the facility. All materials and sources will be documented as a result of the construction process.			
	RA1.5	**Divert waste from landfills.** Reduce waste, and divert waste streams away from disposal to recycling and reuse.	INCLUDE	Improved	3	11
			Notes: The project team will identify means to recycle or applicable reuse destinations for construction waste generated from the project. There will be an operations waste management plan to minimize waste sent to landfills and incinerators. This plan will be executed during construction.			
	RA1.6	**Reduce excavated materials taken off site.** Minimize the movement of soils and other excavated materials off site to reduce transportation and environmental impacts.	INCLUDE	Improved	2	6
			Notes: Excavation materials will be balanced and there will be relatively minimal haul-off. This will allow for a balance in cut/fill and minimize transport away from the site.			
	RA1.7	**Provide for deconstruction and recycling.** Encourage future recycling, up-cycling, and reuse by designing for ease and efficiency in project disassembly or deconstruction at the end of its useful life.	INCLUDE	Improved	1	12
			Notes: The project will generally be designed so that a significant amount of project materials can be easily separated for recycling or readily reused at the end of the project's useful life. No assessments of such capabilities will explicitly be done and no considerations for recycling during operations are being implemented.			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
RA2	RA2.1	**Reduce energy consumption.** Conserve energy by reducing overall operation and maintenance energy consumption throughout the project life cycle.	INCLUDE	Improved	3	18
			Notes: Relative to other desalination plants, this project will operate at an efficient energy level due to supplemented energy supply from methane gas from a nearby landfill. The project team is conducting reviews and feasibility studies to optimize energy consumption of the facility for operations. The project will achieve significant reductions relative to other facilities and will likely be 10%-30% relative reductions.			
	RA2.2	**Use renewable energy.** Meet energy needs through renewable energy sources.	INCLUDE	Improved	4	20
			Notes: The project team will analyze renewable energy sources and seek to meet a significant amount of energy sources from renewables. It is likely that at least 10% of the facility energy consumption will be sourced from renewables (if not more) and be able to be clearly demonstrated.			
	RA2.3	**Commission and monitor energy systems.** Ensure efficient functioning and extend useful life by specifying the commissioning and monitoring of the performance of energy systems.	INCLUDE	Enhanced	3	11
			Notes: The project will not undergo an independent commissioning of the energy and mechanical systems; however, the project will have all documentation necessary to train operations and maintenance personnel. In addition, the design will incorporate advanced monitoring systems to enable energy efficient operations.			
RA3	RA3.1	**Protect fresh water availability.** Reduce the negative net impact on fresh water availability, quantity and quality.	INCLUDE	Superior	9	21
			Notes: The project is assessing water requirements and is will plan to conduct long-term assessments of impacts to water. The water resources being accessed will primarily be replenished in quantity and quality, inclusive of considerations to fresh water withdrawal. Any discharge of water will meet or exceed water quality requirements. While there not be a net zero impact, the project will restore the quantity and quality of surface and ground water supplies to native ecosystem conditions. Estimations of supply/demand will be considered and documentation supporting water resources will be developed.			
	RA3.2	**Reduce potable water consumption.** Reduce overall potable water consumption and encourage the use of greywater, recycled water, and stormwater to meet water needs.	INCLUDE	Restorative	21	21
			Notes: The project is a facility designed to desalinate water and provide water resources to the community. The impacts to potable water usage are tremendous and restore supplies to the community that would otherwise not exist.			
	RA3.3	**Monitor water systems.** Implement programs to monitor water systems performance during operations and their impacts on receiving waters.	INCLUDE	Enhanced	3	11
			Notes: An initial commissioning of the project's water systems is specified in order to validate the design objectives. In addition to commissioning and metering, measures will be incorporated into the design and operation of the project to enable long-term water quality monitoring and reporting of surface and groundwater quantity and quality.			
RA0	RA0.0	**INNOVATE OR EXCEED CREDIT REQUIREMENTS.** To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure.	EXCLUDE	NONE	--	--
			Notes:			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
NATURAL WORLD						
NW1	NW1.1	**Preserve prime habitat.** Avoid placing the project – and the site compound/temporary works – on land that has been identified as of high ecological value or as having species of high value.	INCLUDE	Conserving	14	18
			Notes: The project team will take steps to identify and document areas of prime habitat near or at the project site. The project will avoid development on land judged to be prime habitat. Buffer zones will be incorporated and some habitat restoration will be performed. The project will improve habitat connectivity by linking the various habitats in the project area.			
	NW1.2	**Protect wetlands and surface water.** Protect, buffer, enhance and restore areas designated as wetlands, shorelines, and waterbodies by providing natural buffer zones, vegetation and soil protection zones.	INCLUDE	Improved	1	18
			Notes: The project is avoiding development on wetlands, shorelines, and water bodies. Adequate soil protection zones will be maintained. In addition, the project will seek to enhance any degraded buffer zones around the site.			
	NW1.3	**Preserve prime farmland.** Identify and protect soils designated as prime farmland, unique farmland, or farmland of statewide importance.	EXCLUDE	------	--	--
			Notes: The project is not being developed at or near any designated prime farmland.			
	NW1.4	**Avoid adverse geology.** Avoid development in adverse geologic formations and safeguard aquifers to reduce natural hazards risk and preserve high quality groundwater resources.	INCLUDE	Superior	3	5
			Notes: The project team will identify and address impacts to sensitive or adverse geological locations. The project is being designed in a manner that minimizes impacts to such geology. Natural hazards and aquifers will be avoided with the maintenance of basic geologic functions.			
	NW1.5	**Preserve floodplain functions.** Preserve floodplain functions by limiting development and development impacts to maintain water management capacities and capabilities.	INCLUDE	Improved	2	14
			Notes: The design of the project is water dependent, but is minimizing floodplain impacts. The pre-development floodplain storage is maintained and will not increase flood elevations.			
	NW1.6	**Avoid unsuitable development on steep slopes.** Protect steep slopes and hillsides from inappropriate and unsuitable development in order to avoid exposures and risks from erosion and landslides, and other natural hazards.	INCLUDE	Superior	4	6
			Notes: The siting of the facility has been optimized in conjunction with local stakeholders and the project owners. The selected location is not on hillsides or steep slopes. The possibility or erosion and landslides is minimal.			
	NW1.7	**Preserve greenfields.** Conserve undeveloped land by locating projects on previously developed greyfield sites and/or sites classified as brownfields.	INCLUDE	No Added Value	0	23
			Notes: The project is not being developed on a greyfield or brownfield; however, the project will conserve undeveloped land adjacent to the facilities.			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
NW2	NW2.1	**Manage stormwater.** Minimize the impact of infrastructure on stormwater runoff quantity and quality.	INCLUDE	Enhanced	4	21
			Notes: The project will reduce storm water run-off to pre-development conditions and will significantly improve water storage capacity. Low impact development measures will be employed to minimize storm water runoff.			
	NW2.2	**Reduce pesticide and fertilizer impacts.** Reduce non-point source pollution by reducing the quantity, toxicity, bioavailability and persistence of pesticides and fertilizers, or by eliminating the need for the use of these materials.	INCLUDE	Improved	1	9
			Notes: The facility will not be needing pesticides or fertilizers. The project team will ensure landscaping features are locally adaptable with minimal pest control needs. All run-off will be captured and controlled.			
	NW2.3	**Prevent surface and groundwater contamination.** Preserve fresh water resources by incorporating measures to prevent pollutants from contaminating surface and groundwater and monitor impacts over operations.	INCLUDE	Enhanced	4	18
			Notes: The project will conduct hydrologic delineation studies and spill and leak prevention and response plans will be designed and incorporated into operational procedures. The project will reduce or eliminate polluting substances. Monitoring and control of the surface and groundwater will be performed.			
NW3	NW3.1	**Preserve species biodiversity.** Protect biodiversity by preserving and restoring species and habitats.	INCLUDE	Improved	2	16
			Notes: The project will identify existing habitats on or near the site. In addition, such habitats will be protected. Wildlife movement corridors will be preserved.			
	NW3.2	**Control invasive species.** Use appropriate non-invasive species and control or eliminate existing invasive species.	INCLUDE	Superior	5	11
			Notes: The project team will work with state and local agencies and other groups to identify and use only locally appropriate plants on the site following completion of construction and commencement of operations. No noxious species will be introduced.			
	NW3.3	**Restore disturbed soils.** Restore soils disturbed during construction and previous development to bring back ecological and hydrological functions.	INCLUDE	Conserving	8	10
			Notes: The project will restore 100% of disturbed soils resulting from construction. No previous development has been done at the site, so no prior disturbance will be mitigated. Soils will be restored to their original functions.			
	NW3.4	**Maintain wetland and surface water functions.** Maintain and restore the ecosystem functions of streams, wetlands, waterbodies and their riparian areas.	INCLUDE	Superior	9	19
			Notes: The project will maintain hydrologic connection, protect water quality, protect habitat, and maintain sediment transport. Any wetlands and surface waters will be maintained to their original functionality.			
NW0	NW0.0	**INNOVATE OR EXCEED CREDIT REQUIREMENTS.** To reward exceptional performance beyond the expectations of the system and the application of innovative methods which advance the state of the art for sustainable infrastructure.	EXCLUDE	NONE	--	--
			Notes:			

	Section & Objective Numbers	Objectives	Required / Applicable?	Level of Achievement	Score	Max. Available Points
CLIMATE AND RISK						
CR1	CR1.1	**Reduce greenhouse gas emissions.** Conduct a comprehensive life-cycle carbon analysis and use this assessment to reduce the anticipated amount of net greenhouse gas emissions during the life cycle of the project, reducing project contribution to climate change.	INCLUDE	No Added Value	0	25
			Notes: The project will not undergo a life-cycle carbon assessment. The project will not be designed in a manner that seeks to reduce carbon emissions based on such a lifecycle assessment.			
	CR1.2	**Reduce air pollutant emissions.** Reduce the emission of six criteria pollutants; particulate matter (including dust), ground level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, and noxious odors.	INCLUDE	Improved	2	15
			Notes: California's standards are more stringent than NAAQS, and address additional pollutants beyond the six common air pollutants. The project will meet CAAQS standards for all project activities and in spaces where personnel perform administrative functions. A maintenance program to ensure that these standards remain met throughout the life of the project will be in place.			
CR2	CR2.1	**Assess climate threat.** Develop a comprehensive Climate Impact Assessment and Adaptation Plan.	INCLUDE	No Added Value	0	15
			Notes: The project is not developing a Climate Impact Assessment and Adaptation Plan.			
	CR2.2	**Avoid traps and vulnerabilities.** Avoid traps and vulnerabilities that could create high, long-term costs and risks for the affected communities.	INCLUDE	Enhanced	6	20
			Notes: The project will conduct a comprehensive review to identify the potential risks and vulnerabilities that would be created or made worse by the project, inclusive of climate change impacts and adverse impacts to the community. The project team intends to reduce or eliminate any risks or vulnerabilities in the facility design.			
	CR2.3	**Prepare for long-term adaptability.** Prepare infrastructure systems to be resilient to the consequences of long-term climate change, perform adequately under altered climate conditions, or adapt to other long-term change scenarios.	INCLUDE	Conserving	16	20
			Notes: The project will be designed to accommodate a changing operating environment throughout the project life cycle, in particular with respect to water supply for the community. The long-term degrees of resilience of the facility are relatively high for infrastructure of this kind.			
	CR2.4	**Prepare for short-term hazards.** Increase resilience and long-term recovery prospects of the project and site from natural and man-made short-term hazards.	INCLUDE	Superior	10	21
			Notes: A hazard analysis will be conducted covering the likely natural and man-made hazards in the project area. The project is being designed in a manner that allows for minimal disruption and quick recovery from hazard events beyond standard regulations. The design of the facility limits hazard impact and can be adapted for direct or indirect impacts.			
	CR2.5	**Manage heat islands effects.** Minimize surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates.	INCLUDE	No Added Value	0	6
			Notes: The project will not be designed to reduce heat island effects by reducing the percentage of low solar reflectance index (SRI) surfaces.			
CR0	CR0.0	**INNOVATE OR EXCEED CREDIT REQUIREMENTS.** To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure.	EXCLUDE	NONE	--	--
			Notes:			

LEED-NC 2009 Preliminary Project Checklist

CAW MPWSP

Administration Building

10-Jul-14

Proposed Points	Maybe Points	No				Available Points	Notes
3	8	15	**Sustainable Sites**			26	**Notes**
Yes			Prereq 1	**Construction Activity Pollution Prevention**		Prerequisite	
	1		Credit 1	**Site Selection**		1	Need to check prime farmland and floodplain
		5	Credit 2	**Development Density & Community Connectivity**		5	
		1	Credit 3	**Brownfield Redevelopment**		1	
		6	Credit 4.1	**Alternative Transportation**, Public Transportation Access		6	
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms		1	bicycle parking
	3		Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles		3	Cal Green vehicle space, designated electric car space; no charging
	2		Credit 4.4	**Alternative Transportation**, Parking Capacity		2	2-4 full time workers, ADA space, 22 parking spaces outside of fenc
		1	Credit 5.1	**Site Development,** Protect of Restore Habitat		1	
		1	Credit 5.2	**Site Development,** Maximize Open Space		1	20% vegetated open space
1			Credit 6.1	**Stormwater Design,** Quantity Control		1	reduce sediment, collect trash, detain to historic level, bioretention.
1			Credit 6.2	**Stormwater Design,** Quality Control		1	
		1	Credit 7.1	**Heat Island Effect,** Non-Roof		1	asphalt
	1		Credit 7.2	**Heat Island Effect,** Roof		1	camo white cool roof
	1		Credit 8	**Light Pollution Reduction**		1	dark sky,
4	2	4	**Water Efficiency**			10	**Notes**
Yes			Prereq 1	**Water Use Reduction,** 20% Reduction		Prerequisite	best practices
2		2	Credit 1	**Water Efficient Landscaping**		2 to 4	demo garden, cal poly - artichoke, brussels sprouts, comparison of
		2	Credit 2	**Innovative Wastewater Technologies**		2	living machine - planters for treatment and infiltration - NPDES
2	2		Credit 3	**Water Use Reduction**		2 to 4	30% vs baseline interior low flush toilets, smaple lines recycled, lab,
10	9	16	**Energy & Atmosphere**			35	**Notes**
Yes			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**		Prerequisite	
Yes			Prereq 2	**Minimum Energy Performance**		Prerequisite	10%
Yes			Prereq 3	**Fundamental Refrigerant Management**		Prerequisite	
10		9	Credit 1	**Optimize Energy Performance**		1 to 19	9 pts - 28% over baseleing
	7		Credit 2	**On-Site Renewable Energy**		1 to 7	Tied to EAp2 and EAc1 - wind solar; clips for panels; solar ready ro
		2	Credit 3	**Enhanced Commissioning**		2	
	2		Credit 4	**Enhanced Refrigerant Management**		2	Check with Bmech
		3	Credit 5	**Measurement & Verification**		3	
	?	2	Credit 6	**Green Power**		2	purchasing LF gas? PG&E
3	3	8	**Materials & Resources**			14	**Notes**
Yes			Prereq 1	**Storage & Collection of Recyclables**		Prerequisite	during operations. Recycling receptacles
		3	Credit 1.1	**Building Reuse**, Maintain Existing Walls, Floors & Roof		1 to 3	N/A
		1	Credit 1.2	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements		1	n/A
1	1		Credit 2	**Construction Waste Management**		1 to 2	recycling of steel construction waste diversion. Monteray county rec
		2	Credit 3	**Materials Reuse**		1 to 2	
1	1		Credit 4	**Recycled Content**		1 to 2	Check with CCI
1	1		Credit 5	**Regional Materials**		1 to 2	Check with CCI
		1	Credit 6	**Rapidly Renewable Materials**		1	
		1	Credit 7	**Certified Wood**		1	casework. Cost percentage.
6	2	7	**Indoor Environmental Quality**			15	**Notes**
Yes			Prereq 1	**Minimum IAQ Performance**		Prerequisite	Check with Bmech
Yes			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**		Prerequisite	
		1	Credit 1	**Outdoor Air Delivery Monitoring**		1	Check with Bmech
		1	Credit 2	**Increased Ventilation**		1	Check with Bmech
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction		1	
		1	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy		1	
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants		1	Check with CCI
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings		1	Check with CCI
1			Credit 4.3	**Low-Emitting Materials**, Flooring Systems		1	Check with CCI
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products		1	Check with CCI
	?	1	Credit 5	**Indoor Chemical & Pollutant Source Control**		1	IAQ management
?	1		Credit 6.1	**Controllability of Systems**, Lighting		1	switches task lights; best practice
?		1	Credit 6.2	**Controllability of Systems**, Thermal Comfort		1	zones,
		1	Credit 7.1	**Thermal Comfort**, Design		1	Check with Bmech
		1	Credit 7.2	**Thermal Comfort**, Verification		1	
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces		1	Check with Arch
	1		Credit 8.2	**Daylight & Views**, Views for 90% of Spaces		1	Check with Arch
6			**Innovation & Design Process**			6	**Notes**
1			Credit 1.1	**Innovation in Design:** Exemplary Performance, WEc3 (45%)		1	Check with Bmech
1			Credit 1.2	**Innovation in Design:** Examplary Performance, MRc2 (95%)		1	Check with CCI
1			Credit 1.3	**Innovation in Design:** Examplary Performance, MRc4 (30%)		1	Check with CCI
1			Credit 1.4	**Innovation in Design**		1	
1			Credit 1.5	**Innovation in Design**		1	
1			Credit 2	**LEED® Accredited Professional**		1	
	4		**Regional Priority**			4	**Notes**
	1		Credit 1.1	**Regional Priority**: WEc3 - Water Use Reduction		1	Check with Bmech
	1		Credit 1.2	**Regional Priority**: IEQc8.1 - Daylight		1	Check with Arch
	1		Credit 1.3	**Regional Priority**: EAc2 - Onsite Renewable Energy		1	
	1		Credit 1.4	**Regional Priority**: WEc2 - Innovative Wastewater Technologies		1	
32	28	50	**Project Total** (preliminary pre-certification estimate)			110	
Yes	?	No	**Certified** 40-49 points **Silver** 50-59 points **Gold** 60-79 points **Platinum** 80-110 points				

KEY VE FOCUS POINTS

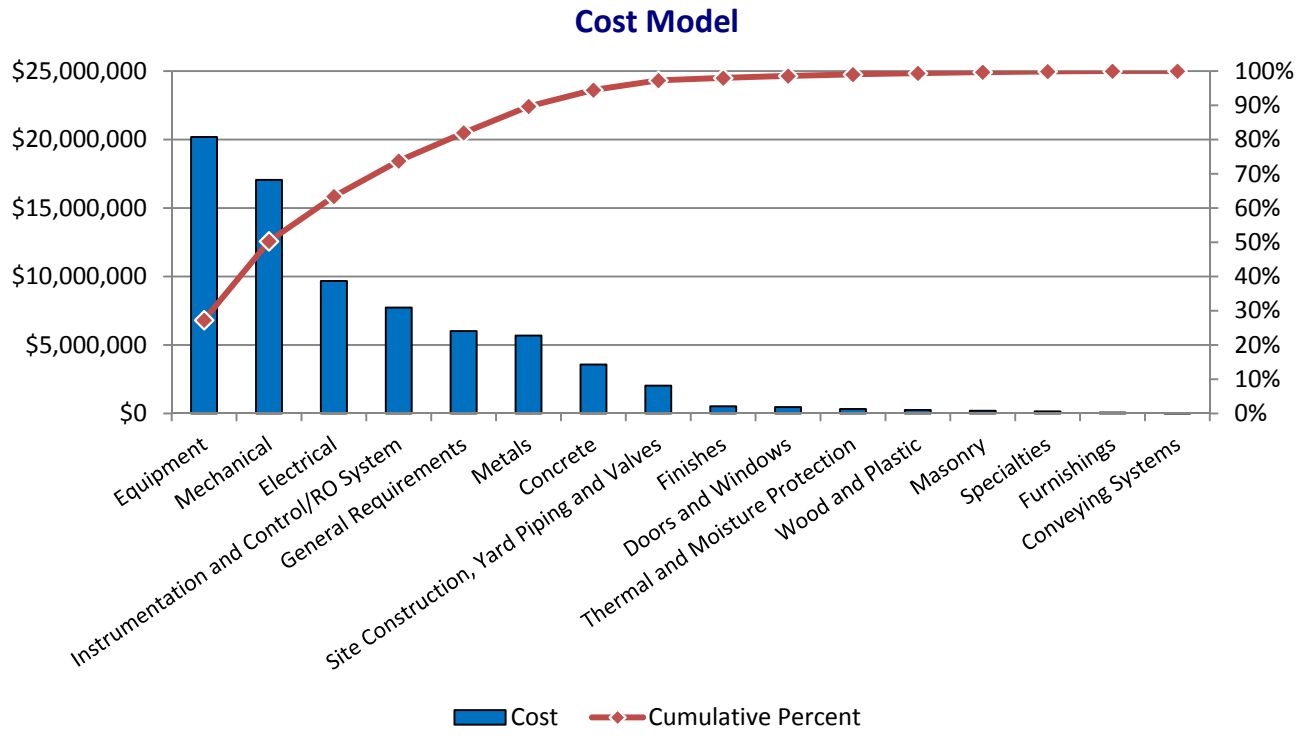
The first day of the VE study included briefings and meetings with CDM Smith, the project's Design-Build contractor and other project stakeholder representatives. The following summarizes key focus points and observations identified during these sessions and during the VE team's initial analysis of the baseline concept.

- The project's power supply is currently still being considered. Options include power from landfill gas generation and PG&E. Rates for respective power supply options are still being determined. Can power storage during off-peak hours be considered? Should one power supply be primary and the other secondary?
- Project is assuming deep dynamic soil compaction to address collapsible soils. Can another means be identified?
- Width of the courtyard between Admin and RO buildings provides separation and area for visitation tours. Can this be reduced?
- Generator provides power for building and water supply pumps, but not to produce desalinated water. Look into sizing options and alternate power supply for back-up power.
- UV treatment appears to be included to address temporary uncertainties by the regulators regarding RO process.
- Buildings are located on the area of the site most prone to settlement during a seismic event. Are other locations or site layouts able to avoid these areas?
- Is an occupancy category IV necessary for the project?
- Project is locating a large amount of equipment and tanks inside the building. Can any of this equipment be exterior with weather protection and covering?
- Courtyard trellis provides aesthetic treatment for both RO and Admin buildings, but little in the way of protection or shade. Can this be reduced?
- Project is assuming direct feed from intakes to pressure filters which could result in sand and deposits clogging the system.
- Sludge handling of the backwash storage basins could be an issue, especially if hazardous materials are encountered. Can WWTP be considered for basin maintenance?
- A portion of the intake water may need to be returned after treatment to agriculture properties. Can second pass treatment be limited to this quantity?
- Project is assuming HDPE below-grade piping for site distribution. Can other pipe material types and above-ground distribution be considered?
- Project is using pressure filters for pre-treatment. Can other types of filters be considered?

- Project is providing storage tanks for filtered water in order to maintain constant pump head. Can this constant head be provided by alternate means?
- Project is assuming brine disposal basin will be necessary when WWTP discharge outfall is not available. Are there other means to keep the plant operational during these times in lieu of brine storage?
- The facility may encounter issues removing large equipment for maintenance relative to access and equipment transport.
- Project is showing extensive irrigation and site landscaping. Can this be reduced or eliminated?
- Project is showing pumps in chemical storage sumps. Where do the pumps discharge to?
- Project is currently assuming rigorous acceptance test procedures and requirements. Can this process be simplified?
- Can the Treated Water Hydraulic Grade Line be revised?

COST MODEL

The VE team leader prepared a cost model from the cost estimate presented in the *Project Information* section of this report. The model is organized to identify major construction elements or trade categories, the original estimated costs, and the percent of total project cost for the significant cost items. The cost model clearly showed the cost drivers for the project and was used to guide the VE team during the VE study.



FUNCTION ANALYSIS

Function analysis was performed on the baseline project which revealed the key functional relationships of both the overall project and specific project elements. In Value Engineering "functions" are always described in a two word abridgement consisting of an active verb and measurable noun (what is being done - the verb - and what it is being done to - the noun) and to do so in the most non-prescriptive way possible. Understanding something with such clarity that it can be described in two words provides the VE team with the ability to separate from the specific tangible aspects of the project and facilitates considering what else can be identified to alternatively provide the respective function.

Random Function Determination

Project Element	Function
Need	Supply Water
Purpose	Improve Water Quality
Second Pass System	Meet Quality Standards
Pressure Filters, Chemical Treatments, Cartridge Filters	Remove Foulants
Pre-Treatment	Protect RO Membranes
R.O. Membranes	Remove Salt
Energy Recovery System	Reduce Energy Use
High Pressure Pumps	Feed Water
Second Pass System	Improve Water Quality
Second Pass System	Accommodate Agriculture Use
UV Disinfection	Improve Water Quality
Sodium Hypochlorite Disinfection	Improve Water Quality
Post Treatment	Reduce Corrosion
UV Disinfection	Meet Regulatory Requirements
Treated Water Storage Tanks	Maintain Pump Head
Treated Water Storage Tanks	Increase Contact Time
Filter Water Storage Tanks	Maintain Pump Head
Second Pass System	Accommodate Water Reuse
Backwash System	Reduce Intake Volumes
Backwash System	Reclaim Water
Brine EQ Basin	Meet Discharge Requirements
Brine EQ Basin	Control Discharge
Post Treatment	Improve Taste
Admin Building	House Staff

Project Element	Function
Admin Building	Support Monitoring
Admin Building	Support Equipment Maintenance
Admin Building	Support Quality Testing
Admin Building	Support Visitation
Courtyard	Separate Staff
Courtyard	Accommodate Tours
Electrical	Supply Power
Electrical	Ensure Redundancy
Roads/Parking	Support Site Circulation
Roads/Parking	Control Spills
Instrumentation & Controls	Monitor System
Instrumentation & Controls	Control Operations
Piping	Circulate Water
Piping	Distribute Chemicals
Acceptance Testing	Ensure Plant Performance

VALUE METRICS

Value Methodology (VM) has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of the role that VM can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

The Value Metrics process was used as an analysis tool to evaluate the Baseline Project (30% Design Submittal) and the VE Alternatives identified during the workshop. Value Metrics is a system of techniques predicated upon the theory that value is an expression of the relationship between the performance of a function and the cost of acquiring it. The process relies upon a fundamental mathematical algorithm for modeling value. It provides a standardized means of identifying, defining, evaluating, and measuring performance. Performance is quantified in terms of how well a set of attributes contribute to the overall functional purpose of a given project.

The basic equation used for calculating value is:

$$Value = \frac{Performance}{Cost + Time}$$

In other words, value is equivalent to the relationship of the resources needed to provide a certain level of performance for a given function. Performance is defined as a set of requirements and attributes of a project's scope that are pertinent to the project's need and purpose. Participant responses are elicited for a series of paired comparisons in which the performance of alternatives are compared, with consideration of the project need and purpose, while taking into account the relative intensity of preference of one criterion over another. While potential schedule impacts of the VE Alternatives are discussed in their respective narratives, the time factor was assumed to be the same the Baseline Concept and the VE Strategy, thus this was not calculated in deriving the value index.

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved and costs for all VE alternatives have been developed, measuring value is very straightforward.

The following pages describe the steps in the Value Metrics process.

Define Performance Requirements

Performance requirements represent essential, non-discretionary aspects of project performance. Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the VE study, cannot be considered as a viable solution. Concepts that do not meet a performance requirement cannot be considered further unless such shortcomings are addressed through the VE study process in the form of VE alternatives. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were selected for this project.

Performance Requirement	Definition
Delivery Method	The project must utilize a design-build delivery method.
Code Requirements	Building(s) will meet all appropriate building and zoning codes.
Critical Schedule Milestones	The project must meet the following critical milestones: Final Plant Design in February 2016. Full Plant Startup in February 2018.
Environmental Approvals	Project must meet all applicable environmental laws and regulations sufficient to receive approvals from regulatory agencies. This requirement will likely set the minimum requirements for the project's environmental impacts and mitigation.
Accessibility	Must meet ADA requirements for new construction.
Project Reliability	Facility must maintain 95% reliability of plant capacity through the use of redundant systems.
Plant Capacity	Desalination plant must be able to generate water at the applicable quality standards at an annual average of 9.6 mgd (or 6.4 mgd if combined with the groundwater replenishment project).
Treatment Processes and Water Quality	The raw water treatment processes have been determined and prescribed in the D/B RFP. Process and Treated Water Quality Requirements have also been determined and prescribed.
Approved Equipment Vendors	Vendors that supply the equipment for the plant have been determined and prescribed in the D/B RFP.
American Water Safety Initiative	Project must comply with the safety standards as noted in the American Water Safety Initiative.

Define Performance Attributes and Scales

Performance attributes represent those aspects of a project's scope that may possess a range of potential values. For example, an attribute called "Environmental Impacts" may have a range of acceptable values for a project ranging from 1 acre to 20 acres of wetlands mitigation. It is clear that a concept that offered 15 acres of mitigation would perform at a higher level than one that offered 5 acres, but both would meet the project's need and purpose, and their values (i.e., the relationship between performance and cost) could be rationally compared. The following performance attributes were selected for this project.

Maintainability

A measure of the life cycle cost efficiency for long-term operations and maintenance considering a 40-year service life.

Rating	Label	Description
0.0	Unacceptable	The project has an unacceptable level of maintainability.
2.0	Poor	The project is expected to require maintenance that far exceeds the norm for a facility of its kind.
4.0	Fair	The project is expected to require greater than normal maintenance due to existing site conditions or materials selection.
6.0	Good	The project provides a satisfactory level of maintainability and is typical of facilities of this nature.
8.0	Very Good	The project provides a high level of maintainability. The facility utilizes many low maintenance features and is better than average in terms of expected maintenance.
10.0	Excellent	The project provides the highest possible level of maintainability and far exceeds expectations when compared to comparable facilities.

Plant Operations

An assessment of how well the facility spaces meet their intended function and the objectives of the overall program as they relate to efficient, safe, and secure plant operations. This attribute considers the size and shape of spaces; sound attenuation; minimizing piping distances, lighting characteristics; and special amenities. Attribute also considers elements such as the efficiency of site circulation; minimizing pipe-run distances, orientation of the building(s); adjacencies of site elements (i.e., buildings, parking lots, walkways and other features).

Rating	Label	Description
0.0	Unacceptable	The design of the building is highly incompatible with the program. There are numerous and significant problems that greatly diminish the functioning of the building.
2.0	Meets Requirements	The design of the building meets the minimum requirements for program compatibility.
4.0	Good	The organization of the internal spaces, size and shape, and effect on building circulation are satisfactory and exceed the minimum requirements of the program in a few areas.
6.0	Very Good	The organization of the internal spaces, size and shape, and effect on building circulation are satisfactory and exceed the minimum requirements of the program in several areas.

Rating	Label	Description
8.0	Excellent	The organization of the internal spaces, size and shape, and effect on building circulation far exceed requirements and provide an enhanced level of compatibility and functionality that will improve operational effectiveness.
10.0	Ideal	The organization of internal spaces, size and shape, and effect on building circulation provide the highest level of performance and compatibility with the program and functioning of the building. The design greatly exceeds the original program and provides the highest desired level of operational effectiveness.

Future Flexibility

An assessment of the flexibility and adaptability of the program spaces and equipment to meet future program needs and changes in technology.

Rating	Label	Description
0.0	Unacceptable	Will not meet future long-term needs.
2.0	Low	Provides a low degree of long-term flexibility.
5.0	Medium	Provides a moderate degree of long-term flexibility.
8.0	High	Provides a high degree of long-term flexibility.
10.0	Ideal	Provides for all foreseeable long-term future uses.

Environmental Impacts

An assessment of the permanent impacts to the environment, including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice); impacts to cultural, recreational, and historic resources.

Rating	Label	Description
0.0	Unacceptable	The degree of impacts is unacceptable and create an untenable situation.
2.0	Poor	Impacts will be severe.
4.0	Fair	Impacts will be moderate.
6.0	Good	Construction impacts will be minimal.
8.0	Very Good	There will be no impacts.
10.0	Excellent	Existing conditions are actually improved upon due to mitigation measures.

Sustainability

An assessment of the sustainability of the project in its efforts to reduce consumption of non-renewable resources, minimize waste, and create healthy, productive environments.

Rating	Label	Description
0.0	Unacceptable	Does not meet minimum expectations for sustainability.
4.0	Fair	Project provides some sustainable features.
6.0	Good	Project includes many sustainable features. Project likely capable of obtaining certification for sustainability by LEED and/or Envision.
8.0	Very Good	Project includes many sustainable features. Project likely capable of obtaining high levels of certification for sustainability by LEED and/or Envision.
10.0	Excellent	Project includes many sustainable features. Project likely capable of obtaining highest levels of certification for sustainability by LEED and Envision.

Aesthetics

An assessment of the facility's aesthetic appeal. This attribute considers how well it responds to the site, surrounding structures, the locale and the building's function. Attribute also considers the ability of the project to accommodate visitations and tours of the plant processes.

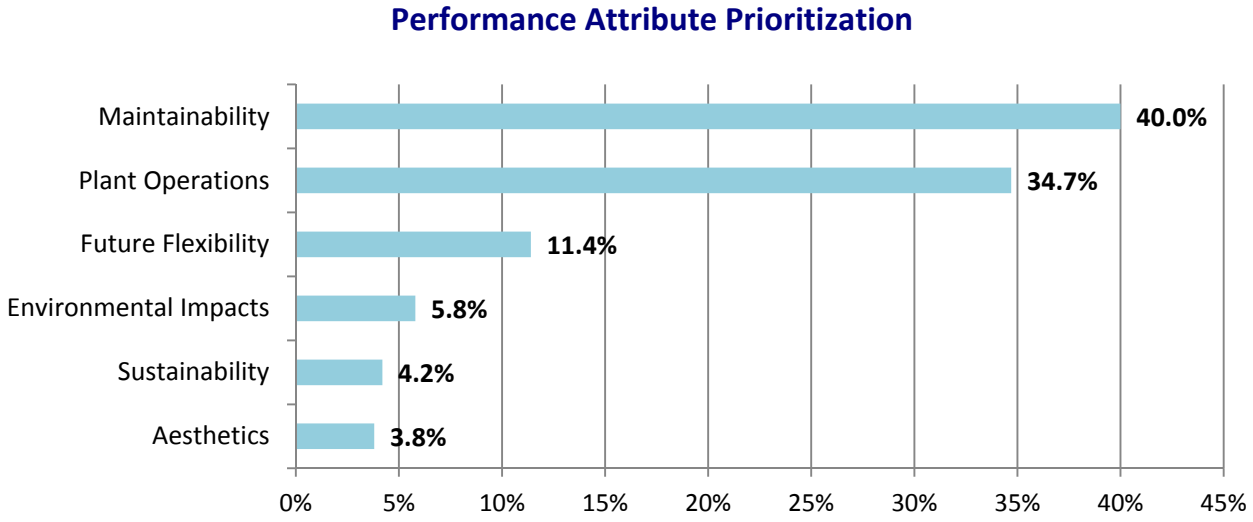
Rating	Label	Description
0.0	Unacceptable	Overall project aesthetics are inappropriate for the location and nature of the building.
3.0	Fair	Overall project aesthetics are of a lower than satisfactory.
5.0	Good	Overall project aesthetics are satisfactory.
7.0	Very Good	Overall project aesthetics are of a greater than satisfactory level.
10.0	Excellent	Overall project aesthetics are of the highest level of appropriateness and compatibility given the location and nature of the building.

Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined and their scales developed, the VE team prioritized them based on their relative importance to the project. The Analytic Hierarchy Process (AHP) was utilized in the prioritization process. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit

relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The chart below provides the results of this analysis and includes the complete breakdown of the priorities, expressed as a percentage of the whole.



Measure Performance of Baseline Concept

The VE team evaluated the performance of the Baseline Concept relative to the scales previously identified. The information below reflects the performance ratings and associated rationale for each attribute.

Maintainability
Rating: 6.5

Rationale: Potential issue with sand accumulation in the pressure filters due to direct flow from the intake pumps. RO units are not stacked. Concrete water storage tanks. No cranes or other lifting devices for maintaining heavy equipment are shown. Minimum standoff distances around equipment are provided. Project is assuming treating the backwash system in order to reuse which will involve maintaining backwash basins. Facility has higher capacity electrical power equipment and higher pressure systems than what is used on other current facilities. N+1 redundancy on equipment allows for components to be taken offline while still maintaining capacity.

Plant Operations
Rating: 6.0

Rationale: Noise issues of the high pressure pumps. Admin building includes laboratory for water testing. Maintenance shop access to the RO plant area could be improved. Compact site layout minimizes pipe runs. Visual connection from admin space to RO area could be improved. Design includes multiple storage tanks, filtration, and additional treatment at select points in the process which could be simplified or reduced. Plant operations appear to be well automated and well controlled. Facility needs to be able to control intake wells from the plant control room. Site pipelines are all assumed to be below-grade HDPE pipes.

Future Flexibility
Rating: 7.0

Rationale: Project has a range of capacities for the RO system (6.4 mgd to 9.6 mgd up to 11.2 mgd) based upon how many trains are operated. Facility has the potential to be expanded for an additional RO train. Proximity to the WWTP and the size of the buildings in combination with membrane filtration would allow the plant to be used for potable water reuse.

Environmental Impacts
Rating: 8.0

Rationale: Typical operations will be to discharge the brine to the WWTP outfall line. Ocean conditions may require the project to revise brine output to be pulsed which impacts the size of the brine storage pit. Backwash system requires storage pits and limits ability to dilute the brine.

Sustainability
Rating: 5.0

Rationale: Initial LEED analysis indicates that the project as currently designed has the potential to obtain 32 'yes' and 28 'maybe' points for LEED certification (a score of 40 is required for basic LEED certification). This indicates that the baseline concept already includes many of the sustainable features that are recommended by the U.S. Green Building Council.

Preliminary Envision analysis indicates that the project as currently designed has the potential to obtain 224 points out of 778 for the Envision Sustainable Infrastructure rating. The project is currently meeting the Bronze level of recognition (requires 20% or more of available points). A total of 234 points would allow the project to achieve the Silver level of recognition (requires 30% or more of available points) under the Institute for Sustainable Infrastructure's Envision rating system. This correlates to an overall level of Enhanced infrastructure sustainability. This indicates that the baseline concept already includes a considerable amount of sustainable features that are recommended by the Institute for Sustainable Infrastructure.

Aesthetics
Rating: 8.0

Rationale: Pre-engineered metal buildings with metal panels. Proposed design is the closest to the California Polytechnic aesthetic vision of all the proposals received.

Measure Performance of VE Alternatives

The VE team prepared performance assessments for each of the VE alternatives during the Development Phase of the VE study. For each alternative, the VE team discussed the performance impacts for each performance attribute, and the rationale for any change in performance as compared to the Baseline Concept was recorded. Please refer to the individual performance assessments in each VE alternative for this information.

Define VE Strategies

VE strategies reflect possible combinations of complimentary VE alternatives. For this study, the VE team identified one VE strategy for consideration, in the table below.

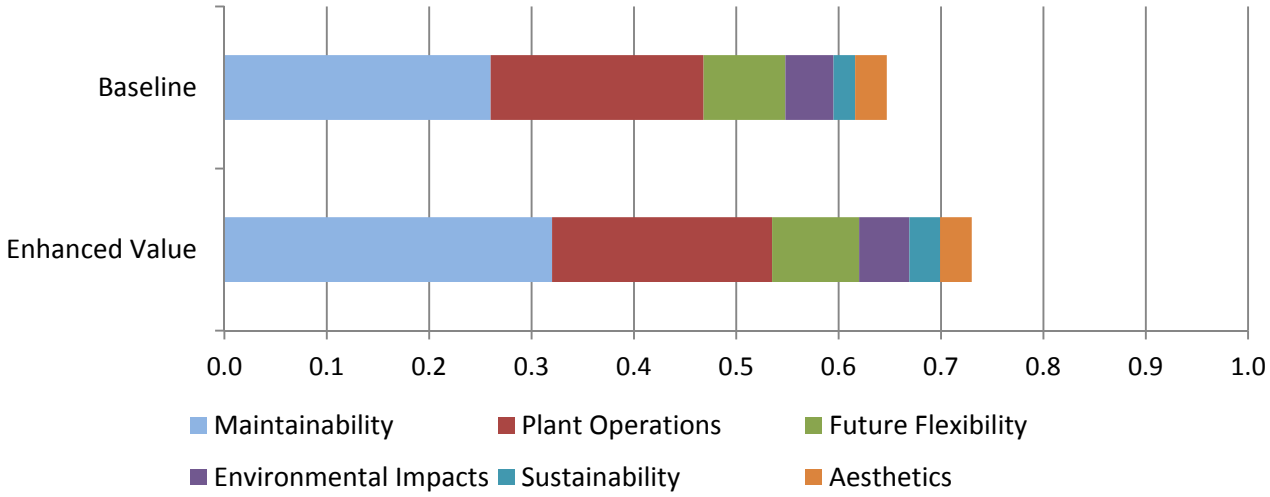
Summary of VE Strategy

Strategy Description	Initial Cost Savings	LCC Savings	Performance Change	Value Change
Enhanced Value Alternatives: BD-6, E-2, E-5, E-6, M-4, TP-1, TP-2, TP-3, TP-4, TP-5, TP-6, TP-7, TP-8, TP-9, TP-10, TP-11	$9,161,000	$23,204,000	+13 %	+29 %

Compare Performance – Baseline Concept and VE Strategy

The VE team considered the combined effect of all VE alternatives for each VE strategy. The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. A total performance score of "1" would indicate the highest level of desired performance (i.e., "ideal" performance). The chart below compares the total performance scores for the Baseline Concept and the VE strategies.

Comparison of Performance



Rating Rationale for VE Strategy

The rating rationale for the performance of the Baseline Concept was presented previously in this section. The rating rationale for the recommended VE strategy developed by the VE team is provided in the following pages.

VE Strategy 1 – Enhanced Value

Maintainability
Rating: 8.0

Rationale: Sand removal results in significantly less maintenance of granular filters. Installing a plug on the main permeate line reduces the frequency and cost of membrane cleaning because it allows the membranes to be rotated and uses all the same membrane types. Using radially split case pumps in lieu of segmental pumps reduces the total number of pumps and requires less and simplified maintenance. Eliminating the backwash treatment system eliminates the sludge maintenance of the backwash storage basins. Using fiberglass for the granular pretreatment filters reduces maintenance relative to replacing the rubber lining of the steel tanks and potential corrosion issues. Replacing the cartridge filters with membranes and eliminating the UV treatment reduces maintenance through the elimination and simplification of equipment. The two CO2 tanks allow the plant to maintain operation during maintenance of one of the tanks.

Plant Operations
Rating: 6.2

Rationale: Eliminating the backwash treatment system will result in slightly improved plant operations through the ability to discharge during constrictive ocean conditions. Installing a second pass brackish RO train on the split stream results in slightly more complex operations – additional membrane vessels – additional efforts needed for monitoring of their performance. Combining RO trains onto single radially split case pumps results in two trains being down during maintenance of a single pump. Proposed pre-treatment revisions will reduce operations activities. Eliminating sulfuric acid addition from the process removes an unneeded step in the water treatment process and reduces the amount of chemicals added to the process.

Future Flexibility
Rating: 7.5

Rationale: Flocculation chambers and membrane pretreatment provide a significant improvement to accommodate future regulations and changes in source water quality. Providing a spare chemical injection function has a significant improvement if the treatment processes are modified in the future per regulatory or program requirement changes.

Environmental Impacts
Rating: 8.5

Rationale: A higher recovery rate on the RO results in less intake of raw water and less impacts in regard to taking groundwater from agricultural lands.

Sustainability
Rating: 7.0

Rationale: Connecting the 4160 to 480 transformers directly to the 21kV switchgear reduces energy usage. Using radially split case pumps reduces energy usage and results in a more sustainable

project. Higher recovery rate on the RO both reduces energy use and reduces the carbon footprint. Eliminating sulfuric acid addition from the process reduces chemicals being transported to the site and chemicals needed to treat the water.

Aesthetics
Rating: 8.0

Rationale: No significant changes or impacts.

Compare Value

The cost and performance elements were compared and normalized for the Baseline Concept and the VE strategy using the following table. The table illustrates how cost scores were derived. In this comparison, a lower score is desirable as the project will benefit from lower costs.

Strategies	Cost	Score
Baseline Concept	$74,029,943	0.532
Enhanced Value	$64,998,943	0.468
TOTAL	**$139,028,886**	**1.000**

Once relative scores for performance, cost were been derived, the next step is synthesize a value index for the Baseline Concept and each of the VE strategies. This is achieved by applying the following algorithm for value:

- V = Value
- f = Function
- P = Performance
- C = Cost
- t = Time
- α = Risk

$$V_f(P,C,t)_{total} = \frac{\sum_{n=1}^{\infty} P_n \cdot \alpha}{\sum_{n=1}^{\infty}[(C_n \cdot \alpha) + (t_n \cdot \alpha)]}$$

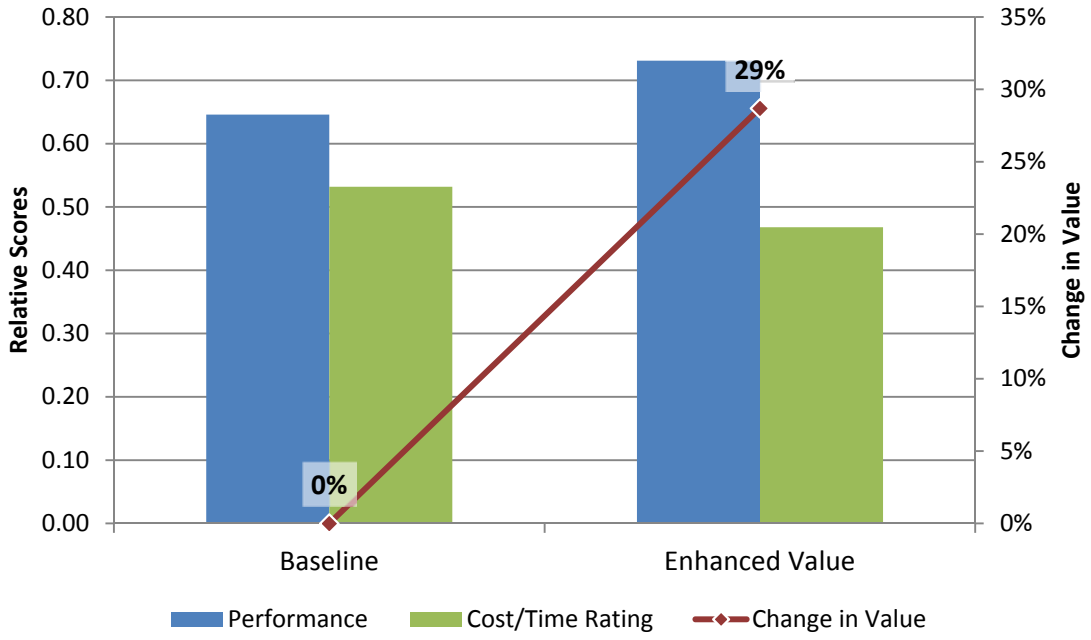
While potential schedule impacts of the VE Alternatives are discussed in their respective narratives, the time factor was assumed to be the same the Baseline Concept and the VE Strategy, thus this was not calculated in deriving the value index. Similarly, risk factors relative to the VE Strategy were evaluated qualitatively and not included in the quantitative calculations of the value index. The risk analysis performed during the VE Study is summarized in the *Risk Analysis* section below.

A Value Matrix was prepared which facilitated the comparison of competing strategies by organizing and summarizing this data into a tabular format. The performance scores for each strategy were divided by the total cost/time scores for each strategy to derive a value index. The value indices for the VE strategies are then compared against the value index of the Baseline Concept and the difference is expressed as a percent (±%) deviation.

Value Matrix
Baseline Concept and VE Strategy

Strategies	Performance Score	Change in Performance	Cost Score	Net Change	Value Index	Change in Value
Baseline Concept	0.646	---	0.532	---	1.214	---
Enhanced Value	0.731	+13 %	0.468	-12 %	1.563	+29 %

Comparison of Value – Baseline Concept and VE Strategy



RISK ANALYSIS

A qualitative risk analysis was performed to summarize the risks related to the project performance, cost, and time (schedule). The VE team, in conjunction with the project team representatives, generated a list of the potential risks.

The focus was to identify risks that are specific to the project. Then the team qualitatively evaluated the likelihood of each risk occurring and its potential impact to cost, schedule, and/or performance. The risks identified were qualified using a calculated indexing scheme that took into account the range of probability and impact in terms of the qualitative ratings (very low to very high). Tornado diagrams were utilized to visually demonstrate the relative ranking of risks against one another in terms of the anticipated project impact. To demonstrate the relative magnitude of risk inherent to project performance, schedule, and cost, bubble charts were utilized. The tornado diagrams and bubble charts display the risks prior to response and implementation of risk response strategies in the form of VE alternatives, as well as after the VE alternatives have been implemented as solutions for maximizing project opportunities and minimizing project threats.

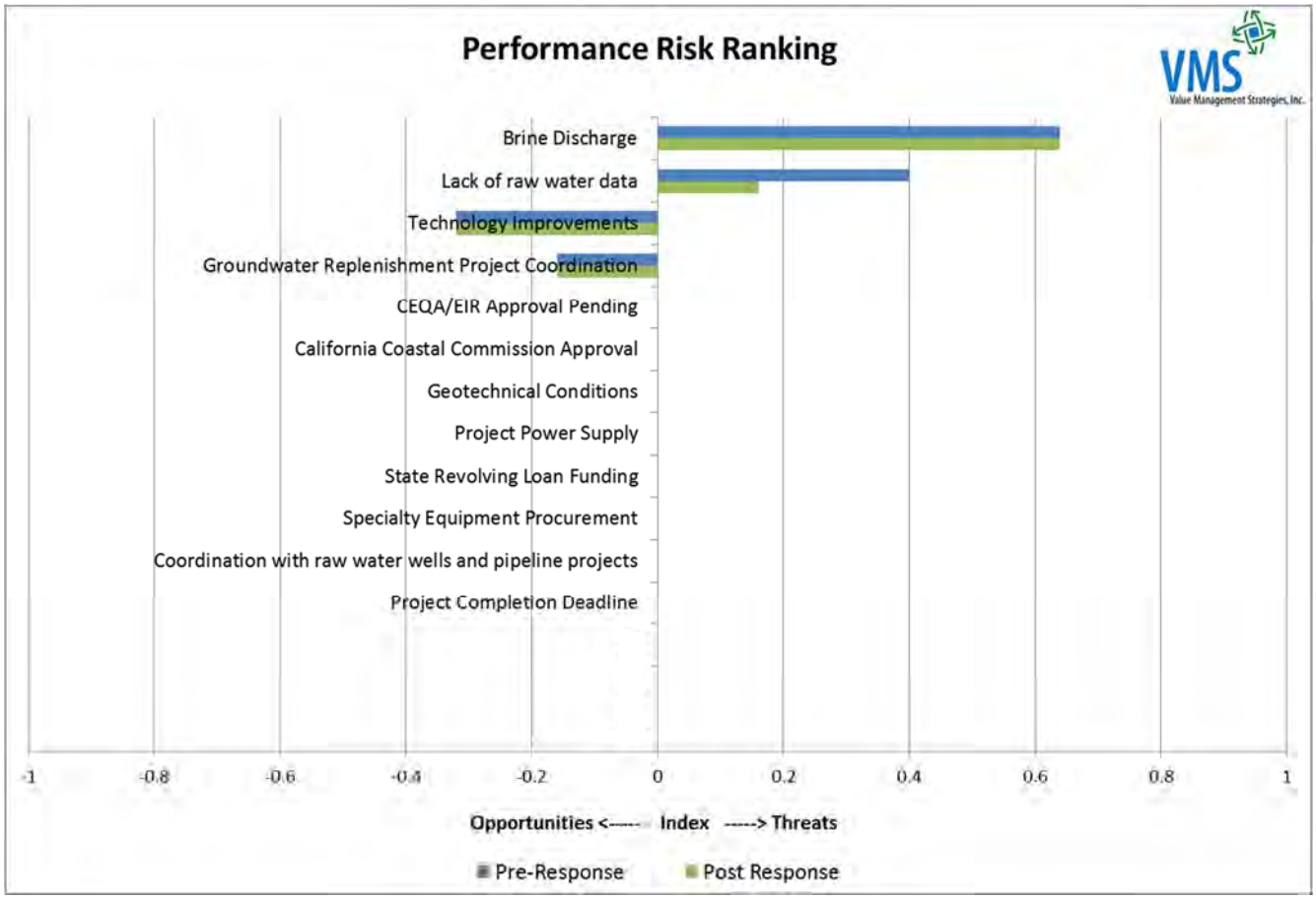
During the VE study, the VE team utilized a qualitative risk model to identify and evaluate the risks of the project. The risk elicitation form in the risk model serves as both the risk register and the format for a risk management plan. The risk model provides an analysis of the risks most in need of management and key delivery stakeholder attention by producing tornado diagrams and bubble charts. A unique risk model was developed for the project in terms of input by the project team and the VE team.

In order to identify those risks that had the largest performance, cost and schedule impacts, tornado diagrams were utilized. The highest threats or opportunities are located at the top of the tornado diagram, while the lowest risk threats or opportunities are at the bottom. The greatest threats require proactive risk management.

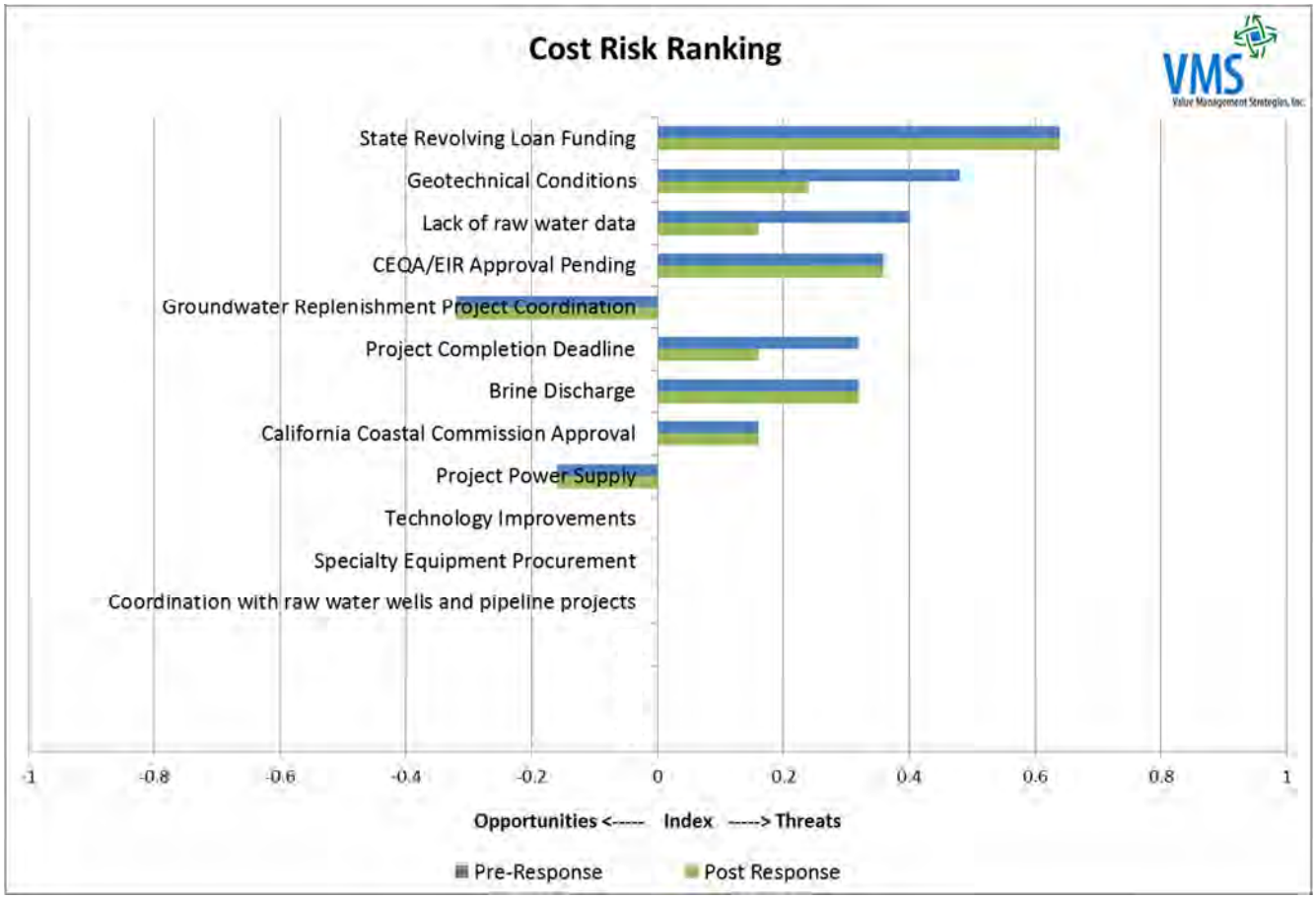
The degree of risk portrayed for the project in the tornado diagrams is based on a calculated index value ranging from zero to nine for threats (and likewise zero to negative nine for opportunities) that determines relative risk by multiplying the probability of occurrence score and the most likely impact score to generate the expected value of impact index value. The following tornado diagrams indicate the highest relative performance, cost, and schedule risks identified during the VE study for the project prior to responding to the risks.

Tornado diagrams were developed for the performance, cost, and schedule risks and show the anticipated relative change to the risk event as a result of proactively responding to and managing the risk through the risk response strategies and VE alternatives. The two different states are labeled as “Pre-Response” and “Post-Response” for indicating that the risk is in a status of being unmanaged or managed, respectively. Using the information portrayed in the tornado diagrams, the greatest risks received the most attention with respect to the development of VE alternatives. In addition, the tornado diagrams provide a good indication of which risks to focus on the most in terms of managing and delivering the project based on the relative rankings. The higher the risk is on the tornado diagram, the more focus it should receive relative to the other risks.

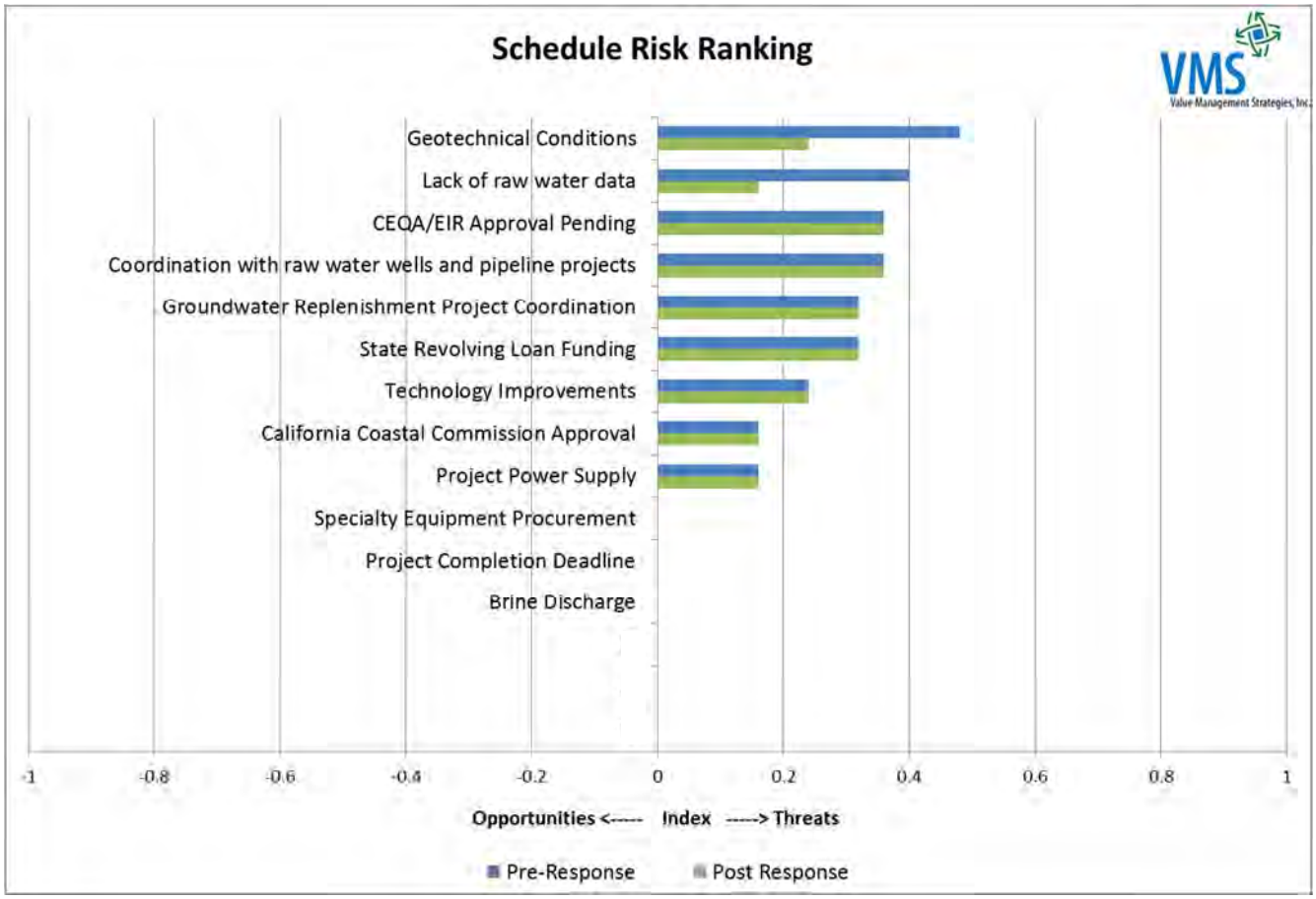
Performance Risk Ranking – Post-Response



Cost Risk Ranking – Post-Response



Schedule Risk Ranking – Post-Response



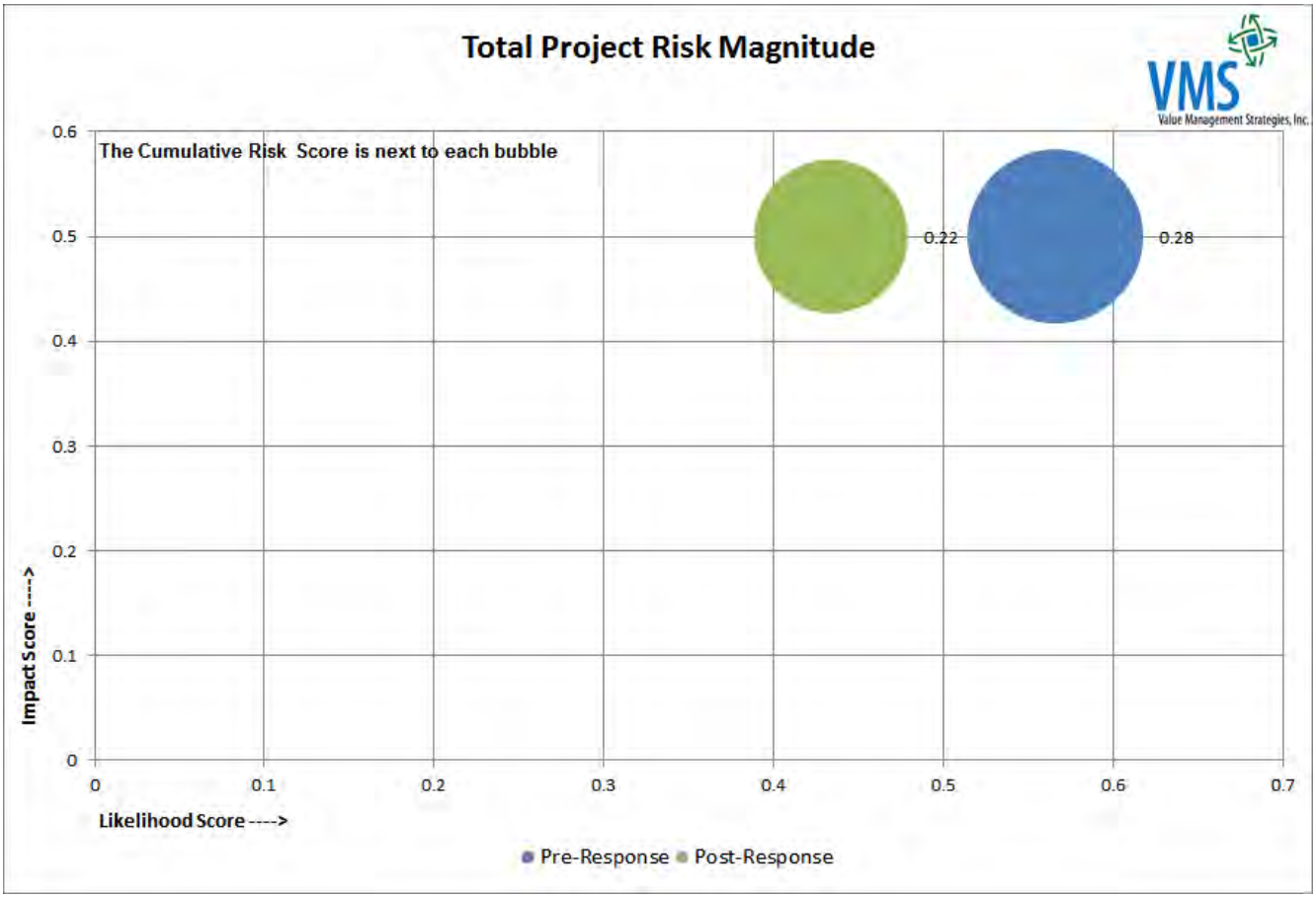
A Bubble Chart was developed for the project, considering all risk parameters. This chart represents the relative magnitude of total inherent risk within the project. The bubble chart normalizes the relative level of likelihood scores, impact scores, and total risk magnitude on a ratio scale that ranges from zero to one. A score of zero indicates that there is no risk and a score of one indicates that there is a maximum level of risk inherent in the specific aspect of project management delivery consideration, i.e., performance, cost, and schedule.

The relative level of risk is indicated in the bubble charts in two fashions for both the Pre-Response and Post-Response states. The first manner that the relative level of risk is indicated is based on where each bubble plots based on the cumulative likelihood score and cumulative impact score. The cumulative likelihood score is plotted on the *X* axis, while the cumulative impact score is plotted on the *Y* axis. Just as in quantitative risk modeling, the cumulative impact score multiplied by the cumulative likelihood score determines the expected level of risk magnitude, or severity. The second manner in which the relative level of risk is indicated is based on the size of the bubble, which is determined by the risk magnitude score. The larger the magnitude of risk, the larger the bubble is. Likewise, the smaller the degree of risk magnitude, the smaller the bubble is. The combination of these two methods of indicating the relative level of risk helps to visually display how the state of risk evolves by comparing the Pre-Response and Post-Response states to one another.

In terms of managing and buffering the effects of risk on the project, the goal of the VE team is to develop risk response strategies and VE alternatives such that the bubble magnitude shrinks in size in response to the relative level of risk reduction achieved through maximizing opportunities and minimizing threats. The placement of the bubble also helps visually demonstrate which factors are driving the risk management effects. The ideal scenario would be for the Post-Response bubble to completely move to the (0,0) plot space on the chart in terms of its X and Y coordinates. This would indicate that all of the risk from the project was removed. While this is an ideal state, there is an extremely small chance of this happening, as there will almost always certainly be residual risk that remains.

The following bubble chart represents the Pre-Response and Post-Response states based on the risks elicited on the first day of the VE study.

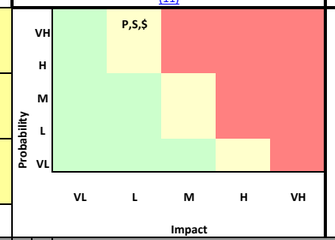
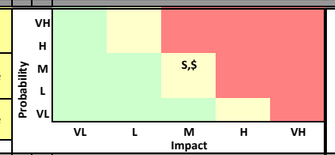
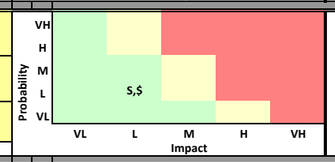
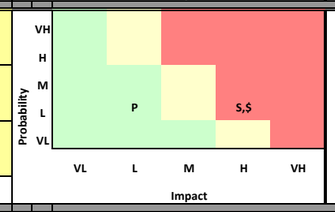
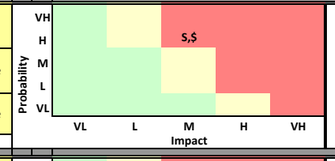
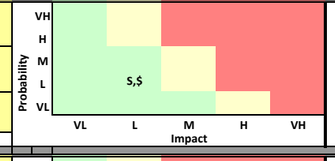
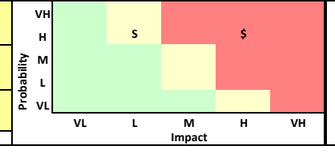
Overall Project Risk Magnitude



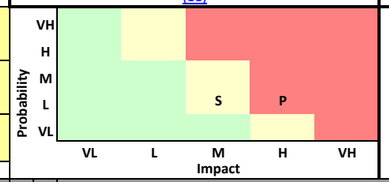
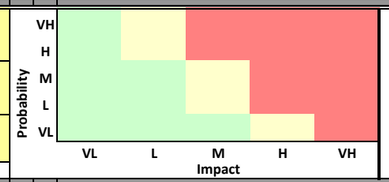
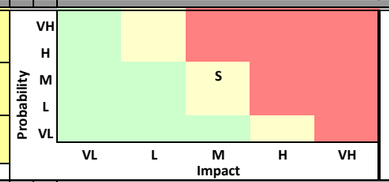
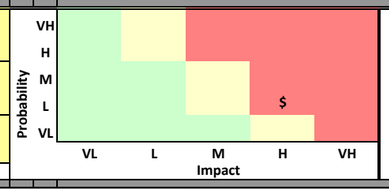
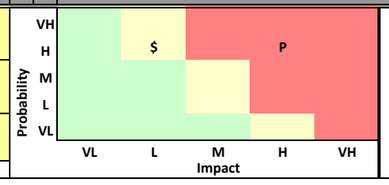
Risk Registers were developed for the project and are provided on the following pages. These Risk Registers provide all of the risk information for each risk including descriptions, triggers, probabilities, impacts and potential risk response strategies. Project management should utilize this information to proactively manage project risk as the project is developed. Risk Registers developed for both the Pre-Response and Post-Response models are included on the following pages.

Project Title: Monterey Peninsula Water Supply Project - Desalination Plant
Date: 8-Jul-14

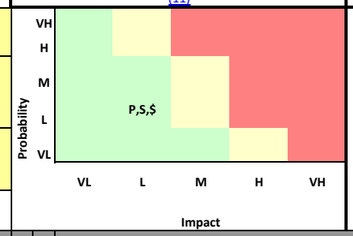
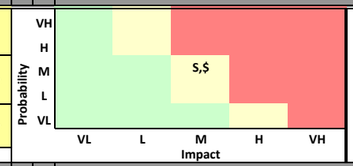
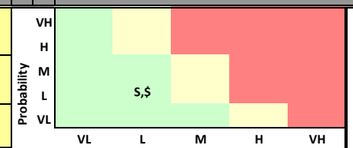
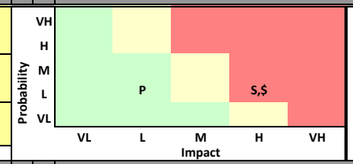
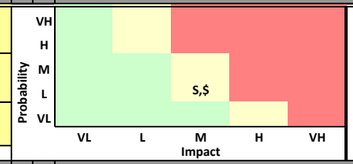
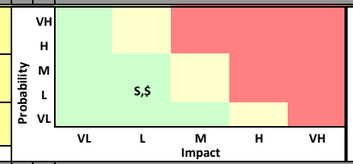
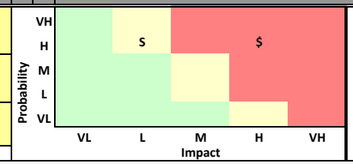
PROJECT RISK MANAGEMENT PLAN

Risk Identification Pre-Response				Qualitative Analysis				Response Strategy		Monitoring and Tracking		
ID #	Event Name	SMART Column	Threat / Opportunity	Type	Probability	Impact	Risk Matrix	Strategy	Response Actions including advantages and disadvantages	Responsibilty (Task Manager)	Status Interval or Milestone Check	Date, Status and Review Comments
(3)	(5)	(6)	(5)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	Lack of raw water data	No raw water quality data currently available. Test intake well construction scheduled for late 2014. Water quality may impact treatment processes and capacities. Multiple construction windows for intake well construction will impact Acceptance Testing. Additionally, initial modeling has shown that the raw water quality will change over time. There is a risk that the proposed intake wells will not produce the quantities as currently estimated, thus limiting the total capacity of the water supply project.	Threat	Performance	Very High	Low						
			Threat	Schedule		Low						
			Threat	Cost		Low						
2	CEQA/EIR Approval Pending	CEQA/EIR documents are being developed concurrent with design. Approval of the environmental documents may require revisions to project design. Brine disposal is the primary unknown or challenges with the EIR approval at this time.		Performance	Moderate							
			Threat	Schedule		Moderate						
			Threat	Cost		Moderate						
3	California Coastal Commission Approval	CCC approval is scheduled to occur at the 90% Design in late 2015 which may result in late-stage design changes in order to obtain approval.		Performance	Low							
			Threat	Schedule		Low						
			Threat	Cost		Low						
4	Groundwater Replenishment Project Coordination	Plant capacity is dependent on the implementation and success of the groundwater replenishment project which is currently being developed. Can plant operate at 6.4 mgd if groundwater can provide a portion of water supply? Certain equipment has long lead times which could not be procured until decision is made. If decision is delayed until scheduled construction, this may impact the schedule and cost.	Opportunity	Performance	Low							
			Threat	Schedule		High						
			Opportunity	Cost		High						
5	Geotechnical Conditions	Preliminary geotechnical information suggests portions of project site will be subject to settlement during a seismic event. The R.O. and Admin Buildings are located in this area of the site, thus requiring mitigation. There is a potential for encountering hazardous materials being adjacent to the landfill.		Performance	High							
			Threat	Schedule		Moderate						
			Threat	Cost		Moderate						
6	Project Power Supply	Project's power supply source is currently still being considered. Options include power from landfill gas generation and PG&E. Rates for respective power supply are still being determined.		Performance	Low							
			Threat	Schedule		Low						
			Opportunity	Cost		Low						
7	State Revolving Loan Funding	The project may be eligible for partial funding from the State Revolving Loan Fund. However, conditions of the funding include the Buy American Act which will raise the price of the project due to valve supplier and other equipment.		Performance	High							
			Threat	Schedule		Low						
			Threat	Cost		High						

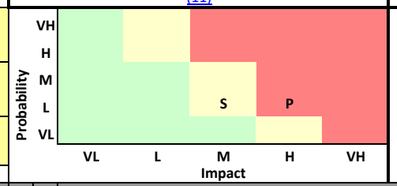
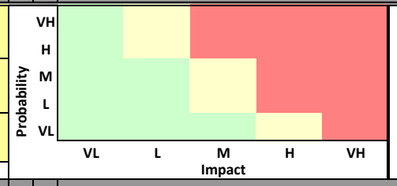
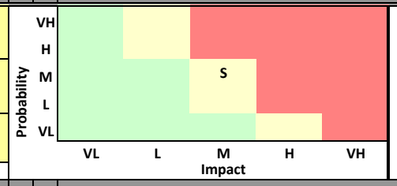
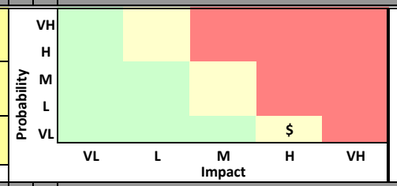
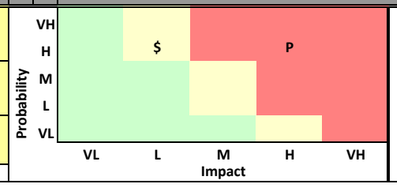
PROJECT RISK MANAGEMENT PLAN

Risk Identification Pre-Response				Qualitative Analysis				Response Strategy		Monitoring and Tracking		
ID #	Event Name	SMART Column	Threat / Opportunity	Type	Probability	Impact	Risk Matrix	Strategy	Response Actions including advantages and disadvantages	Responsibilty (Task Manager)	Status Interval or Milestone Check	Date, Status and Review Comments
(3)	(5)	(6)	(5)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
8	Technology Improvements	Newer technology may be available prior to completion of project design and/or construction.	Opportunity Threat 	Performance Schedule Cost	Low	High Moderate 						
9	Specialty Equipment Procurement	Certain specialty equipment have long lead times.	 Threat 	Performance Schedule Cost		 						
10	Coordination with raw water wells and pipeline projects	Project is part of a larger water supply project including separate water intake and pipeline projects.	 Threat 	Performance Schedule Cost	Moderate	 Moderate 						
11	Project Completion Deadline	Project must be operational by 2018 in order to avoid penalties due to continued water intake from Carmel River.	 Threat	Performance Schedule Cost	Low	 High						
12	Brine Discharge	Preliminary modeling indicates ocean conditions may prevent brine discharge as currently assumed using energy recovery system, thus requiring plant shut down during such times.	Threat Threat	Performance Schedule Cost	High	High Low						

PROJECT RISK MANAGEMENT PLAN

Priority	Event Name	SMART Column	Risk Trigger	Threat / Opportunity	Type	Probability	Impact	Risk Matrix	Strategy	Response Actions including advantages and disadvantages	Responsibilty (Task Manager)	Status Interval or Milestone Check	Date, Status and Review Comments
	Risk Identification Post-Response				**Qualitative Analysis**				**Response Strategy**		**Monitoring and Tracking**		
(1)	(5)	(6)	(7)	(5)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	Lack of raw water data	No raw water quality data currently available. Test intake well construction scheduled for late 2014. Water quality may impact treatment processes and capacities. Multiple construction windows for intake well construction will impact Acceptance Testing. Additionally, initial modeling has shown that the raw water quality will change over time. There is a risk that the proposed intake wells will not produce the quantities as currently estimated, thus limiting the total capacity of the water supply project.		Threat	Performance	Low	Low		Mitigate	Membrane pretreatment mitigates risk associated with unknown source water quality as it provides more robust flexibility to variances in water quality. Constructing aspects of the project that are not subject to raw water quality first may allow the other features time to be revised when the information becomes available.			
				Threat	Schedule		Low						
				Threat	Cost		Low						
2	CEQA/EIR Approval Pending	CEQA/EIR documents are being developed concurrent with design. Approval of the environmental documents may require revisions to project design. Brine disposal is the primary unknown or challenges with the EIR approval at this time.			Performance	Moderate							
				Threat	Schedule		Moderate						
				Threat	Cost		Moderate						
3	California Coastal Commission Approval	CCC approval is scheduled to occur at the 90% Design in late 2015 which may result in late-stage design changes in order to obtain approval.			Performance	Low							
				Threat	Schedule		Low						
				Threat	Cost		Low						
4	Groundwater Replenishment Project Coordination	Plant capacity is dependent on the implementation and success of the groundwater replenishment project which is currently being developed. Can plant operate at 6.4 mgd if groundwater can provide a portion of water supply? Certain equipment has long lead times which could not be procured until decision is made. If decision is delayed until scheduled construction, this may impact the schedule and cost.		Opportunity	Performance	Low	Low						
				Threat	Schedule		High						
				Opportunity	Cost		High						
5	Geotechnical Conditions	Preliminary geotechnical information suggests portions of project site will be subject to settlement during a seismic event. The R.O. and Admin Buildings are located in this area of the site, thus requiring mitigation. There is a potential for encountering hazardous materials being adjacent to the landfill.			Performance	Low			Mitigate	Shifting site layout away from suspect areas reduces risk related to collapsible soils.			
				Threat	Schedule		Moderate						
				Threat	Cost		Moderate						
6	Project Power Supply	Project's power supply source is currently still being considered. Options include power from landfill gas generation and PG&E. Rates for respective power supply are still being determined.			Performance	Low							
				Threat	Schedule		Low						
				Opportunity	Cost		Low						
7	State Revolving Loan Funding	The project may be eligible for partial funding from the State Revolving Loan Fund. However, conditions of the funding include the Buy American Act which will raise the price of the project due to valve supplier and other equipment.			Performance	High							
				Threat	Schedule		Low						
				Threat	Cost		High						

PROJECT RISK MANAGEMENT PLAN

Priority	Risk Identification Post-Response				Qualitative Analysis				Response Strategy		Monitoring and Tracking		
	Event Name	SMART Column	Risk Trigger	Threat / Opportunity	Type	Probability	Impact	Risk Matrix	Strategy	Response Actions including advantages and disadvantages	Responsibilty (Task Manager)	Status Interval or Milestone Check	Date, Status and Review Comments
(1)	(5)	(6)	(7)	(5)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
8	Technology Improvements	Newer technology may be available prior to completion of project design and/or construction.		Opportunity	Performance	Low	High						
				Threat	Schedule		Moderate						
					Cost								
9	Specialty Equipment Procurement	Certain specialty equipment have long lead times.			Performance								
				Threat	Schedule								
					Cost								
10	Coordination with raw water wells and pipeline projects	Project is part of a larger water supply project including separate water intake and pipeline projects.			Performance	Moderate							
				Threat	Schedule		Moderate						
					Cost								
11	Project Completion Deadline	Project must be operational by 2018 in order to avoid penalties due to continued water intake from Carmel River.			Performance	Very Low			Mitigate	Crashing the construction schedule with multiple crews can reduce project delivery schedule by upwards of 6 months.			
					Schedule								
				Threat	Cost		High						
12	Brine Discharge	Preliminary modeling indicates ocean conditions may prevent brine discharge as currently assumed using energy recovery system, thus requiring plant shut down during such times.		Threat	Performance	High	High						
					Schedule								
				Threat	Cost		Low						

IDEA EVALUATION

IDEA EVALUATION

The ideas generated by the VE team were carefully evaluated, and project-specific attributes were applied to each idea to assure an objective evaluation.

PERFORMANCE ATTRIBUTES

The following are key performance attributes identified for this project and used to assist the VE team in evaluating the ideas:

- Maintainability
- Plant Operations
- Future Flexibility
- Environmental Impacts
- Sustainability
- Aesthetics

The VE team enlisted the assistance of the stakeholders, operators and project team (when available) to develop these attributes so that the evaluation would reflect their specific requirements.

EVALUATION PROCESS

The VE team generated and evaluated ideas on how to perform the various project functions using other approaches. Each idea was evaluated with respect to the functional requirements of the project. Performance, cost, time, and risk may also have been considered during this evaluation.

Once each idea was fully evaluated, it was rated by the team. The rating "DEV" indicates an idea that was carried forward and developed as a VE Alternative; "DS" indicates a general design comment that falls under the category of Design Suggestions; the rating "DIS" was used for ideas that were determined to provide little benefit to the project, and were dismissed from further VE team consideration. The rating "ABD" was applied to ideas that the team felt the project was already doing.

Ideas rated for development as a VE Alternative or Design Suggestion were developed further and those that were found to have the greatest potential for value improvement are documented in the *VE Alternatives* section of this report.

IDEA SUMMARY

All of the ideas that were generated during the Speculation Phase using brainstorming techniques were recorded on the following pages. The team considered concepts for improving all project functions as well as the identified risks.

IDEA SUMMARY LIST

Idea Number and Description	Rating
1: Connect existing reservoirs at the headwaters of the Salinas River in lieu of Desalination plant	DIS
2: Consider assuming a higher recovery rate on the RO to 50% on the first pass and 90% on the second pass (48% total recovery)	DEV
3: Use a geogrid-reinforced soil mat in lieu of dynamic soil compaction	DEV
4: Preload soils at building footprints in lieu of dynamic soil compaction	w/ 3
5: Shift site layouts to avoid collapsible soils	DEV
6: Use above-ground FRP piping in lieu of below grade HDPE	DEV
7: Consider injection points above grade for maintenance purposes	DS
8: Reduce the width of the courtyard between the Admin and RO buildings	DIS
9: Simplify landscaping using xeriscaping principles and eliminate irrigation	DEV
10: Use membrane pretreatment instead of conventional filtration (eliminates cartridge filtration)	w/ 84
11: Pursue CT credits for granular filters	w/ 84
12: Install flocculation chamber upstream of the pretreatment filters to gain CT credits	w/ 84
13: Eliminate the backwash treatment system and discharge directly to brine basin	DEV
14: Consider alternate material for structural members in lieu of metal (ie., glulam)	w/ 28
15: Use high pressure pumps at intake wells in lieu of filtered water storage tanks	w/ 85
16: Install pump station upstream of pretreatment filters in lieu of treated water storage tanks	w/ 85
17: Relocate VFDs for RO feed water high pressure pumps to filter effluent transfer pumps	DEV
18: Use VFDs and a vertical turbine in lieu of filtered water storage tanks	w/85
19: Eliminate the UV treatment system	DEV
20: Make the UV treatment system a temporary condition during acceptance testing	w/ 19
21: Increase occupancy categories of process structures (category IV for the process-critical facilities)	DEV
22: Consider sand removal process prior to pretreatment	DEV
23: Consider selecting either the hypochlorite generator or having it delivered, not both	DIS
24: Eliminate onsite hypochlorite generation	DIS
25: Eliminate sulfuric acid addition to process	DEV

Idea Number and Description	Rating
26: Eliminate the mixer between the scalant addition point and cartridge filters	DS
27: Relocate sodium bisulfate addition point to upstream of the RO membranes	DIS
28: Consider alternate material for construction of Admin building in lieu of pre-engineered metal	DIS
29: Consider single-ply roof versus standing seam metal	w/ 28
30: Increase size of the filtered water storage tanks	DEV
31: Consolidate filtered water and treated water storage tanks from two to one	DIS
32: For 6.4 MGD plant option, eliminate brine pit and circulate the permeate and brine until discharge is allowed	DEV
33: Relocate select equipment or tanks to covered exterior in lieu of in RO building	DIS
34: Eliminate pumps in chemical storage sumps	DEV
35: Revise configuration of RO trains to accommodate flat foot foundation	DEV
36: Install a plug on the main permeate line after the second or third membrane and use all of the same elements	DEV
37: Install a second pass brackish RO train on the split stream to improve water quality and reduce energy use	DEV
38: Use radially split case pumps in lieu of segmental pumps	DEV
39: Use one high pressure pump to feed two trains	w/ 38
40: Use DrinTec Calcite Contactors in lieu of Cal Flo	DS
41: Coordinate with wastewater treatment plant to handle backwash basin maintenance	DS
42: Locate the Groundwater Replenishment Project at the Desalination plant	DIS
43: Evaluate the project's sustainability features relative to LEED and Envision Certification	DEV
44: Use fuel cells for power supply and to heat the influent water	DIS
45: Treat only the agricultural quantity requirement with second pass RO	DIS
46: Mix the RO effluent with other water to dilute quantities in lieu of performing a second pass	DIS
47: Provide lifts to move heavy equipment	DEV
48: Ensure project is considering removal and maintenance of large equipment	DS
49: Consider installing skylights and other applications of natural lighting	DS
50: Ensure ease of access for valve operations, membrane removal, and energy recovery devices removal	DS

Idea Number and Description	Rating
51: Revise layout of buildings to provide direct visual connection to the RO trains from the controls room	DIS
52: Consider consolidating the RO and Admin buildings into a single structure	DIS
53: Install acceptance testing connections as permanent	DEV
54: Eliminate baffles in the treated water storage tanks; obtain CT points elsewhere	DEV
55: Construct the filtered water storage tanks out of concrete and construct as rectangular	DEV
56: Construct rectangular concrete tanks in lieu of circular	w/ 55
57: Consider two C02 tanks in lieu of one	DEV
58: Use fiberglass for the granular pretreatment filters in lieu of steel	DEV
59: Explore the opportunity to use aeration in lieu of chlorination for iron manganese removal	DIS
60: Eliminate the physical connection from the landfill and have PG&E wheel the power to the Desalination plant	DS
61: Connect the 4160 to 480 transformers directly to the 21kV switchgear	DEV
62: Install system to blend the brine with raw water	DEV
63: Reevaluate the assumptions for number of employees operating the plant	DIS
64: Install secure Wi-Fi network interfaced with a SCADA system for plant controls	DS
65: Reduce the size of the generator to life safety code only	DIS
66: Eliminate the emergency generator and provide dual feeds to the project	DIS
67: Use test well data to confirm feasibility of higher recovery rate in time to incorporate into project	DS
68: Refine the design to meet test well data water quality information	DEV
69: Pre-purchase the minimum equipment based upon test well data and PUC approval	DS
70: Revise construction schedule to construct the known project elements first (i.e., service pumps, treated water storage, Admin building)	DEV
71: Seek earlier approval by California Coastal Commission if possible	ABD
72: Confirm site layout can accommodate delivery truck turning radii and confirm paving design at turns are concrete	DS
73: Identify parking area for delivery trucks in the event multiple trucks are at the plant simultaneously	ABD
74: Use recycled materials in construction of the site circulation and drives	DIS
75: Right-size fixture counts for intended use of the facility	DIS

Idea Number and Description	Rating
76: Limit RO train height to maximum 6 feet for accessibility. Resize the building accordingly.	DIS
77: Revise layout of RO and Admin building: create one building with overlook, improved sight lines and a reduced courtyard	DEV
78: Construct Admin building (or portion of) as a two-story or split-level structure	DIS
79: Install sound attenuation measures around energy recovery equipment	DS
80: Designate decibel noise level limits for all spaces	w/ 79
81: Verify any local requirements for noise levels	w/ 79
82: Eliminate fire protection of the buildings where not required by code	ABD
83: Provide a spare chemical injection function to Desalination plant	DEV
84: Consider more efficient means of meeting CT requirements with flocculation chamber or membrane pretreatment	DEV
85: Optimize configuration from intake wells to RO membrane system in lieu of filtered water storage tanks	DEV

DEV: Develop (as a VE Alternative)

DS: Design Suggestion

w/ #: Idea is combined with another Alternative or Design Suggestion

ABD: Already Being Done (in the Baseline Concept)

DIS: Dismissed

VALUE ENGINEERING PROCESS

VALUE ENGINEERING PROCESS

A systematic approach is used in the VE study. The key procedures followed were organized into three distinct parts: (1) Pre-Study Preparation, (2) VE Study, and (3) Post-Study Procedures.

PRE-STUDY PREPARATION

In preparation for the VE study, the team leader reviews critical aspects of the project and areas for improvement. In the week prior to the start of the VE study, the VE team reviews the documents provided by the designer to become better prepared for the study. In addition, performance attributes and requirements are initially identified that are relevant to the project.

VE STUDY

The Value Methodology (VM) Job Plan is followed to guide the teams in the consideration of project functionality and performance, potential schedule issues, high cost areas, and risk factors in the design. These considerations are taken into account in developing alternative solutions for the optimization of project value. The Job Plan phases are:

- Information Phase
- Function Phase
- Speculation Phase
- Evaluation Phase
- Development Phase
- Presentation Phase

Information Phase

At the beginning of the VE study, the design team presents a more detailed review of the design and the various systems. This includes an overview of the project and its various requirements, which further enhances the VE team's knowledge and understanding of the project. The project team also responds to questions posed by the VE team.

The project's performance requirements and attributes are discussed, and the performance of the baseline concept is evaluated.

Function Phase

Key to the VM process is the function analysis techniques used during the Function Phase. Analyzing the functional requirements of a project is essential to assuring an owner that the project has been designed to meet the stated criteria and its need and purpose. The analysis of these functions in terms cost, performance, time and risk is a primary element in a VE study, and is used to develop alternatives. This procedure is beneficial to the VE team, as it forces the participants to think in terms of functions and their relative value in meeting the project's need and purpose. This facilitates a deeper understanding of the project.

Speculation Phase

The Speculation Phase involves identifying and listing creative ideas. During this phase, the VE team participates in a brainstorming session to identify as many means as possible to provide the necessary project functions. Judgment of the ideas is not permitted in order to generate a broad range of ideas.

The idea list includes all of the ideas suggested during the study. These ideas should be reviewed further by the project team, since they may contain ideas that are worthy of further evaluation and may be used as the design develops. These ideas could also help stimulate additional ideas by others.

Evaluation Phase

The purpose of the Evaluation Phase was to systematically assess the potential impacts of ideas generated during the Speculation Phase relative to their potential for value improvement. Each idea was evaluated in terms of its potential impact to cost, overall project performance, constructability, schedule and risk. Once each idea was fully evaluated, it was given a rating to identify whether it would be carried forward and developed as a recommendation, dismissed from further consideration or is already being done.

DEV	VE Alternative
DS	Design Suggestion
ABC	Already Being Done
DIS	Dismiss

Development Phase

During the Development Phase, the highly rated ideas are expanded and developed into VE alternatives. The development process considers the impact to performance, cost, time, and risk of the alternative concepts relative to the baseline concept. This analysis is prepared as appropriate for each alternative, and the information may include a performance assessment, initial cost, and life-cycle cost comparisons, schedule analysis, and an assessment of risk. Each alternative describes the baseline concept and proposed changes and includes a technical discussion. Sketches and calculations are also prepared for each alternative as appropriate.

Presentation Phase

The VE study concludes with a preliminary presentation of the VE team's assessment of the project and VE alternatives. The presentation provides an opportunity for the owner, project team, and stakeholders to preview the alternatives and develop an understanding of the rationale behind them. The VE study's facilitator also presented an overview of the VE process and preliminary findings during a Special Joint Meeting of the Monterey Peninsula Water Authority and the Water Supply Project Governance Committee on July 10th, which was open to the public at Monterey City Hall. The meeting was well attended and allowed the water authority, governance committee, stakeholders and the public to understand and ask questions about the VMS process, the objectives and results of the VE study.

POST-STUDY PROCEDURES

A *Draft Value Engineering Study Report* is prepared after the completion of the workshop. This report summarizes the activities and results of the VE study. Once this report has been reviewed by the owner and project team, an implementation meeting is held in order to determine the disposition of the alternatives presented therein. An implementation plan is developed for those accepted VE alternatives, detailing actions, responsibilities, and key milestones for integrating them into the project. VE alternatives that are rejected include a summary of the reasons for their rejection. A *Final VE Study Report* is prepared once the implementation results are finalized.

MONTEREY PENINSULA WATER SUPPLY DESAL PLANT

VALUE ENGINEERING STUDY AGENDA

July 7 – 11, 2014

VE Study Meeting Location: **California American Water**
511 Forest Lodge Rd
Pacific Grove, CA 93950

July 7	**Monday**	
8:30	**VE Study Kickoff Meeting** **Welcome & Introductions** **VE Process and Agenda Overview** **Identify VE Study Objectives** **A/E Design Team's Presentation of Project** • **Project Background** • **D/B RFP Requirements** • **Design Concept Overview** • **Project Issues & Constraints** • **Project Schedule & Construction Challenges**	**All Project Stakeholder Representatives**
10:30	**Conclusion of VE Study Kickoff Meeting**	
10:30	TAC Meeting – Provide Comments, Project Issues, or Value Targets to VE Team	TAC Members
10:45	VE Performance Criteria Development and Prioritization	VE Team
11:30	VE Team Analysis and Rating of Baseline Concept	
12:00	Lunch	
1:00	VE Team Review and Discussion of Project Documents Identify Project Issues and Value Targets VE Team Review of Cost Model	
3:30	Function Analysis/Fast Diagram	
5:00	Adjourn	
July 8	**Tuesday**	
8:00	Team Brainstorming of Creative Ideas	VE Team
12:00	Lunch	
1:00	Creative Idea Generation Cont'd	
2:00	Evaluation of Ideas	
4:30	Assign Ideas for Development Discuss Development Process and Expectations	
5:00	Adjourn	
July 9	**Wednesday**	
8:00	Value Alternative Development	VE Team
10:00	**Mid-point Review of Preliminary VE Alts**	**Project Stakeholder Reps**
12:00	Lunch	
1:00	Value Alternative Development Cont'd	
5:00	Adjourn	

MONTEREY PENINSULA WATER SUPPLY DESAL PLANT

VALUE ENGINEERING STUDY AGENDA

July 7 – 11, 2014

July 10	**Thursday**	
8:00	Value Alternative Development Cont'd	VE Team
12:00	Lunch	
1:00	Complete Value Alternative Development	
3:30	Prepare for VE Presentation	
5:00	Adjourn	
7:00	**Preliminary Briefing of VE Results to Water Board**	

July 11	**Friday**	
8:00	Finalize Presentation Preparation	VE Team
10:00	**VE Study Results Presentation**	**All Project Stakeholder Representatives**
12:00	Adjourn	

VALUE ENGINEERING STUDY MEETING ATTENDEES

Monterey Peninsula Water Supply Project – Desalination Plant

NAME	POSITION/ROLE	ORGANIZATION	TELEPHONE	E-MAIL
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VALUE ENGINEERING STUDY MEETING ATTENDEES

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Final Value Engineering Study Report
MONTEREY PENINSULA WATER SUPPLY PROJECT – DESALINATION PLANT
Monterey Peninsula Regional Water Authority

August 2014

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