Appendix A
Cost Evaluation

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A cost evaluation was developed in 2003 for a 40 mgd BARDP facility at the East Contra Costa, Near Bay Bridge, and Oceanside sites and for a 120 mgd facility at the East Contra Costa site. At the time, the agencies' cumulative need for desalination water was estimated at 120 mgd. Another cost evaluation was developed in 2005 to incorporate the revised cumulative need for 65 mgd of desalination water and to provide a cost for the proposed scenarios. For the 2005 evaluation, the total desalination water need was estimated at 65 mgd for dry years and 10 mgd for wet years. Since then, the estimated need was reduced to 65 mgd in dry years only. However, the production of 10 mgd at East Contra Costa during wet/normal years is included for cost comparison purposes. In addition, the agencies are interested in finding customers for the desalination water during wet and normal years.

Capital and operation and maintenance (O&M) costs were developed for various plant sizes at the three top-ranked sites: East Contra Costa, Near Bay Bridge and Oceanside. Capital costs ranged from $234 million to $400 million, and annual O&M costs ranged from $25 million to $47.5 million. Current product water costs for dry year operation only were estimated at between $1,237 and $2,994 per acre-foot, with a 65 mgd plant at the East Contra Costa site (Scenario 1) producing the least expensive water.

This evaluation was conducted using the Mirant Pittsburg Plant to represent the East Contra Costa site.

A.1 PURPOSE AND SCOPE

This section presents feasibility-level cost estimates for the five production scenarios evaluated in Section 2.3. The scenarios include desalination plants at the three top-ranked sites: East Contra Costa, Near Bay Bridge, and Oceanside (shown in Figure 2-2 in Section 2). A flowchart illustrating each production and distribution scenario is included in Section 2 (Figure 2-11).

The cost evaluation presents estimates based on a production of desalination water in both dry and wet years at the East Contra Costa site.

The scope of work for developing the feasibility-level cost estimates included the following activities:

- Developing revised annualized capital and O&M costs for seawater reverse osmosis (SWRO) and brackish water reverse osmosis (BWRO)
- Developing revised product water costs per acre-foot for each scenario.

This cost estimate does not account for varying raw intake water temperatures and land acquisition costs.

A.2 METHOD AND ASSUMPTIONS

The cost evaluation was developed using the following steps:

1. A conceptual desalination process was developed for BWRO and SWRO. These processes require assumptions for raw water quality and product water quality goals as well as process recoveries.
2. Flow rates for RO processes were estimated for the five scenarios.

3. Capital costs were developed.
4. O&M costs were developed.
5. Product water costs were calculated for both continuous operation (dry and wet years) and sporadic operation (dry years only).

The following sections present the assumptions used to develop the conceptual desalination process and obtain flow rates for the various plant sizes.

A.2.1 Raw and Product Water Qualities

The level of TDS in the feedwater is a crucial parameter for the RO desalination process because of its effect on pressure requirements, power costs, and recovery rates. Table A-1 shows the variability of TDS among the three sites. These TDS levels were considered representative of each site and were used to develop a conceptual desalination process. The cost estimate is based on this conceptual process.

Table A-1
Assumed Raw Water TDS (mg/L)

East Contra Costa	Near Bay Bridge	Oceanside
5,737	30,400	35,000

Another important assumption for the RO desalination process is the quality of the product water. Table A-2 presents the product water quality goals for two main parameters: TDS and hardness. The goals are the result of a consensus among the partner agencies.

Table A-2
Product Water Quality Goals

Constituents (mg/L)	East Contra Costa	Near Bay Bridge	Oceanside
TDS	200	300	300
Hardness (as calcium carbonate)	100	150	150

In addition, raw water supply at each site was assumed to be from surface water containing suspended solids. Therefore, the treatment process would include filtration of the raw water to provide total suspended solids (TSS) levels suitable for RO desalination. A membrane microfiltration process was assumed as the filtration rather than conventional filtration.

A.2.2 Recovery

The recovery, or the percentage of water entering a treatment process or plant recovered as usable water, is another important parameter for the development of the RO desalination process.

Two different recoveries can be associated with a desalination plant. *Desalination process recovery* is the percentage of desalinated water *recovered* from the desalination process feedwater. *Overall plant recovery* is the percentage of raw water entering the desalination plant that is recovered as potable water. The difference in recoveries can occur if some water bypasses the RO desalination process. In this case, the overall plant recovery would be greater than the RO process recovery.

RO process recovery depends primarily on the raw water TDS. For SWRO plants, RO process (and overall) recovery is typically about 50 percent. For BWRO plants, RO recovery is usually about 60 percent to 85 percent, although higher recovery ratios can be achieved. Overall recovery for a BWRO plant is usually higher than the RO recovery because some of the raw water may be able to bypass the RO process and be blended with RO permeate to meet the product water quality goals. In addition, SWRO process recovery can be limited by the maximum allowable membrane operating pressure.

The RO process feedwater pressure required depends primarily on the TDS of the raw water. The higher the TDS, the higher the RO feedwater pressure needed to obtain a given RO process recovery.

Table A-3 shows approximate RO feedwater pressures and commonly observed RO recoveries based on feedwater TDS.

Table A-3
Feedwater Pressure and Reverse Osmosis Recovery Rates

Feedwater TDS Ranges (mg/L)	Operating Pressure (psi)	Recovery (%)
15,000–45,000	800–1,200	40—60
3,500–15,000	600–800	60—85
500–3,500	100–600	60—85

A.2.3 Conceptual Process Flow Diagrams

The previous assumptions were used to develop the following conceptual desalination process at each site.

A.2.3.1 Brackish Water Reverse Osmosis (BWRO)

Figure A-1 is a conceptual process flow diagram for a desalination plant at the East Contra Costa site. The process shown in the figure is based on a raw water TDS of 5,737 mg/L and a product water TDS of 200 mg/L and hardness (as calcium carbonate) of 100 mg/L. Flow rates (in mgd) and TDS values are shown for two product water capacities, 40 mgd and 120 mgd.

The assumed treatment process recoveries are shown on Figure A-1. For example, the filtration process recovery (“Y”) is shown as 92 percent.

While detailed raw water quality data were not available for this conceptual-level evaluation, it is likely that the TDS of the combined permeate streams (Stream 11 on Figure A-1) would consist primarily of sodium and chloride with very little hardness or alkalinity. Therefore, as noted in Figure A-1, the TDS of the combined permeate flows would be about 150 mg/L—50 mg/L less than the product water goal of 200 mg/L TDS. The 50 mg/L was provided as an allowance for adding hardness and alkalinity in the post-treatment process.

The process shown in Figure A-1 is described as follows:

- Raw water is filtered to remove suspended solids prior to RO desalination.
- All of the filtered water is desalinated by RO (first-pass RO).
- To meet the Mirant Pittsburg Plant site TDS goal (200 mg/L), it would be necessary to desalinate a portion of the first-pass RO permeate in a second RO pass.
- The first-pass RO and second-pass RO streams are combined and post-treated.
- The second-pass RO concentrate is returned to the first-pass RO feedwater stream because the TDS of the second-pass RO concentrate is less than that of the filtered raw water. This reduces the TDS of the first-pass RO feedwater and conserves filtered water, thus reducing the required capacity of the filtration process as compared to disposing of the second-pass RO concentrate.
- The filter backwash water and first-pass RO concentrate streams are combined and disposed of in the Bay.
- The post-treated combined permeate flows are delivered to customers.

A.2.3.2 Seawater Reverse Osmosis (SWRO)

Figure A-2 is a conceptual process flow diagram for a 40 mgd SWRO plant at the Oceanside and Near Bay Bridge sites. Similar to the BWRO process flow diagram, the combined first- and second-pass RO streams are shown with a projected TDS of 200 mg/L, which is 100 mg/L less than the TDS goal of 300 mg/L. To adjust hardness and alkalinity in post-treatment, some RO feedwater would bypass the desalination process and blend with the desalted water. This would also increase the TDS to 300 mg/L.

A.2.3.3 Flow Rates for Scenario Evaluation Process

The scenarios defined in Section 2.3 combine SWRO and BWRO plants with capacities ranging from 10 to 65 mgd as shown in the flowchart illustrating each production and distribution scenario (Figure 2-11 in Section 2). The flow rates for these plant capacities were extrapolated from the 40 mgd BWRO and SWRO conceptual processes (Figures A-1 and A-2, respectively).

For the East Contra Costa site, two sets of flow quantities were developed: one set for single-pass RO and one for two-pass RO. To account for varying levels of raw intake water salinity levels during wet and dry years, it was assumed for all scenarios that the East Contra Costa plant would produce single-pass RO product water in wet years and two-pass RO product water in dry years. It was further assumed that in wet years, the East Contra Costa plant would produce only 25 mgd of product water for all scenarios. Table A-4 presents the flow rates used to develop the cost evaluation.

Table A-4
Flow Quantities

East Contra Costa Site (One-Pass RO)

Stream	1	2	3	4	5	6	7	8	9	10	11	12	13
	Raw Water	Filtered Water	Filter Backwash	1st Pass RO			2nd Pass RO				Combined Permeate	Combined Wastewater	Product Water
				Feed	Permeate	Concentrate	Bypass	Feed	Permeate	Concentrate			
TDS	5737	5737	5737	5737	230	19000	-	-	-	-	230	19000	230
mgd	39.1	35.9	3.1	35.9	25.2	10.8	-	-	-	-	25.2	10.8	25
mgd	54.7	50.3	4.4	50.3	35.2	15.1	-	-	-	-	35.2	15.1	35
mgd	62.5	57.5	5.0	57.5	40.3	17.3	-	-	-	-	40.3	17.3	40
mgd	70.3	64.7	5.6	64.7	45.3	19.4	-	-	-	-	45.3	19.4	45
mgd	101.6	93.4	8.1	93.4	65.4	28.0	-	-	-	-	65.4	28.0	65

East Contra Costa Site (Two-Pass RO)

Stream	1	2	3	4	5	6	7	8	9	10	11	12	13
	Raw Water	Filtered Water	Filter Backwash	1st Pass RO			2nd Pass RO				Combined Permeate	Combined Wastewater	Product Water
				Feed	Permeate	Concentrate	Bypass	Feed	Permeate	Concentrate			
TDS	5737	5737	5737	5720	230	19000	230	230	20	4200	150	16000	200
mgd	15.6	14.4	1.3	14.6	10.2	4.4	6.3	4.0	3.8	0.2	10.1	5.6	10
mgd	39.1	35.9	3.1	36.4	25.5	10.9	15.8	9.9	9.4	0.5	25.2	14.1	25
mgd	54.7	50.3	4.4	51.0	35.7	15.3	22.1	13.8	13.1	0.7	35.3	19.7	35
mgd	62.5	57.5	5.0	58.3	40.8	17.5	25.3	15.8	15.0	0.8	40.3	22.5	40
mgd	70.3	64.7	5.6	65.6	45.9	19.7	28.5	17.8	16.9	0.9	45.3	25.3	45
mgd	101.6	93.4	8.1	94.7	66.3	28.4	41.1	25.7	24.4	1.3	65.5	36.5	65

Table A-4
Flow Quantities

Near Bay Bridge Site

Stream	1	2	3	4	5	6	7	8	9	10	11	12	13
	Raw Water	Filtered Water	Filter Backwash	1st Pass RO			2nd Pass RO				Combined Permeate	Combined Wastewater	Product Water
				Feed	Permeate	Concentrate	Bypass	Feed	Permeate	Concentrate			
TDS	30,400	30,400	30,400	30,200	310	60,800	310	310	20	6,200	200	56,400	300
mgd	87.8	80.8	7.0	81.6	40.8	40.8	24.0	16.8	16.0	0.8	40.0	47.8	40

Oceanside Site

Stream	1	2	3	4	5	6	7	8	9	10	11	12	13
	Raw Water	Filtered Water	Filter Backwash	1st Pass RO			2nd Pass RO				Combined Permeate	Combined Wastewater	Product Water
				Feed	Permeate	Concentrate	Bypass	Feed	Permeate	Concentrate			
TDS	35,000	35,000	35,000	34,700	350	70,000	7,350	350	20	7,000	200	64,900	300
mgd	44.0	40.5	3.5	40.9	20.5	20.5	11.0	9.5	9.0	0.5	20.0	24.0	20
mgd	65.9	60.7	5.3	61.4	30.7	30.7	16.5	14.2	13.5	0.7	30.0	35.9	30
mgd	87.9	80.9	7.0	81.8	40.9	40.9	22.0	18.9	18.0	0.9	40.0	47.9	40

A.3 CONCEPTUAL CAPITAL COSTS

The following components were evaluated as part of the overall capital costs.

A.3.1 Off-Site Facilities

Any desalination plant constructed for the BARDP would require off-site facilities including raw water supply facilities, concentrate disposal facilities, and product water delivery pipelines and pump stations. The following assumptions were made about off-site facilities needed for the three sites:

- East Contra Costa site (based on the Mirant Pittsburg Plant site)
  - Raw water would be obtained from the power plant's cooling water system
  - Concentrate disposal would take place via the power plant's cooling water return line
  - Product water delivery to EBMUD's Mokelumne Aqueducts would require a pump station (with a 500-foot lift) and a 3-mile-long, 4-foot-diameter pipeline for the 40 mgd alternative
- Near Bay Bridge site
  - The raw water intake would be 3 miles long and 60 inches in diameter and would obtain feedwater from the Bay at a depth of over 20 feet
  - Concentrate disposal would take place via the existing treated wastewater outfall
  - Product water delivery to the EBMUD distribution system would require a pump station to lift the water about 100 feet through a pipeline 4 feet in diameter and about 2 miles long
- Oceanside site
  - A raw water intake would be 1 mile long and would have a pipe diameter of between 42 and 60 inches, depending on the plant capacity.
  - Concentrate disposal would take place via the treated wastewater ocean outfall
  - Product water delivery to the Sunset Reservoir would require a pump station (with a 400-foot lift) and a 3-mile-long, 4-foot-diameter pipeline

A.3.2 Capital Costs of Major Plant Components

A number of the unit costs were based on quotes obtained from vendors and contractors. Others were based on unit costs developed for other projects of similar scale. Costs for the welded steel pipe were obtained from Continental Pipe Manufacturing Company on October 12, 2005. It was assumed that installed pipe costs were 1.5 times the pipe cost. Estimated capital costs of major desalination plant components include the following.

A.3.2.1 Raw Water Intake Allowances

Table A-5 presents raw water intake costs for various plant sizes at the three top-ranked sites.

Table A-5
Raw Water Intake Allowances

East Contra Costa Site

Assume raw water will be obtained from Mirant Pittsburg Plant's cooling water system.

mgd	Allowance
40	2,000,000
120	5,000,000

Assume that raw water intake costs for East Contra Costa follow linear relationship:

y= 37,500x + 500,000

m = 37,500

b= 500,000

East Contra Costa Raw Water Intake Allowances			
mgd	Raw Water Intake (mgd)	Allowance	Rounded Allowance
25	39	1,964,844	2,000,000
35	55	2,550,781	2,600,000
45	70	3,136,719	3,200,000
65	102	4,308,594	4,400,000

Near Bay Bridge Site

Assume 60-inch diameter welded steel pipe installed via jet trenching

Jet Trench Cost =	$ 750	per LF
Welded Steel Pipe cost (installed) =	$ 518	per LF
Pipe length (3 miles) =	$ 15,840	LF
Total intake pipe installation cost (rounded)=	$ 1,270	per LF
Near Bay Bridge Raw Water Intake Allowance =	$ 20,200,000	

Oceanside Site

Assume pipe to be placed in tunnel, and tunnel/pipe to extend 1 mile into the ocean

Tunnel/Pipe length (1 mile) = 5,280 LF

Table A-5
Raw Water Intake Allowances

Oceanside Raw Water Intake Allowance										
	Feedwater Flow (mgd)	**Feedwater Flow (gpm)**	**Pipe Size (inches)**	**Pipe Material**	**Tunnel Cost ($/LF)**	**Installed Pipe cost ($/LF)**	**Tunnel Cost plus Installed Pipe Cost ($/LF)**	**Tunnel Pipe Length (LF)**	**Construction Cost ($)**	**Construction Cost ($ rounded)**
Oceanside (20 mgd)	44.0	30,556	42	Welded Steel Pipe	3500	320	3820	5,280	20,169,600	20,200,000
Oceanside (30 mgd)	65.2	45,278	54	Welded Steel Pipe	3750	430	4180	5,280	22,070,400	22,100,000
Oceanside (40 mgd)	87.0	60,417	60	Welded Steel Pipe	3750	520	4270	5,280	22,545,600	22,600,000

For the East Contra Costa site, it was assumed that raw water would be obtained from an existing intake structure. The raw water intake costs were extrapolated from the pre-feasibility intake costs developed in 2003. The pre-feasibility intake costs were $2 million for a 40 mgd plant and $5 million for a 120 mgd plant.

For the Near Bay Bridge site, it was assumed that the raw water intake pipe would extend 3 miles into the Bay and be installed using jet trenching methods. Unit costs for this method were assumed to be 20 percent of projected unit tunneling costs. The pipe diameter (60 inches) was sized for an 88 mgd raw intake flow (for the 40 mgd plant). The pipe material was assumed to be welded steel pipe.

For the Oceanside site, it was assumed that the raw water intake pipe would extend 1 mile into the ocean (where the ocean depth is approximately 34 feet). It was further assumed that a tunnel would be constructed to house the intake pipe. The intake pipe was sized for the various scenarios. Tunneling costs were based on costs developed for the Bay Division Pipelines Hydraulic Capacity Upgrade Project (SFPUC 2002).

A.3.2.2 Membrane Filtration

The raw water filtration was assumed at $0.50/gallon per day (gpd) of filtrate flow.

A.3.2.3 Reverse Osmosis

The first-pass and second-pass BWRO equipment were estimated at $0.75/gpd and $0.60/gpd of permeate capacity, respectively, for the East Contra Costa site.

SWRO equipment was estimated at $1.50/gpd of permeate capacity for the Near Bay Bridge and Oceanside sites.

A.3.2.4 Product Water Facilities

Costs for product water facilities were developed for each scenario and include the following cost items:

- Storage tanks
- 1,600-horsepower pumps
- Pump station buildings
- Welded steel pipe transmission lines

Product water facilities costs are included in Table A-6.

Table A-6
Product Water Facilities Costs

East Contra Costa Site	Unit	East Contra Costa (25 mgd) Quantity	Unit Cost	Cost	East Contra Costa (35 mgd) Quantity	Unit Cost	Cost	East Contra Costa (45 mgd) Quantity	Unit Cost	Cost
Storage Tank 36' Dia x 33' High	EA	1	1,250,000	1,250,000	1	1,250,000	1,250,000	1	1,250,000	1,250,000
Pumping Station Building	LS	1	1,000,000	1,000,000	1	1,000,000	1,000,000	1	1,000,000	1,000,000
Pumps (1,600 HP each)	EA	2	270,000	540,000	3	270,000	810,000	3	270,000	810,000
Steel Welded Pipe 36" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	4400	280	1,232,000	-	-	-	-	-	-
Steel Welded Pipe 36" Dia (3/8" thick)	LF	7000	420	2,940,000	-	-	-	-	-	-
Steel Welded Pipe 42" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	-	-	-	4400	490	2,156,000	4400	490	2,156,000
Steel Welded Pipe 42" Dia (3/8" thick)	LF	-	-	-	7000	730	5,110,000	7000	730	5,110,000
Steel Welded Pipe 54" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	-	-	-	-	-	-	-	-	-
Steel Welded Pipe 54" Dia (3/8" thick)	LF	-	-	-	-	-	-	-	-	-
Steel Welded Pipe 54" Dia (1/2" thick)	LF	-	-	-	-	-	-		-	-
General Conditions Costs (25%)				1,740,500			2,581,500			2,581,500
Total Product Water Facilities Cost				8,702,500			12,907,500			12,907,500

East Contra Costa Site	Unit	East Contra Costa (65 mgd) Quantity	Unit Cost	Cost
Storage Tank 36' Dia x 33' High	EA	1	1,250,000	1,250,000
Pumping Station Building	LS	1	1,000,000	1,000,000
Pumps (1,600 HP each)	EA	4	270,000	1,080,000
Steel Welded Pipe 36" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	-	-	-
Steel Welded Pipe 36" Dia (3/8" thick)	LF	-	-	-
Steel Welded Pipe 42" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	-	-	-
Steel Welded Pipe 42" Dia (3/8" thick)	LF	-	-	-
Steel Welded Pipe 54" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF	7000	800	5,600,000
Steel Welded Pipe 54" Dia (3/8" thick)	LF	4400	1,200	5,280,000
Steel Welded Pipe 54" Dia (1/2" thick)	LF	-	-	-
General Conditions Costs (25%)				3,552,500
Total Product Water Facilities Cost		0		17,762,500

Table A-6
Product Water Facilities Costs

Oceanside Site	Unit	Oceanside (20 mgd)			Oceanside (30 mgd)			Oceanside (40 mgd)		
		Quantity	Unit Cost	Cost	Quantity	Unit Cost	Cost	Quantity	Unit Cost	Cost
Storage Tank 36' Dia x 33' High	EA	1	1,250,000	1,250,000	1	1,250,000	1,250,000	1	1,250,000	1,250,000
Pumping Station Building	LS	1	1,000,000	1,000,000	1	1,000,000	1,000,000	1	1,000,000	1,000,000
Pumps (1,600 HP each)	EA	2	270,000	540,000	2	270,000	540,000	4	270,000	1,080,000
Steel Welded Pipe 30" Dia (3/8" thick)	LF	13000	370	4,810,000						
Steel Welded Pipe 42" Dia (3/8" thick)	LF				13000	730	9,490,000	13000	730	9,490,000
Steel Welded Pipe 54" Dia (1/2" thick)	LF		-	-		-	-	-	-	-
Steel Welded Pipe 54" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF		-	-		-	-	-	-	-
Steel Welded Pipe 54" Dia (3/8" thick)	LF		-	-		-	-	-	-	-
General Conditions Costs (25%)				1,900,000			3,070,000			3,205,000
Total Product Water Facilities Cost				9,500,000			15,350,000	0		16,025,000

Near Bay Bridge Site	Unit	Near Bay Bridge (40 mgd)		
		Quantity	Unit Cost	Cost
Storage Tank 36' Dia x 33' High	EA	1	1,250,000	1,250,000
Pumping Station Building	LS	1	1,600,000	1,600,000
Pumps (1,600 HP each)	EA	5	270,000	1,350,000
Steel Welded Pipe 42" Dia (1/2" thick)	LF	13000	1260	16,380,000
Steel Welded Pipe 54" Dia (1/2" thick)	LF		-	-
Steel Welded Pipe 54" Dia (3/8" thick) - along transmission line, open space, no ROW cost)	LF		-	-
Steel Welded Pipe 54" Dia (3/8" thick)	LF		-	-
General Conditions Costs (25%)				5,145,000
Total Product Water Facilities Cost				25,725,000

A.3.2.5 Concentrate Disposal

A $2 million allowance was used for concentrate disposal for all scenarios. In each case, it was assumed that the concentrate would be blended with current discharges (cooling water or wastewater) using existing facilities. For the East Contra Costa site, the disposal would take place via the existing Mirant Pittsburg Plant cooling water system. For both the Near Bay Bridge and Oceanside sites, disposal would take place via the existing treated wastewater outfall.

A.3.2.6 Other Costs

Costs for electrical and instrumentation controls, chemical feed systems, buildings, and site development as well as planning, permitting, engineering, and administration were taken as percentages of construction cost (Table A-7). A contingency of 25 percent was applied to the construction and planning, permitting, engineering, and administrative costs.

Table A-7
Other Costs Estimated as Percentage of Construction Cost

Cost Item	Percentage of Construction Cost
Electrical and Instrumentation Control Systems	10
Chemical Feed Systems	3
Buildings	5
Site Development	5
Planning, Permitting, Engineering, & Administrative	15

Other costs should be expected in implementing a desalination plant. For example, land and right-of-way costs can be significant. In addition, it was assumed that sufficient electrical power was available at the sites. These and other potential costs cannot be identified until additional detailed studies are prepared.

A.3.3 Scenario Capital Costs

Table A-8 summarizes the estimated capital costs.

Table A-8
Estimated Capital Costs

	Scenario 1	Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	East Contra Costa (65 mgd)	Oceanside (40mgd)	East Contra Costa (25mgd)	Near Bay Bridge (40 mgd)	East Contra Costa (25 mgd)	Oceanside (30 mgd)	East Contra Costa (35 mgd)	Oceanside (20 mgd)	East Contra Costa (45 mgd)
Quantities	mgd								
Filter Feedwater	102	88	39	88	39	66	55	44	70
Filtrate	93	81	36	81	36	61	50	40	65
First Pass BW RO Permeate	65	0	25	0	25	0	35	0	45
Second Pass BW Permeate	9	18	9	16	9	14	9	9	9
Sea Water RO	0	41	0	41	0	31	0	20	0
Overall Plant Recovery	64%	46%	64%	46%	64%	46%	64%	46%	64%
Cost Items	$, In Millions								
Raw Water Intake	4.4	22.6	2.0	20.2	2.0	22.1	2.6	20.2	3.2
Filtration	46.7	40.5	18.0	40.4	18.0	30.3	25.2	20.2	32.3
First Pass Brackish Water RO	49.1	0	18.9	0	18.9	0	26.4	0	34.0
Second Pass Brackish Water RO	6	10.8	6	9.6	6	8.1	6	5.4	6
Sea Water RO	0	61.4	0	61.2	0	46.0	0	30.7	0
Electrical & Instrumentation	16.3	19.9	7.2	20.7	7.2	16.1	9.7	11.4	11.7
Chemical Feeds	4.9	6.0	2.2	6.2	2.2	4.8	2.9	3.4	3.5
Buildings	8.2	10.0	3.6	10.3	3.6	8.0	4.9	5.7	5.9
Site Civil	8.2	10.0	3.6	10.3	3.6	8.0	4.9	5.7	5.9
Product Water Facilities	17.8	16.1	8.8	25.8	8.8	15.4	13.0	9.5	13.0
Concentrate Disposal	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Cost without contingent line items	125.6	153.3	55.3	159.2	55.3	124.0	74.8	88.0	90.1
Total Construction cost with contingent line items	163.1	199.1	71.8	206.8	71.8	161.0	97.1	114.3	117.1
Construction	163.1	199.1	71.8	206.8	71.8	161.0	97.1	114.3	117.1
Planning, Permitting, Engineering & Administrative Costs (15%)	24.5	29.9	10.8	31.0	10.8	24.1	14.6	17.1	17.6
Contingency (25%)	46.9	57.2	20.6	59.4	20.6	46.3	27.9	32.9	33.7
Capital Cost per site	234.5	286.2	103.2	297.2	103.2	231.4	139.6	164.3	168.3
Capital Cost per Scenario	234	389		400		371		333	

Note: Costs reflect the estimation performed in November 2005. No inflation was applied to the costs.

A.4 CONCEPTUAL O&M COSTS

A.4.1 O&M Costs of Major Plant Components

O&M costs related to membrane replacement, labor, chemical feed systems, and miscellaneous maintenance costs are detailed below.

A.4.1.1 Membrane Replacement

Membrane microfiltration/ultrafiltration replacement cost was estimated at $15 per million gallons (MG) of filtrate.

The replacement costs of BWRO and SWRO membranes was estimated at $50/MG and $200/MG of permeate, respectively.

A.4.1.2 Labor

The labor costs for various plant sizes are shown in Table A-9.

Table A-9
Annual Plant Labor Costs

Plant Size	Plant Personnel	Annual Cost
20 mgd	5–6	$500,000
25 mgd	5–6	$500,000
30 mgd	7–8	$670,000
35 mgd	7–8	$670,000
40 mgd	10–12	$1 million
45 mgd	10–12	$1 million
65 mgd	14–16	$1,340,000

A.4.1.3 Chemical Feed Systems

A number of chemicals would be involved in the membrane filtration, RO desalination, and post-treatment (including disinfection) processes. Therefore, for this conceptual-level cost evaluation, chemical costs were based on experience with previous filtration and RO plants. For purposes of this report, the following chemical costs were used:

- Membrane filtration—$25/MG of filtrate
- RO desalination—$100/MG of RO permeate
- Post-treatment—$75/MG of product water (East Contra Costa site); $125/MG of product water (Near Bay Bridge and Oceanside)

A.4.1.4 Power

Power costs were estimated using $0.08 per kilowatt hour (kWh) for all scenarios. To account for lower O&M costs at the East Contra Costa site during wet years (when only single-pass RO is needed), the estimated power consumption costs were halved. The power consumption was estimated at:

- East Contra Costa site—7,500 kWh/MG of product water
- Near Bay Bridge site—19,000 kWh/MG of product water
- Oceanside site—22,000 kWh/MG of product water

These power consumption figures include pumping the raw water to the filtration process, filtration process power, RO process power, and product water pumping. Energy recovery from the RO concentrate is also included.

A.4.1.5 Other Miscellaneous Costs

Miscellaneous maintenance, repairs, and replacement not covered above were estimated as 2 percent of construction cost.

A.4.2 Scenario O&M Costs

Table A-10 summarizes the estimated O&M costs.

Table A-10
Estimated O&M Costs

	Scenario 1	Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	East Contra Costa (65 mgd)	Oceanside (40 mgd)	East Contra Costa (25 mgd)	Near Bay Bridge (40 mgd)	East Contra Costa (25 mgd)	Oceanside (30 mgd)	East Contra Costa (35 mgd)	Oceanside (20 mgd)	East Contra Costa (45 mgd)
Plant Production (MGY)	22,540	13,870	8,670	13,870	8,670	10,410	12,140	6,940	15,610
O&M Cost Items	$, In Millions								
Labor	1.3	1.0	0.5	1.0	0.5	0.7	0.7	0.5	1.0
Electrical	13.5	24.4	5.2	21.1	5.2	18.3	7.3	12.2	9.4
Membrane Replacement	1.8	3.6	0.8	3.5	0.8	2.7	1.0	1.8	1.3
Chemical Feed System	5.1	4.5	2.2	4.4	2.2	3.4	2.9	3.3	3.6
Miscellaneous Maintenance	3.3	4.0	1.4	4.1	1.4	3.2	1.9	2.3	2.3
O&M Cost per site	25.0	37.4	10.1	34.1	10.1	28.2	13.8	20.1	17.6
O&M Cost per Scenario	25.0	47.5		44.2		42.1		37.7	

Plant Production: assumed plants operational 95% of the time

Labor
20 mgd plant staff - 5-6 personnel @ $500,000/year total cost
25 mgd plant staff - 5-6 personnel @ $500,000/year total cost
30 mgd plant staff - 7-8 personnel @$670,000/year total cost
35 mgd plant staff - 7-8 personnel @ $670,000/year total cost
40 mgd plant staff - 10-12 personnel @ $1 million/year total cost
45 mgd plant staff - 10-12 personnel @ $1 million/year total cost
65 mgd plant staff - 14-16 personnel @ $1,340,000 million/year total cost

Electrical
Power costs were estimated using: $ 0.08
Assumed power consumptions:
East Contra Costa site: 7,500 KwHr/MG of product water
Near Bay Bridge site: 19,000 KwHr/MG of product water
Oceanside Site: 22,000 KwHr/MG of product water

Membrane Replacement
Membrane Filtration: $15/MG of filtrate
Brackish RO membranes: $50/MG of permeate
Seawater RO membranes: $200/MG of permeate

Chemical Feed System
Membrane Filtration: $25/MG of filtrate
Reverse Osmosis Desalting: $100/MG of RO permeate
Post Treatment (East Contra Costa): $75/MG of product water
Post Treatment (Near Bay Bridge and Oceanside): $125/MG of product water /KwHr

Miscellaneous Maintenance
Assumed 2% of scenario capital costs

Note: Costs reflect the estimation performed in November 2005. No inflation was applied to the costs.

A.5 PRODUCT WATER COST

"Product water cost" is the sum of the annual (amortized) capital cost plus annual O&M costs divided by the volume (acre-feet per year) of product water. The capital costs for each scenario were annualized to account for the interest rate and plant life. With an assumed interest rate of 5.5 percent and plant life of 30 years, the annual amortization factor was 0.0688. The annualized capital costs were developed using the capital costs for each site, rather than annualizing the total scenario capital costs.

Wet Year and Dry Year Costs were developed based on quantities shown in the flowchart of production and distribution scenarios (Figure 2-11 in Section 2).

It was assumed that an offline desalination plant must sustain a reduced flow to maintain the integrity of the RO membranes. To account for these O&M costs, an allowance of 20 percent of the dry year O&M costs for that site was added to the total wet year O&M costs of that scenario.

The use of existing infrastructure for water treatment and conveyance has a significant cost. This capital system recovery cost is not included in this estimate. The capital system recovery cost will depend on water quantity and frequency of use of the infrastructure. In addition, it was assumed that there would be one dry year for every two wet years. Several of the sites would only be operational during dry years. To account for this, the annual costs for the following included annual costs for two wet years and one dry year: 40 mgd East Contra Costa (dry year), 40 mgd Oceanside (dry year), 40 mgd Near Bay Bridge (dry year), 30 mgd Oceanside (dry year), and 20 mgd Oceanside (dry year). During plant operation, the water cost assumes the on-stream factor (percent operating time in a year) is 95 percent.

An assumed annual inflation rate of 3 percent was applied to the O&M costs, and the projected product water costs for 2030 (year of projection for water demand) and 2012 (year of projection for construction) were listed alongside the product water costs for 2007.

Table A-11 presents product water costs for different plant sizes and operational scenarios at the three sites.

Table A-11
Estimated Product Water Costs ($/acre-foot)

Year 2007				
Plant Site	**Plant Capacity (mgd)**	**All Year Operation[1]**		**Dry Year Operation Only[2]**
		Wet Year	**Dry Year**	
East Contra Costa	10	$ 559	$ 669	
	15			$ 1,363
	25			$ 1,325
	35			$ 1,271
	55			$ 1,237
Oceanside	20			$ 2,994
	30			$ 2,808
	40			$ 2,694
Near Bay Bridge	40			$ 2,633

Year 2012				
Plant Site	**Plant Capacity (mgd)**	**All Year Operation[1]**		**Dry Year Operation Only[2]**
		Wet Year	**Dry Year**	
East Contra Costa	10	$ 605	$ 733	
	15			$ 1,453
	25			$ 1,413
	35			$ 1,358
	55			$ 1,322
Oceanside	20			$ 3,218
	30			$ 3,017
	40			$ 2,902
Near Bay Bridge	40			$ 2,823

Year 2030				
Plant Site	**Plant Capacity (mgd)**	**All Year Operation[1]**		**Dry Year Operation Only[2]**
		Wet Year	**Dry Year**	
East Contra Costa	10	$ 843	$ 1,060	
	15			$ 1,911
	25			$ 1,861
	35			$ 1,803
	55			$ 1,759
Oceanside	20			$ 4,360
	30			$ 4,087
	40			$ 3,966
Near Bay Bridge	40			$ 3,793

Notes:
Cost estimation was developed in 2005. A 3% inflation factor was applied to obtain current and projected costs.
1 The plant was assumed to operate at full capacity all years. The on-stream factor was assumed at 95%.
2 The product water costs for dry year assumed a sequence of one dry year for every two wet years. Furthermore, it was assumed that an offline desalination plant must sustain a reduced flow to maintain the integrity of the RO membranes. For that reason, the wet year O&M costs was estimated at 20 percent of the dry year O&M costs.

Table A-12 shows the product water costs for dry year operation for the desalination scenarios considered.

Table A-12
Summary of Product Water Cost for Dry Year Operation ($/acre-foot)

Year 2007						
Scenarios	**Plant Configuration and Capacity (mgd)**			**Product Water Cost ($/AF)**		
	East Contra Costa Site	**Near Bay Bridge Site**	**Oceanside Site**	**East Contra Costa Site**	**Near Bay Bridge Site**	**Oceanside Site**
Scenario 1	65	-	-	$ 1,237	-	-
Scenario 2	25	40	-	$ 1,363	-	$ 2,694
Scenario 3	25	-	40	$ 1,363	$ 2,633	-
Scenario 4	35	30	-	$ 1,325	-	$ 2,808
Scenario 5	45	20	-	$ 1,271	-	$ 2,994

Year 2012						
Scenarios	**Plant Configuration and Capacity (mgd)**			**Product Water Cost ($/AF)**		
	East Contra Costa Site	**Near Bay Bridge Site**	**Oceanside Site**	**East Contra Costa Site**	**Near Bay Bridge Site**	**Oceanside Site**
Scenario 1	65	-	-	$ 1,322	-	-
Scenario 2	25	40	-	$ 1,453	-	$ 2,902
Scenario 3	25	-	40	$ 1,453	$ 2,823	-
Scenario 4	35	30	-	$ 1,413	-	$ 3,017
Scenario 5	45	20	-	$ 1,358	-	$ 3,218

Year 2030						
Scenarios	**Plant Configuration and Capacity (mgd)**			**Product Water Cost ($/AF)**		
	East Contra Costa Site	**Near Bay Bridge Site**	**Oceanside Site**	**East Contra Costa Site**	**Near Bay Bridge Site**	**Oceanside Site**
Scenario 1	65	-	-	$ 1,759	-	-
Scenario 2	25	40	-	$ 1,911	-	$ 3,966
Scenario 3	25	-	40	$ 1,911	$ 3,793	-
Scenario 4	35	30	-	$ 1,861	-	$ 4,087
Scenario 5	45	20	-	$ 1,803	-	$ 4,360

Notes:
1. The costs were developed in 2005. An inflation factor of 3% was applied to obtain current and projected costs.
2. The product water costs for dry year assumed a sequence of one dry year for every two wet years. Furthermore, it was assumed that an offline desalination plant must sustain a reduced flow to maintain the integrity of the RO membranes. For that reason, the wet year O&M costs was estimated at 20 percent of the dry year O&M costs.

A.6 FINDINGS

The factors that most affect water cost are the raw water TDS, the interest rate obtained for project financing, and the electrical energy costs.

Because electrical energy costs would constitute a greater part of the water cost for an SWRO desalination plant, energy costs will have more influence on the water cost for an SWRO plant than for a BWRO plant.

Based on the cost parameters included in this analysis, the most desirable location for a regional plant would be a location with the lowest-salinity feedwater, lowest electrical energy cost, and lowest interest rate. Additionally, the plant would have to be permittable and environmentally acceptable.

The East Contra Costa site may offer the lowest-cost option for a regional plant based upon the assumptions in this study.

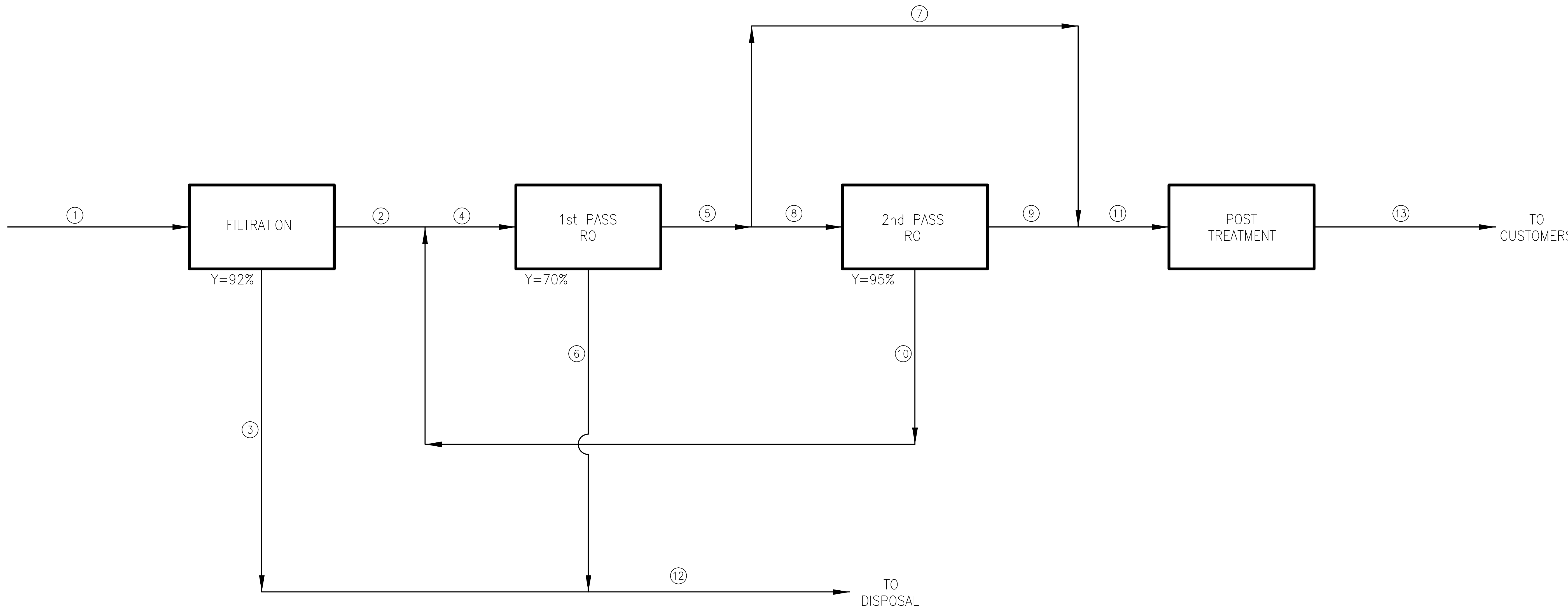
A more detailed analysis is necessary to determine the requirement for siting a desalination plant at any of these locations.

A.7 LIMITATIONS

This cost estimate is based on a conceptual level of design. Various components of the system may change during final design that could affect costs. Also, it was assumed that the desalination plant would operate only one-third of the time. This assumption overestimates the use of a 65 mgd desalination plant. Different operating scenarios could have substantial impacts on the cost.

The cost to operate the plant varies with source water temperature and salinity. The cost estimation assumes that the source water's salinity and temperature are stable and do not fluctuate. In reality, the source water conditions will vary over time, which could affect the production water cost. Since the exact location of the desalination plant has not yet been determined, the cost for land acquisition was not factored into the overall cost. If land needs to be purchased, the costs could be substantial depending upon the location.

The interest rate and inflation rate are considered fixed for the estimation of capital costs and annual projected project water costs; the fluctuation of rates is not accounted for.



STREAM	1	2	3	4	5	6	7	8	9	10	11	12	13
	RAW WATER	FILTERED WATER	FILTER BACKWASH	1st PASS RO			2nd PASS RO				COMBINED PERMEATE	COMBINED WASTEWATER	PRODUCT WATER
				FEED	PERMEATE	CONCENTRATE	BYPASS	FEED	PERMEATE	CONCENTRATE			
TDS	5737	5737	5737	5720	230	19,000	230	230	20	4200	150	16,000	200
MGD	62.5	57.5	5.0	58.3	40.8	17.5	25	15.8	15	0.8	40	22.5	40
MGD	187.5	172.5	15	174.9	122.4	52.5	75	47.4	45	2.4	120	67.5	120

REV DATE DESCRIPTION APPR

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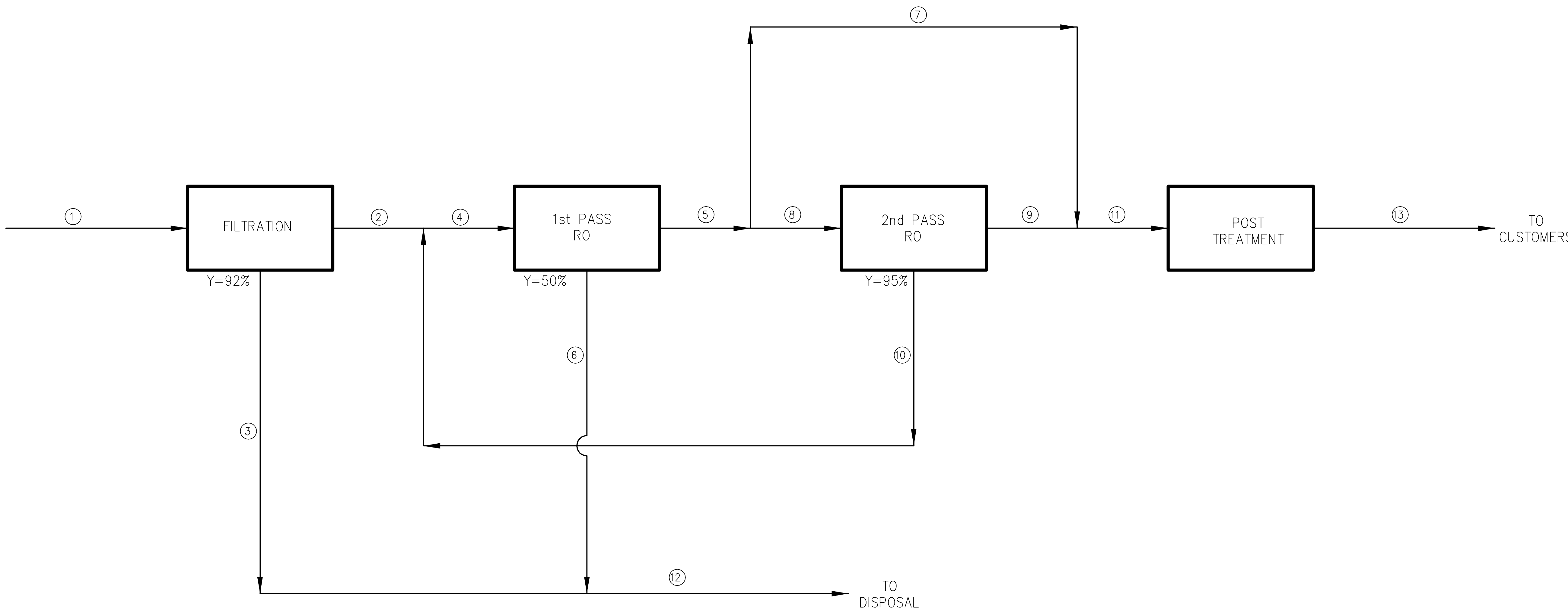
BAY AREA REGIONAL DESALINATION PROJECT

FIGURE A-1
BRACKISH WATER REVERSE OSMOSIS
PROCESS FLOW DIAGRAM

DRAWING D-601
SHEET 1 OF 000 SHEETS



STREAM	1	2	3	4	5	6	7	8	9	10	11	12	13
EBMUD	RAW WATER	FILTERED WATER	FILTER BACKWASH	1st PASS RO			2nd PASS RO				COMBINED PERMEATE	COMBINED WASTEWATER	PRODUCT WATER
				FEED	PERMEATE	CONCENTRATE	BYPASS	FEED	PERMEATE	CONCENTRATE			
TDS	30,400	30,400	30,400	30,200	310	60,800	310	310	20	6200	200	56,400	300
MGD	87.8	80.8	7.0	81.6	40.8	40.8	24	16.8	16	0.8	40	47.8	40
OCEANSIDE													
TDS	35,000	35,000	35,000	34,700	350	70,000	7350	350	20	7000	200	64,900	300
MGD	87.9	80.9	7.0	81.8	40.9	40.9	22	18.9	18	0.9	40	47.9	40

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BAY AREA REGIONAL DESALINATION PROJECT

FIGURE A-2
SEAWATER REVERSE OSMOSIS PROCESS FLOW DIAGRAM

DRAWING D-602
SHEET 2 OF 000 SHEETS

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Appendix B

Potential Desalination Plant Location Ratings

LOCATION/ CRITERIA	C&H Sugar Refinery		Mirant Contra Costa Plant, Antioch	
	RATING	COMMENT	RATING	COMMENT
Feedwater Quality	3	Near Delta but far enough down. May not be an issue but freshwater is available.	3	Good because of low salinity in the Delta.
Water Cost	2	Near seawater salinity so will be near highest cost for desalination.	4	Near best achievable because of low salinity. Desalination plant will be low in cost. Available power supply is a benefit.
Water Rights/Permits	1	Proximity to Delta may complicate issue.	3	There is a “take permit” but will need a “use” permit.
Public Acceptance	3	Proximity to Delta and industry.	2	Fish intake, power plant is detraction.
Grant Potential	2	Nothing particularly advantageous about this site.	3	Average; no particular advantage.
Regional Capability	2	Small site will limit the plant size.	4	Could provide very high volume, which is beneficial as a regional supply.
Environmental	3	In high-mixing zone but still close to the Delta.	2	Good disposal but salinity discharge will be an issue as well as intake.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	Pico Power Plant, Santa Clara		Los Esteros Power Plant, San Jose	
	RATING	**COMMENT**	**RATING**	**COMMENT**
Feedwater Quality	4	Brackish groundwater.	4	Brackish groundwater.
Water Cost	5	Lowest potential cost because of brackish groundwater.	5	Lowest potential cost because of brackish groundwater.
Water Rights/Permits	3	Above-average ability to get groundwater rights.	3	Above average as it is groundwater.
Public Acceptance	1	Perception that groundwater is polluted; proximity to power plant.	1	Perception that groundwater is polluted.
Grant Potential	3	Not big but groundwater is listed as a grant potential.	3	Nothing very advantageous but groundwater is listed as a grant potential.
Regional Capability	1	Very limited capacity for a regional supply.	1	Very limited capacity for a regional supply.
Environmental	2	Brine discharge in South Bay; hydrogeology	2	Brine discharge in South Bay; hydrogeology

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	Mirant Pittsburg Plant		Palo Alto Water Pollution Control Plant	
	RATING	**COMMENT**	**RATING**	**COMMENT**
Feedwater Quality	3	Good because of low salinity in the Delta.	4	Brackish groundwater.
Water Cost	4	Near best achievable because of low salinity. Desalination plant will be low in cost. Available power supply is a benefit.	5	Lowest potential cost because of brackish groundwater.
Water Rights/Permits	3	There is a “take permit” but will need a “use” permit.	3	Above average as it is groundwater.
Public Acceptance	2	Fish intake, power plant is detraction.	1	Perception that groundwater is polluted.
Grant Potential	3	Average; no particular advantage.	3	Nothing very advantageous but groundwater is listed as a grant potential.
Regional Capability	4	Could provide very high volume, which is beneficial as a regional supply.	1	Very limited capacity for a regional supply.
Environmental	2	Good disposal but salinity discharge will be an issue as well as intake.	2	Brine discharge concerns and hydrogeology.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	BDPL 1&2 at Dumbarton Point		Near Bay Bridge Site	
	RATING	**COMMENT**	**RATING**	**COMMENT**
Feedwater Quality	3	Average salinity but lower in summer as result of waste water treatment plant (WWTP) discharge.	3	Good flow and mixing as near the Golden Gate Bridge but close to WWTP.
Water Cost	2	Quite good because of low salinity.	2	Will be high because water is near seawater salinity.
Water Rights/Permits	2	Fair capability.	2	Fair capability.
Public Acceptance	1	South Bay has several WWTPs and is considered polluted by many.	3	Close to WWTP.
Grant Potential	3	Average with high capacity for regional capability.	3	High regional capability.
Regional Capability	4	Access to major multi-agency distribution.	4	High volume and good location for distribution system.
Environmental	2	Concerns regarding new South Bay discharges.	3	Location is industrial area; some concern with eelgrass.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	Treasure Island Site		Oceanside Site, San Francisco	
	RATING	COMMENT	RATING	COMMENT
Feedwater Quality	4	Close to the Golden Gate Bridge but will be near seawater salinity in quality.	3	Ocean water is good but proximity to wastewater treatment plant must be addressed. Site is described as "near Oceanside Water Pollution Control Plant" so that the site represents an area along the shore.
Water Cost	1	Highest cost because near seawater salinity and high cost of distribution system from Treasure Island.	2	Will be high cost for desalination system.
Water Rights/Permits	3	Should not be difficult.	2	Should not be difficult for water rights but proximity to National Park is an issue.
Public Acceptance	4	Perception is probably good but proximity to former military base may be problematic.	3	If plant is designed to avoid perception of location near WWTP could be OK but still will be a concern.
Grant Potential	2	Poor for grant potential.	4	Has high regional concept related to peninsula and brine discharge.
Regional Capability	4	Good as with an adequate distribution system, could serve agencies on both sides of the Bay.	3	Large size potential and location near distribution system.
Environmental	1	New development area but still in Bay. Pipeline across Bay would be a major issue.	3	Ability to take advantage of high mixing zone.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	Barge Mounted Plant	
	RATING	**COMMENT**
Feedwater Quality	3	Average as can be located anywhere in the Bay.
Water Cost	3	Average as could be less expensive than a fixed-location plant.
Water Rights/Permits	1	Movable “take rights” will be difficult to obtain.
Public Acceptance	4	Will be viewed as temporary and movable.
Grant Potential	4	Innovative design.
Regional Capability	2	Limited in flow.
Environmental	1	Very difficult to permit.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

LOCATION/ CRITERIA	Mallard Slough		San Francisco Airport	
	RATING	**COMMENT**	**RATING**	**COMMENT**
Feedwater Quality	3	Low salinity and close to Delta.	3	Average Bay seawater salinity but high total suspended solids.
Water Cost	4	Will be low water cost because of the low salinity.	2	Will be high cost because of salinity and water treatment requirements.
Water Rights/Permits	3	Some existing water rights.	2	Fair permit potential.
Public Acceptance	2	Already have some acceptance but may cause perception issue regarding fish.	2	Already high-profile area, making acceptance an issue.
Grant Potential	3	Average. Plant would improve water quality in system.	3	Average; nothing particularly advantageous about location.
Regional Capability	1	Limited distribution requirements and currently limited flow.	3	Average.
Environmental	3	Several studies already exist for this site.	3	Many environmental studies have been completed.

Ratings: 5 = Ideal or best conceivable; 4 = excellent, 3 = good or above average; 2 = fair or below average; 1 = Poor; 0 = conditionally acceptable; -1 = absolutely unacceptable.

Appendix C
Initial Scenario Development and Evaluation and Rating Results

Appendix C. Initial Scenario Development and Evaluation and Ranking Results C-1

C.1 Initial Scenario Development C-1
C.2 Scenario Evaluation Ratings and Agency Value Assessment.. C-8

Figures

C-1 Oceanside 65 mgd Plant
C-2 Near Bay Bridge 65 mgd Plant
C-3 East Contra Costa 65 mgd Plant
C-4 East Contra Costa 25 mgd Plant
C-5 Near Bay Bridge 40 mgd Plant and East Contra Costa 25 mgd Plant
C-6 Oceanside 30 mgd and East Contra Costa 35 mgd
C-7 East Contra Costa 45 mgd Plant and Oceanside 20 mgd Plant

Tables

C-1 Group Ratings for Environmental Issues
C-2 Group Ratings for Permitting Issues
C-3 Group Ratings for Institutional Issues
C-4 Group Ratings for Public Perception Issues
C-5 Group Ratings for Operational Issues
C-6 Assessment of Intra-Issue Values
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C.1 INITIAL SCENARIO DEVELOPMENT

Seven operational scenarios (project alternatives) consisting of combinations of different desalination plant capacities at the three top-ranked sites (East Contra Costa, Oceanside, and Near Bay Bridge) were developed to meet the agencies' cumulative dry year demand of 65 mgd from the year 2010 to beyond the year 2030 and a cumulative wet year demand of 25 mgd.

The seven scenarios were:

- A single 65 mgd plant at East Contra Costa (Figure C-1)
- A single 65 mgd plant at Oceanside (Figure C-2)
- A single 65 mgd plant at Near Bay Bridge (Figure C-3)
- A 40 mgd plant at Oceanside and a 25 mgd plant at East Contra Costa (Figure C-4)
- A 40 mgd plant at Near Bay Bridge and a 25 mgd plant at East Contra Costa (Figure C-5)
- A 30 mgd plant at Oceanside and a 35 mgd plant at East Contra Costa (Figure C-6)
- A 45 mgd plant at East Contra Costa and a 20 mgd plant at Oceanside (Figure C-7)

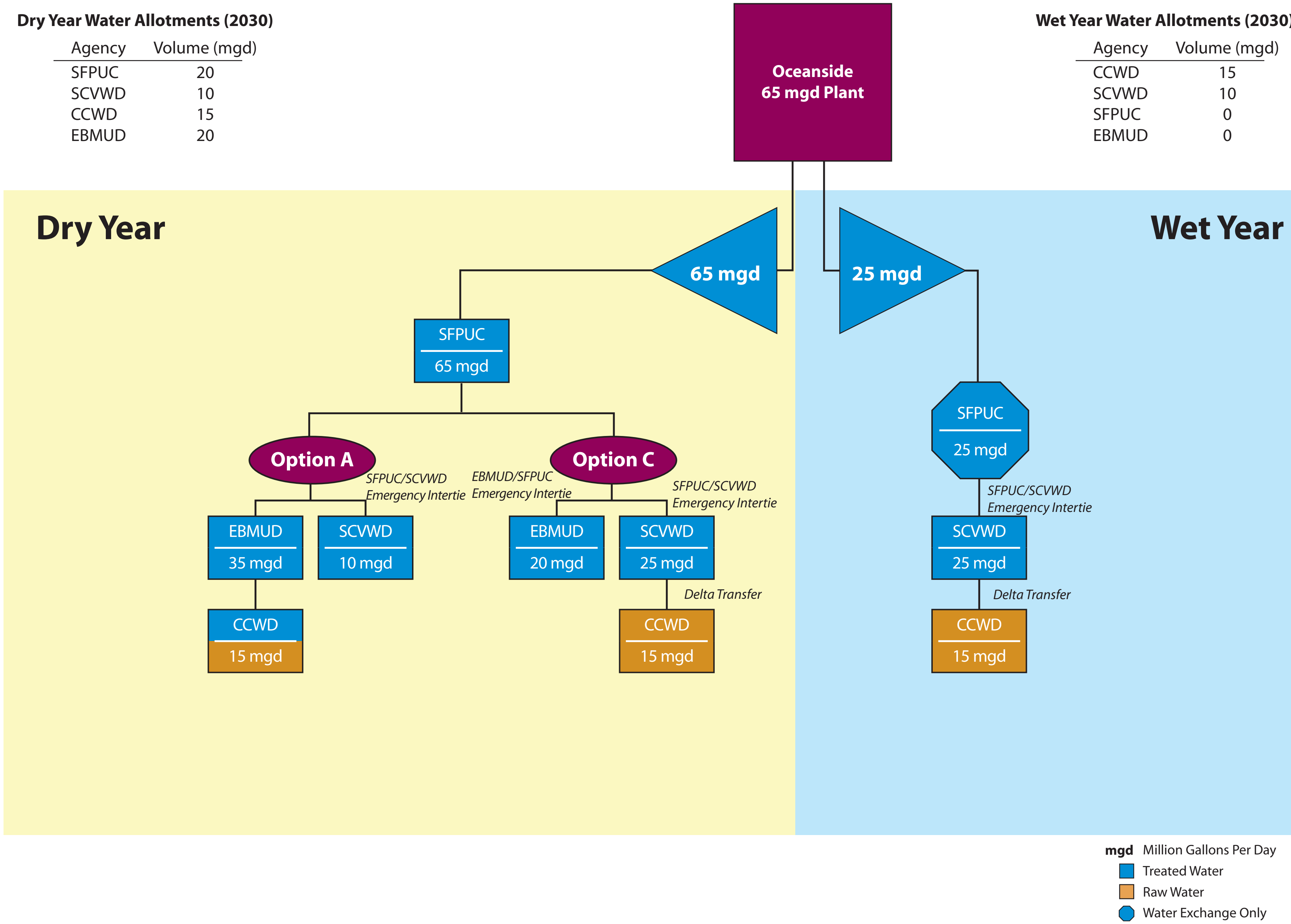
After the initial seven scenarios were developed, they were analyzed for potential fatal flaws based on scenario feasibility. Based on these criteria, two of the seven potential scenarios were considered to be infeasible: the Oceanside 65 mgd plant, due to insufficient space; and the Near Bay Bridge 65 mgd plant, due to institutional constraints on the exchange of water. The five remaining scenarios were considered to be feasible and were further evaluated as described in Section 2.3. After the scenarios were developed, the agencies revised their estimated needs for desalinated water to include dry years only. The five remaining scenarios evaluated in Section 2.3 show the potential to produce up to 25 mgd of desalinated water during wet years if third-party customers for the water are identified.

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



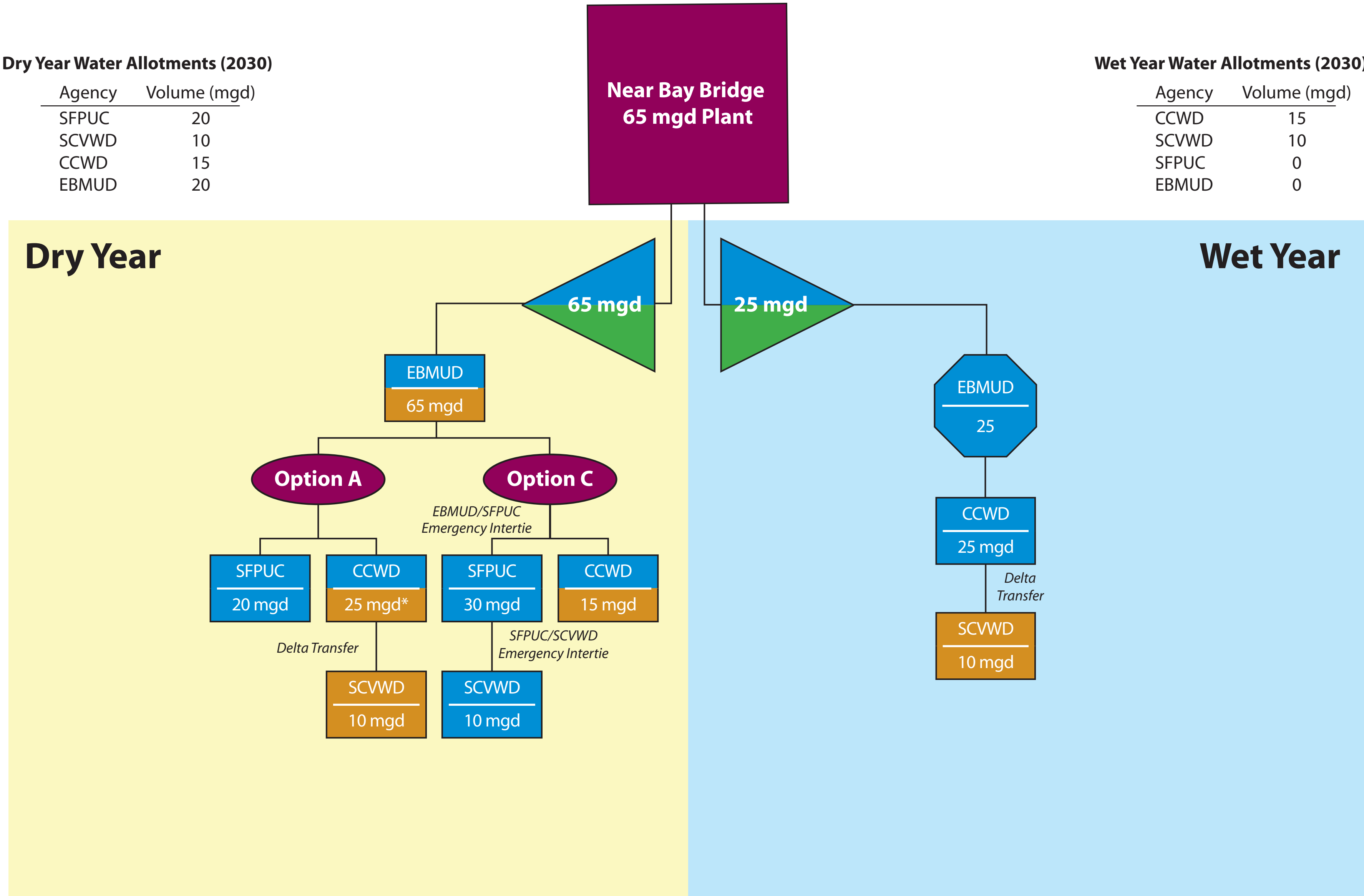
URS	26814534.14000 Bay Area Regional Desalination Project	Oceanside 65 mgd Plant	Figure C-1

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



mgd Million Gallons Per Day

Treated Water

Raw Water

One-Pass RO Water

No Net Gain; Water Exchange Only

* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (MPP)

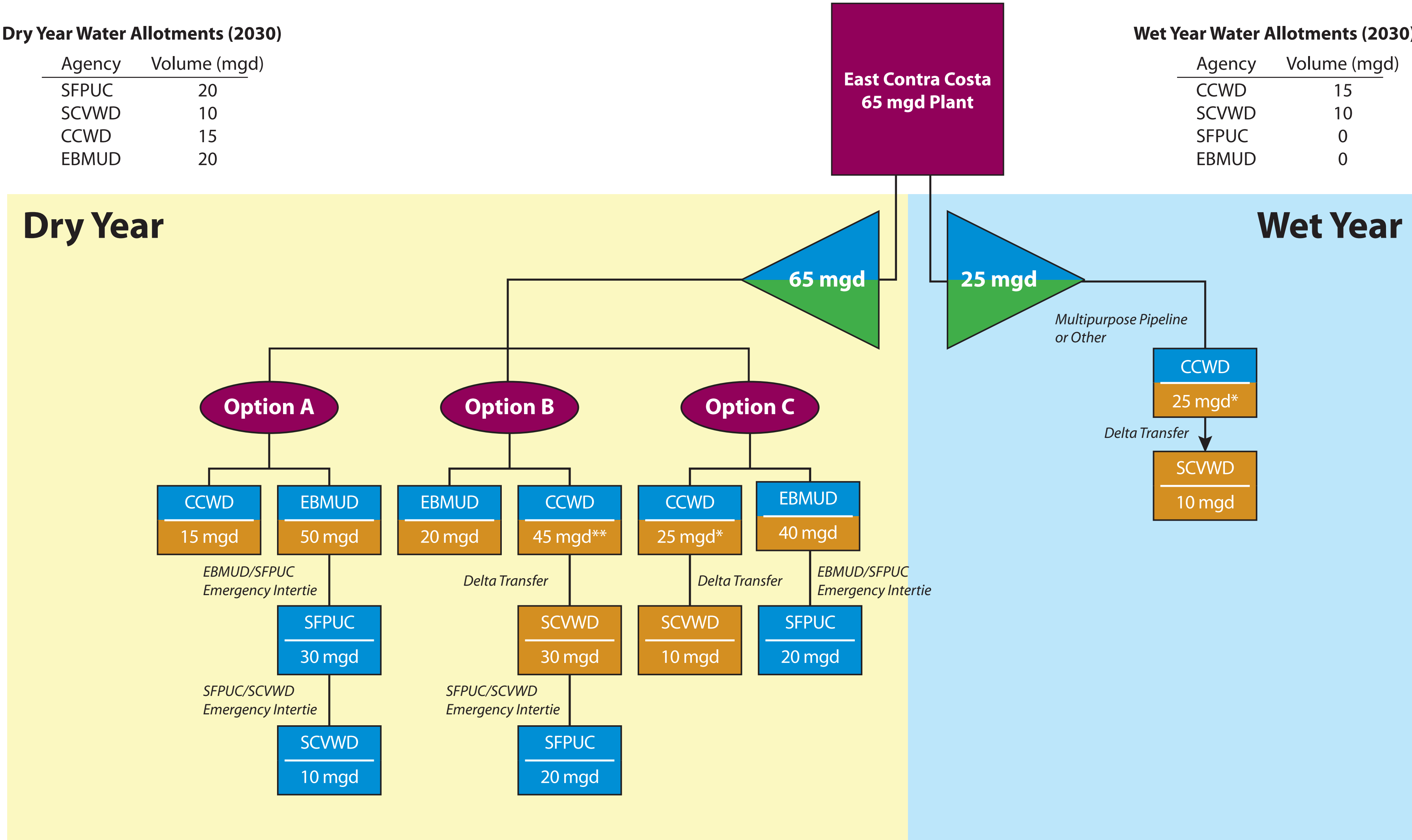
URS	26814534.14000 Bay Area Regional Desalination Project	Near Bay Bridge 65 mgd Plant	Figure C-2

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (mpp)

** Either all the water can be diverted through raw water pipelines, or 25 mgd can be transported as treated water through the MPP, and the balance can be transferred as raw water

mgd Million Gallons per Day
- Two-Pass RO Water
- Raw Water
- One-Pass RO Water

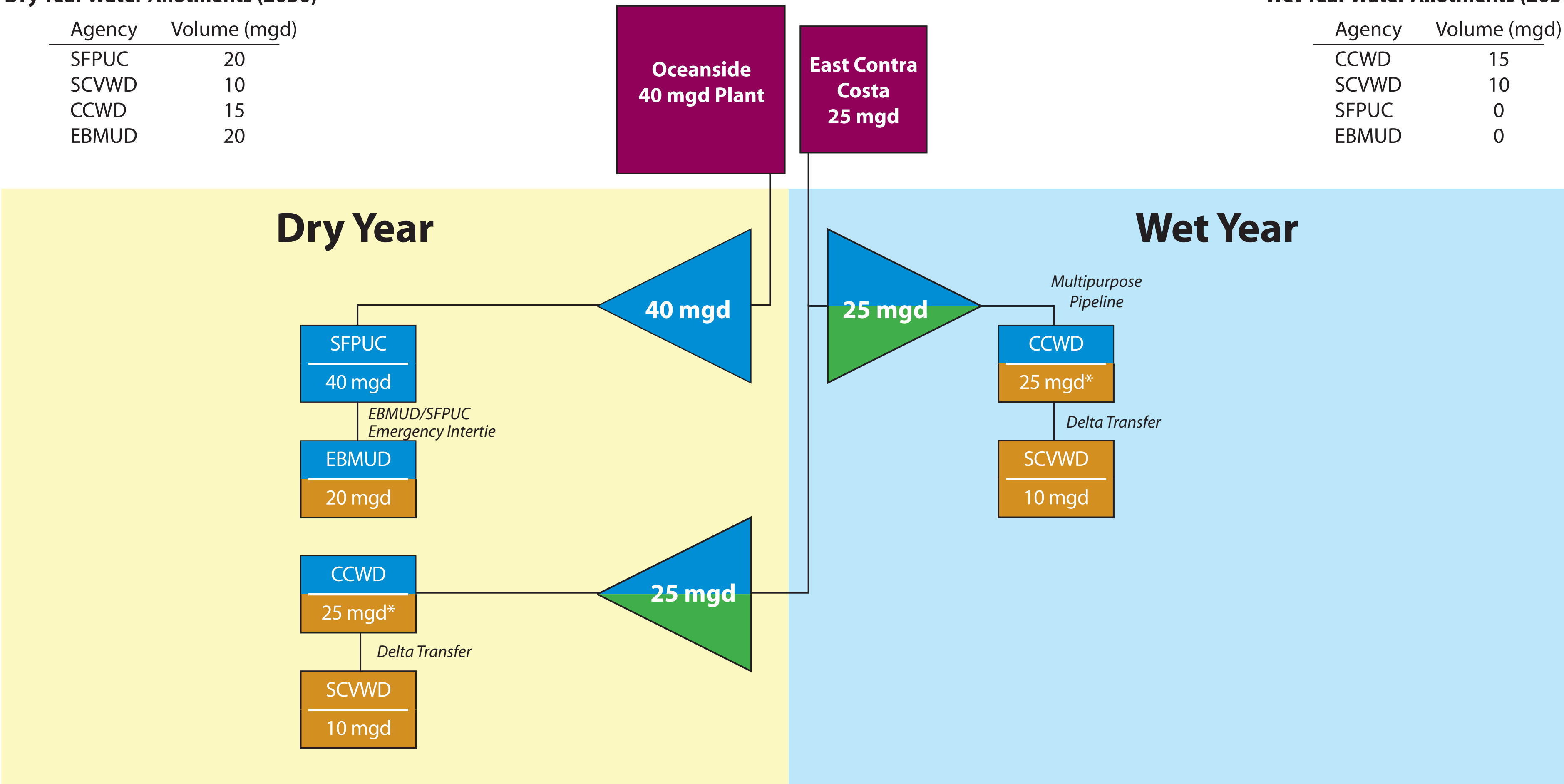
URS	26814534.14000 Bay Area Regional Desalination Project	East Contra Costa 65 mgd Plant	Figure C-3

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (MPP)

mgd Million Gallons Per Day
- Treated Water
- Raw Water
- One-Pass RO Water

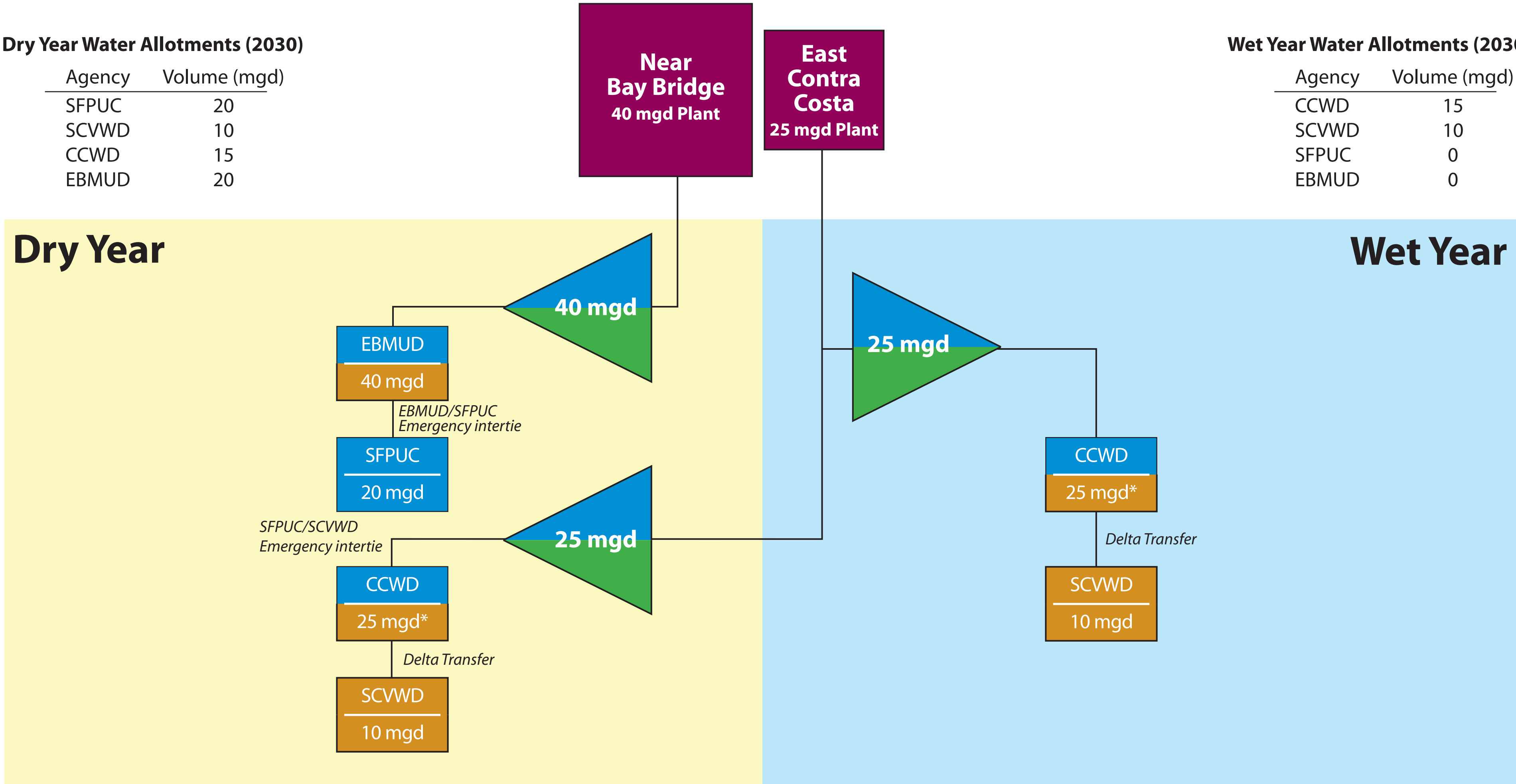
URS	26814534.14000 Bay Area Regional Desalination Project	East Contra Costa 25 mgd Plant	Figure C-4

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (MPP)

mgd Million Gallons Per Day
Two-Pass RO Water
Raw Water
One-Pass RO Water

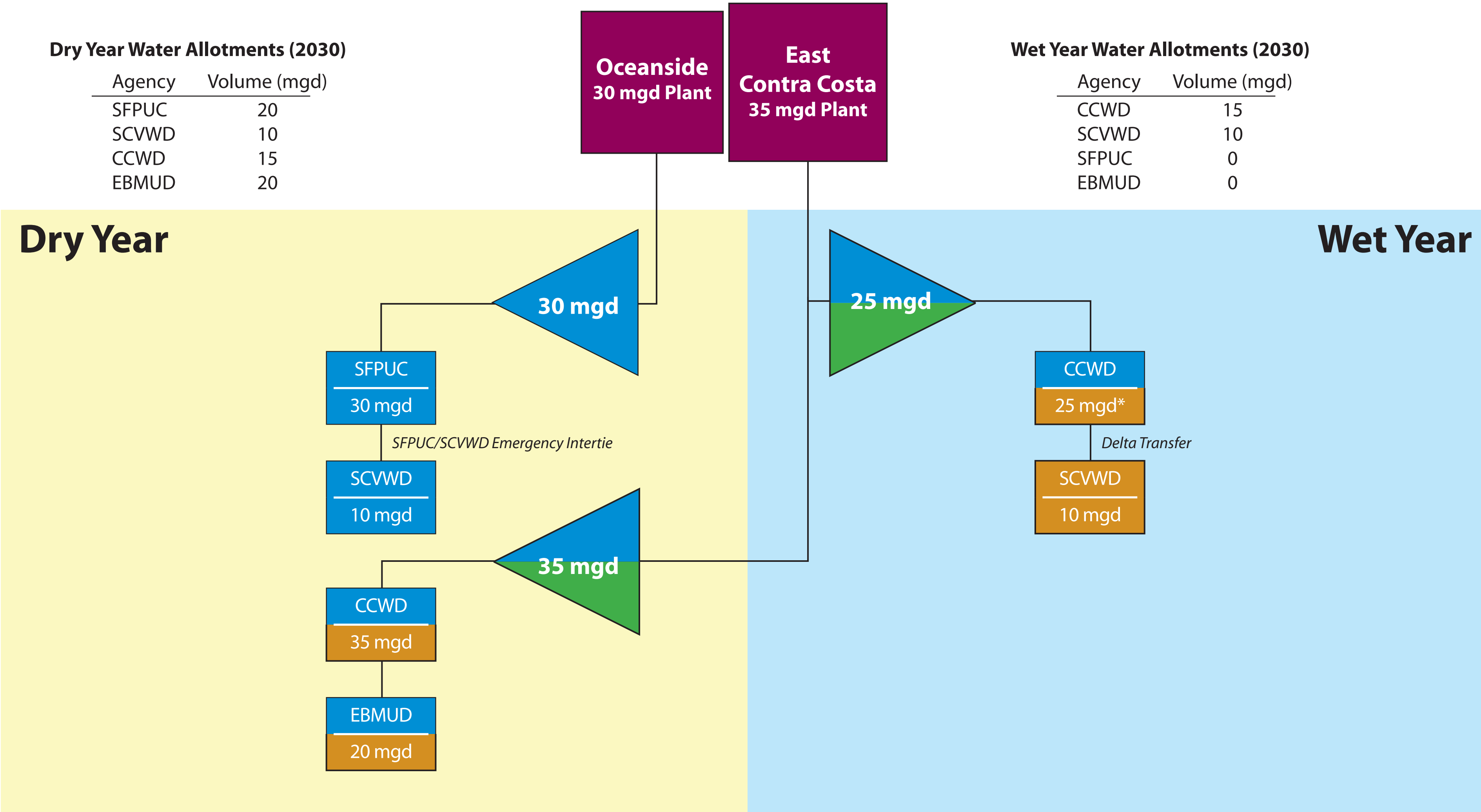
URS	26814534.14000 Bay Area Regional Desalination Project	Near Bay Bridge 40 mgd Plant and East Contra Costa 25 mgd Plant	Figure C-5

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (MPP)

mgd Million Gallons Per Day
- Two-Pass RO Water
- Raw Water
- One-Pass RO Water

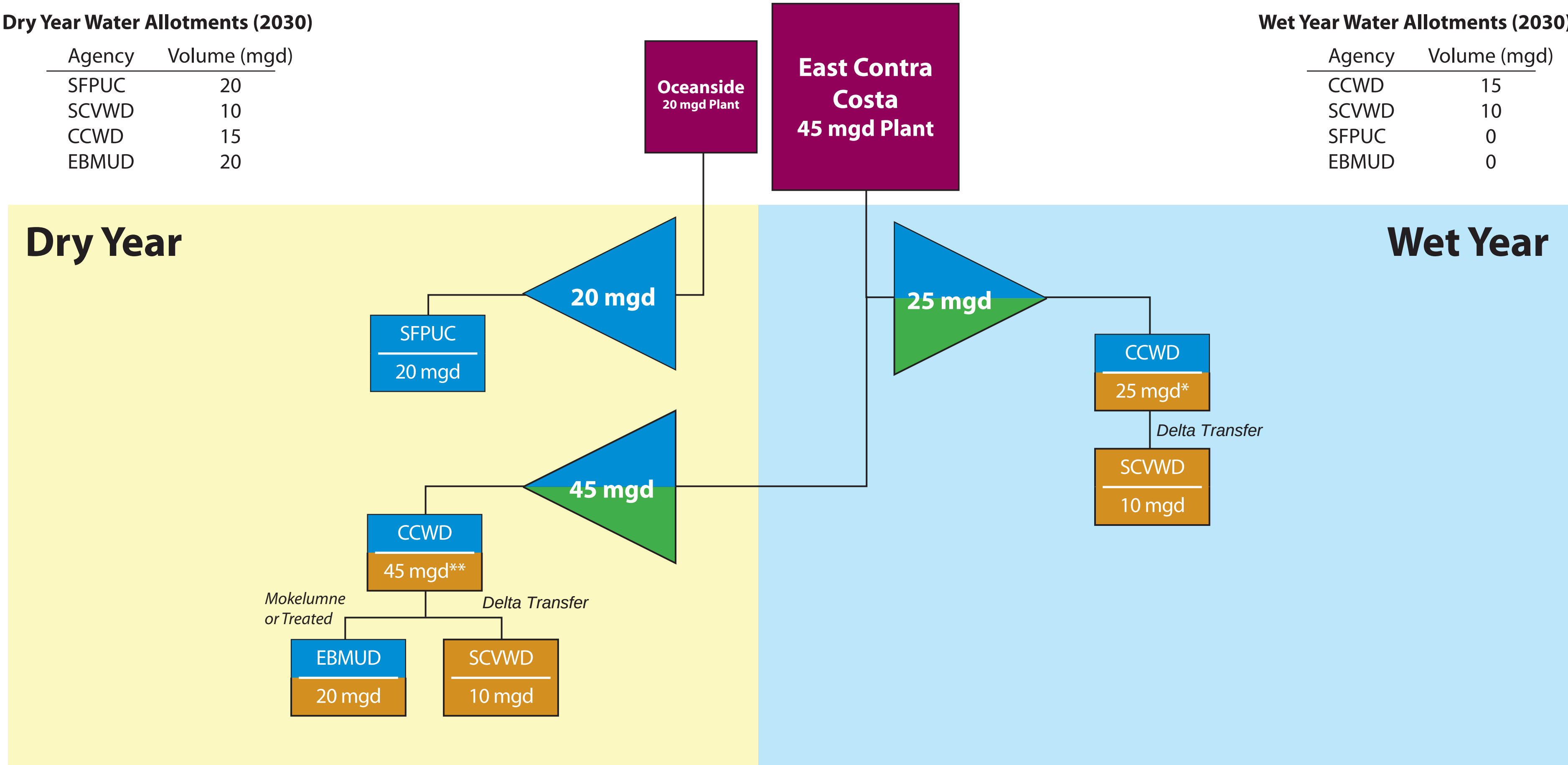
URS	26814534.14000 Bay Area Regional Desalination Project	Oceanside 30 mgd and East Contra Costa 35 mgd	Figure C-6

Dry Year Water Allotments (2030)

Agency	Volume (mgd)
SFPUC	20
SCVWD	10
CCWD	15
EBMUD	20

Wet Year Water Allotments (2030)

Agency	Volume (mgd)
CCWD	15
SCVWD	10
SFPUC	0
EBMUD	0



* Up to 25 mgd of treated water may be conveyed through the Multipurpose Pipeline (MPP)

** Either all the water can be diverted through raw water pipelines, or 25 mgd can be transported as treated water through the MPP, and the balance can be transferred as raw water

mgd Million Gallons per Day

- Two-Pass RO Water
- Raw Water
- One-Pass RO Water

URS	26814534.14000 Bay Area Regional Desalination Project	East Contra Costa 45 mgd Plant and Oceanside 20 mgd Plant	Figure C-7

C.2 SCENARIO EVALUATION RATINGS AND AGENCY VALUE ASSESSMENT

Table C-1
Group Ratings for Environmental Issues

Subissue (Criteria for Scenario Evaluation)	Scenarios				
	1 Single 65 mgd Facility at East Contra Costa	2 40 mgd Facility at Oceanside and 25 mgd Facility at East Contra Costa	3 40 mgd Facility at Near Bay Bridge and 25 mgd Facility at East Contra Costa	4 30 mgd Facility at Oceanside and 35 mgd Facility at East Contra Costa	5 20 mgd Facility at Oceanside and 45 mgd Facility at East Contra Costa
Visual Sensitivity	+2	-2	+2	-2	-2
Land-Based Biology	+2	-1	0	-1	-1
Water-Based Biology	-2	-1	-1	-1	-2
Historic Resources	+2	+2	+2	+2	+2
Noise	0	0	0	0	0
Recreation	+2	-1	+2	-1	-1
Agricultural Lands	+2	+2	+2	+2	+2
High Energy Requirement	+2	-1	0	0	+1

Table C-2
Group Ratings for Permitting Issues

Criteria for Scenario Evaluation	Scenarios				
	1 Single 65 mgd Facility at East Contra Costa	**2 40 mgd Facility at Oceanside and 25 mgd Facility at East Contra Costa**	**3 40 mgd Facility at Near Bay Bridge and 25 mgd Facility at East Contra Costa**	**4 30 mgd Facility at Oceanside and 35 mgd Facility at East Contra Costa**	**5 20 mgd Facility at Oceanside and 45 mgd Facility at East Contra Costa**
NPDES Permit	-2	0	0	-1	-1
BCDC Permit	+2	+2	-1	+2	+2
Coastal Development Permit	+2	-2	+2	-2	-2
Encroachment Permit	-1	-1	-2	-1	-1
Appropriative Water Right Permit	-2	+1	+1	-1	-2

Table C-3
Group Ratings for Institutional Issues

Criteria for Scenario Evaluation	Scenarios				
	1 Single 65 mgd Facility at East Contra Costa	**2 40 mgd Facility at Oceanside and 25 mgd Facility at East Contra Costa**	**3 40 mgd Facility at Near Bay Bridge and 25 mgd Facility at East Contra Costa**	**4 30 mgd Facility at Oceanside and 35 mgd Facility at East Contra Costa**	**5 20 mgd Facility at Oceanside and 45 mgd Facility at East Contra Costa**
Need for multiple exchanges to allocate water to each agency	0	0	0	0	0
Pipeline constraints that necessitate differences in water treatment level between water received and water conveyed	-1	+1	+1	+1	+1
Agencies give up higher quality water in exchange for lower quality water (non-desalination water only)*	Agency 1 – 0 Agency 2 – 0 Agency 3 – 0 Agency 4 – +1	Agency 1 – +1 Agency 2 – 0 Agency 3 – 0 Agency 4 – 0	Agency 1 – +1 Agency 2 – 0 Agency 3 – 0 Agency 4 – 0	Agency 1 – +1 Agency 2 – 0 Agency 3 – 0 Agency 4 – +1	Agency 1 – 0 Agency 2 – 0 Agency 3 – 0 Agency 4 – +1
One or more agencies serve as a "pass-through" with no net increase in water supply.	0	0	0	0	0

*Rating varied among agencies, reflecting different agency-specific priorities.

Table C-4
Group Ratings for Public Perception Issues

Criteria for Scenario Evaluation	Scenarios				
	1 Single 65 mgd Facility at East Contra Costa	**2 40 mgd Facility at Oceanside and 25 mgd Facility at East Contra Costa**	**3 40 mgd Facility at Near Bay Bridge and 25 mgd Facility at East Contra Costa**	**4 30 mgd Facility at Oceanside and 35 mgd Facility at East Contra Costa**	**5 20 mgd Facility at Oceanside and 45 mgd Facility at East Contra Costa**
Proximity of intake to wastewater outfall	+1	0	-2	0	0

Table C-5
Group Ratings for Operational Issues

Criteria for Scenario Evaluation	Scenarios				
	1 Single 65 mgd Facility at East Contra Costa	**2 40 mgd Facility at Oceanside and 25 mgd Facility at East Contra Costa**	**3 40 mgd Facility at Near Bay Bridge and 25 mgd Facility at East Contra Costa**	**4 30 mgd Facility at Oceanside and 35 mgd Facility at East Contra Costa**	**5 20 mgd Facility at Oceanside and 45 mgd Facility at East Contra Costa**
Susceptibility of plant to natural hazards	+1	-2	0	-2	-2
Water supply reliability*	Agency 1– +1 Agency 2– +1 Agency 3– 0 Agency 4– 0	Agency 1– +1 Agency 2– 0 Agency 3– +2 Agency 4– +1	Agency 1– +1 Agency 2– +2 Agency 3– 0 Agency 4– 0	Agency 1– +1 Agency 2– +2 Agency 3– +2 Agency 4– +2	Agency 1– +1 Agency 2– +1 Agency 3– +2 Agency 4– 0

*Rating varied among agencies, reflecting different agency-specific priorities.

Table C-6
Assessment of Intra-Issue Values

Issue	Subissue	Relative Value of Improvement (Scale of 0 to 10)			
		Agency 1	Agency 2	Agency 3	Agency 4
Environmental Resource Protection	Visual sensitivity of plant location	4	6	5	6
	Potential impacts to land-based biology	4	9	8	8
	Potential impacts to water-based biology	4	10	10	8
	Potential impacts to historic resources	4	7	7	2
	Presence of sensitive noise receptors	4	6	6	4
	Potential impacts to recreation resources	4	6	3	4
	Potential impacts to agricultural lands	4	5	4	10
	High energy requirement (for plant operation)	10	5	9	4
Permitting	NPDES Permit	9	7	6	5
	BCDC Permit	4	7	7	5
	Coastal Development Permit	4	8	9	6
	Encroachment Permit	2	5	5	10
	Appropriative Water Right Permit	10	10	10	0
Institutional/Legal	Need for multiple exchanges to allocate water to each agency	5	8	10	5
	Pipeline constraints due to type of water conveyed (raw or treated)	5	2	9	8
	Agencies give up higher-quality water in exchange for lower-quality water	10	10	8	10
	Agencies serve only as a “pass-through” with no net increase in water supply	2	6	7	5
Reliability	Plant susceptibility to natural hazards	4	7	8	5
	Water supply system reliability (during emergencies)	10	8	10	10
	Water supply system reliability (during non-emergency periods)	5	10	9	8

Table C-7
Assessment of Inter-Issue Values

Issue	Specific Subissue (least desirable)	Agency 1	Agency 2	Agency 3	Agency 4
		(Scale of 0 to 10)			
Environmental	Potential impacts to water-based biology	4	9	6	6
Permitting	Appropriative water rights permit	7	10	7	6
Institutional/Legal	Agencies give up higher-quality water in exchange for lower-quality water (non-desalination water only)	9	8	8	10
Cost	Product water cost	10	6	9	5
Public Perception	Proximity of intake to wastewater outfall	8	7	5	5
Reliability	Water supply system reliability (during emergencies)	4	5	10	8

Appendix D
Revised Tables from Plant Capacity and Operational Assessment

As of November 2006, SFPUC revised its desalination needs estimate to 26 mgd. The future demand for year 2030 is estimated at 300 mgd, and the future rationing is estimated at 20 percent. Based on 82 years of monthly drought data, SFPUC determined that during an 8.5-year design drought, the agency would need an average of 23 mgd from the potential desalination plant. The maximum need for this design drought would be 26 mgd. For that reason, the tables and figures from the needs assessment were revised using a need of 26 mgd for SFPUC in all dry years.

Table D-1
Summary of BARDP Desalination Plant Use, 1920–2002

Desalination Needs	CCWD	EBMUD	SFPUC	SCVWD	BARDP
Number of Years with Needs	10	23	37	6	44
Percent of Total Years with Needs	12%	28%	45%	7%	53%

Note: Based on CCWD, SFPUC, and SCVWD 2030 demand projections and EBMUD 2020 demand projections.

Table D-2
Distribution and Quantity of Yearly Desalination Supply, 1920–2002

Total Yearly Supply	Number of years	Percent of Total Years	Percent of Years (when in use)
0 mgd	39	47%	
10-19 mgd	1	1%	2%
20-29 mgd	22	27%	50%
30-39 mgd	2	2%	5%
40-49 mgd	11	13%	25%
50-59 mgd	1	1%	2%
> 60 mgd	7	8%	16%

Table D-3
Plant Usage by Agencies

No. of Agencies Using Desalination Plant	Number of Years of Operation	Percent of Years of Operation (when in use)
0	39	--
1	23	52%
2	13	30%
3	5	11%
4	3	7%

Table D-4
Desalination Plant Operation Statistics, 1920–2002

Characteristic	Value
Maximum number of consecutive years using desalination	11
Maximum number of consecutive years not using desalination	7
Largest supply needed	71 mgd
Smallest supply needed	10 mgd
Average period of use	3.7 years
Average period of nonuse	3 years
Average supply needed if in use	37 mgd
Median supply needed if in use	26 mgd

Note: Based on CCWD, SFPUC, and SCVWD 2030 demand projections and EBMUD 2020 demand projections.

Figure D-1
Distribution of Desalination Supply Needed, 1920–2002

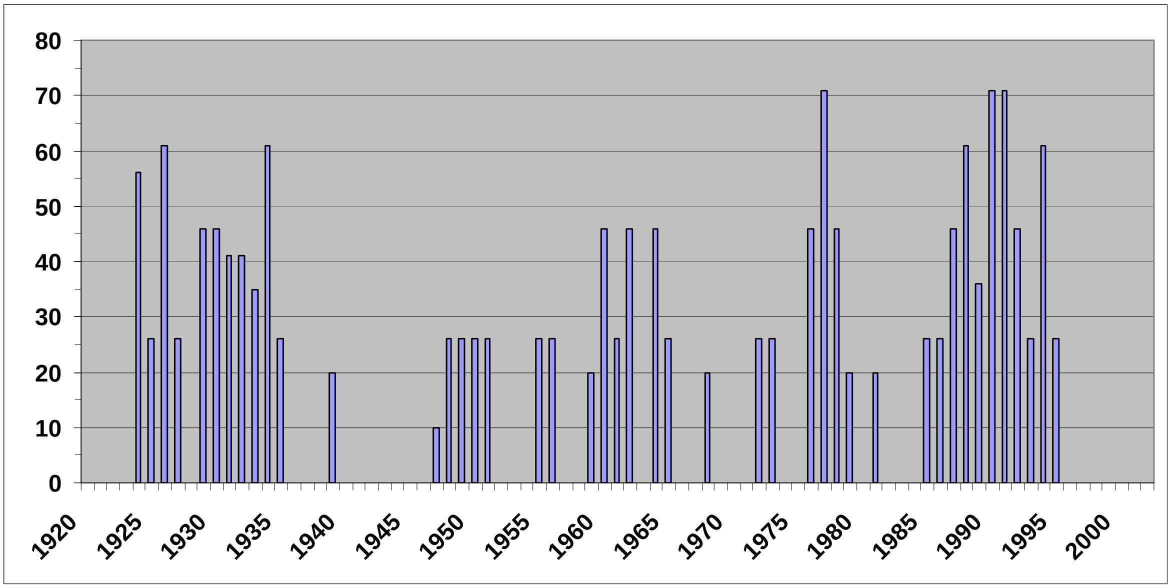
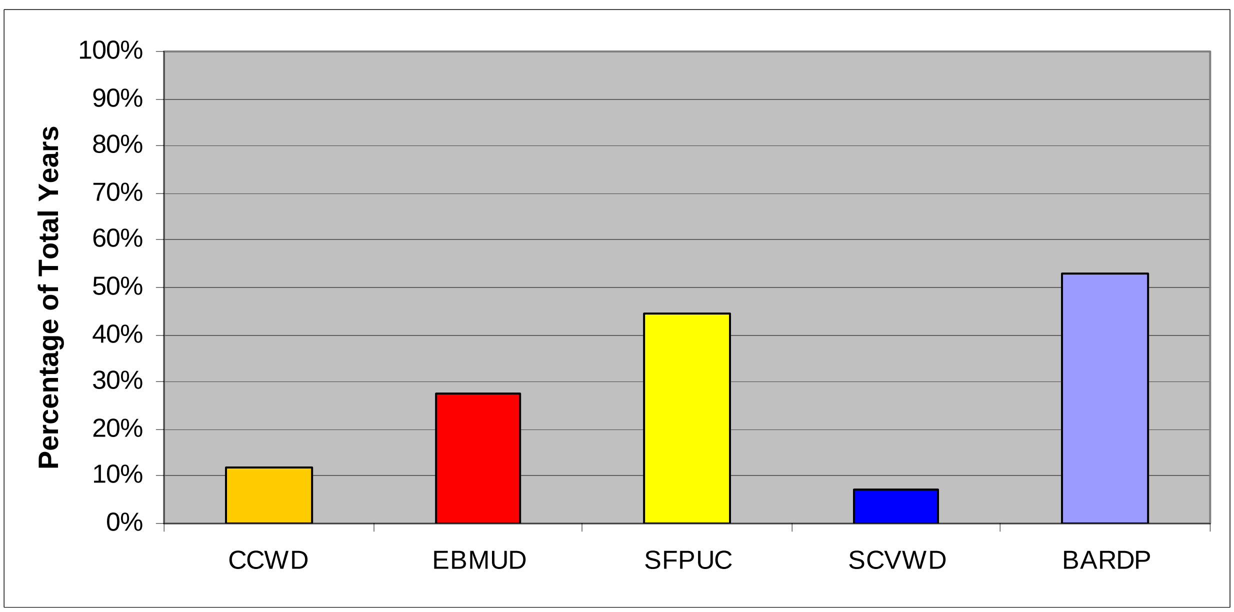


Figure D-2
Needs for Desalination Water Supply, 1920–2002



Note: Based on CCWD, SFPUC, and SCVWD 2030 demand projections and EBMUD 2020 demand projections.

Appendix E
Optimization of Desalination Plant Capacity

Appendix E. Optimization of Desalination Plant Capacity E-1

E.1 Risk Criterion Approach E-1
E.1.1 Method E-1
E.1.2 Results and Discussion E-1
E.1.3 Cost-Benefit Analysis Approach E-2
E.2 Results and Discussion E-4
E.2.1 Plot of Benefit-to-Cost Ratio E-4
E.2.2 Sensitivity Analysis E-4

Table

E-1 Risk of Exceeding Gaps for Different Plant Capacities

Figures

E-1 Risk of Exceeding Gap for Given Capacity in a Dry Year
E-2 Relative Unit Cost of Making Up Water Supply Gap (Base Case)
E-3 Cumulative Relative Cost and Benefit as a Function of Plant Capacity
E-4 Relative Capital Cost as a Function of Plant Capacity
E-5 Analysis of Optimal Plant Capacity (Base Case)
E-6 Relative Capital Cost as a Function of Plant Capacity for Sensitivity Analysis
E-7 Sensitivity Analysis of Relative Capital Cost
E-8 Relative Unit Cost of Making Up Water Supply Gap
E-9 Sensitivity Analysis of Unit Cost of Meeting Gap in a Dry Year

As of November 2006, SFPUC revised its desalination needs estimate to 26 mgd. The future demand for year 2030 is estimated at 300 mgd, and the future rationing is estimated at 20 percent. Based on 82 years of monthly drought data, SFPUC determined that during an 8.5-year design drought, the agency would need an average of 23 mgd from the potential desalination plant. The maximum need for this design drought would be 26 mgd. For that reason, the results from the plant capacity and operational assessment were revised using a need of 26 mgd for SFPUC in all dry years (see Appendix D).

Based on results and conclusions of the plant capacity and operational assessment, the next refinement step was to optimize the desalination plant capacity. Two approaches were used for the analysis: the risk criterion approach and the benefit-to-cost ratio approach. The following provides a summary of the two approaches as well as the results.

E.1 RISK CRITERION APPROACH

E.1.1 Method

The risk was defined as the probability of exceeding a specified difference between the total desalination water need in a dry year and the desalination plant capacity. This specified difference is referred to as a gap. This probability was estimated as the proportion of dry years in which the gap between the total desalination water need and an assumed plant capacity would exceed a specified amount.

For this analysis, the historical hydrological record from 1920 to 2002 was assumed to represent future hydrological conditions following the construction of the plant. Dry years in which desalination water could be used were identified for each agency using agency-specified criteria (Section 3.2.1). Each agency estimated its desalination water need for a dry year.

A total of 31 dry years in which desalination water could have been used were identified during the hydrological record. The sum of the individual agency needs provided an estimate of the total desalination water need in each dry year (Section 3.2.1).

For each dry year, the gap between the total desalination water need and the plant capacity was calculated based on an assumed plant capacity. The proportion of dry years in which the gap exceeded different amounts was calculated for different plant capacities (from 10 to 71 mgd). The gaps are expressed as a percentage of the maximum desalination water need, 71 mgd (Table E-1). Thus, for example, a 10 percent gap in a dry year would mean a shortage of 7.1 mgd.

E.1.2 Results and Discussion

Plots of the risk (i.e., the proportion of dry years) of exceeding different gaps for various plant capacities are shown in Figure E-1. If criteria are specified for the maximum gap allowed in a dry year and the maximum allowable risk of exceeding that gap, the minimum plant capacity that would meet the two criteria can be identified. Table E-1 shows the minimum plant capacity for different combinations of the two criteria. For example, if the maximum allowable gap is 20 percent (i.e., a shortage of 14.2 mgd) and the maximum percentage of dry years in which this gap is exceeded is specified to be 10 percent (i.e., no more than 10 percent of dry years would experience a gap of more than 14.2 mgd), then the minimum plant capacity that would satisfy these two criteria would be 61 mgd.

Table E-1
Risk of Exceeding Gaps for Different Plant Capacities

Maximum Allowable % Gap in a Dry Year	Maximum Allowable Percentage of Dry Years Exceeding Gap Limit	Minimum Plant Capacity (mgd)
0%	5%	71
	10%	61
	15%	61
	20%	46
10% (=7.1 mgd)	5%	71
	10%	61
	15%	61
	20%	41
20% (=14.2 mgd)	5%	61
	10%	61
	15%	61
	20%	41
30% (=21.3 mgd)	5%	61
	10%	41
	15%	41
	20%	26
40% (=28.4 mgd)	5%	46
	10%	41
	15%	41
	20%	20
50% (=35.5 mgd)	5%	41
	10%	26
	15%	26
	20%	15

The risk criterion approach does not use an economic analysis of the cost impact of the water supply gaps in dry years and the plant capital cost. The cost-benefit analysis approach, which is described next, incorporates principles of economic analysis to identify the optimal plant capacity.

E.1.3 Cost-Benefit Analysis Approach

This approach uses a benefit-to-cost ratio to identify the optimal plant capacity. In calculating this ratio, the following definitions are used:

- "Benefit" is the *cost savings* in future dry years because of having a desalination plant of a certain capacity
- "Cost" is the *capital cost* of the desalination plant

Cost savings reflect the fact that the plant would meet some or all of the water needs in dry years, thus avoiding the cost of securing the needed amounts of water in those years through the open market or other sources. Mathematically, the benefit of a plant with a certain capacity can be expressed as the following:

Benefit = Cnp – Cpc (Equation E-1)

In which:

Cnp = cumulative costs of the actions needed to meet water supply gaps in dry years, assuming no desalination plant is constructed, and

Cpc = cumulative costs of the actions needed to meet water supply gaps in dry years, assuming a desalination plant of a certain capacity is constructed.

Because the analysis uses the ratio of benefit to cost, only relative benefits and relative plant capital costs need to be estimated. Assumptions made in estimating these parameters are described below.

E.1.3.1 Estimate of Relative Benefits

As described above, the gap between the total desalination water need and the assumed plant capacity was estimated for each dry year using the historical hydrological record. For the no-plant option, the gap would be equal to the total desalination water need. It was assumed that the gap would be met by securing water from other sources (e.g., open market, groundwater, etc.). The relative cost of meeting this gap was estimated as follows:

Relative cost of meeting a gap = Amount of gap x Relative unit cost (Equation E-2)

For the base case analysis, a constant unit cost was assumed (Figure E-2). The influence of variable unit costs was assessed in the sensitivity analysis discussed later.

Using Equation E-2, the relative cost of meeting the gap in each dry year was calculated for a range of plant capacities using the historical hydrological record. The cumulative relative cost for a plant of a given capacity was calculated as the sum of the relative costs over the hydrological record.

The relative benefit of each capacity-plant was then calculated using Equation E-1. Figure E-3 shows the cumulative relative cost and benefit as a function of plant capacity.

E.1.3.2 Estimate of Relative Capital Costs

The relative capital costs for plant capacities of 25, 40, 55, and 65 mgd were calculated based on previous cost estimation results (Appendix A). A relationship between the capital cost and plant capacity was developed using these cost data. The capital cost for a 71 mgd plant was then calculated using this relationship. The largest plant (71 mgd) was defined as having a relative capital cost of 1. The capital costs for other capacities were calculated as a proportion of the capital cost of the 71 mgd plant. Figure E-4 shows a plot of the relative capital cost versus the plant capacity and a mathematical equation fitted to the data points. The equation shows that the capital cost has a fixed cost of $35 million and a variable cost of $2.9 million/mgd.

E.2 RESULTS AND DISCUSSION

E.2.1 Plot of Benefit-to-Cost Ratio

Figure E-5 shows a plot of the ratio of relative cost savings to relative capital cost as a function of plant capacity. The plot exhibits a typical convex surface that reaches a plateau around a capacity of 40 mgd. Thus, for the inputs described above, the optimal plant capacity is assessed to be around 40 mgd.

E.2.2 Sensitivity Analysis

A sensitivity analysis was performed to assess the impact of changing the base-case assumptions regarding capital costs and relative costs of meeting gaps in dry years. The results are discussed below.

The base-case relative capital cost relationship shown in Figure E-6 assumed that the fixed capital cost was $35 million and the variable cost was $2.9 million/mgd. Two different scenarios regarding the fixed capital cost were analyzed. One scenario assumed that the fixed cost was zero, while the other scenario assumed that the fixed cost would be 40 percent higher than the base case (that is, $50 million). For both scenarios, the same variable cost of $2.9 million/mgd was assumed. Figure E-6 shows the relative capital costs for various plant capacities for three fixed capital cost components: $35 million (base case), no fixed cost, and $50 million.

Results are shown in Figure E-7. Clearly, the optimal capacity is sensitive to the assumed fixed capital cost component. The optimal capacity changes from about 40 mgd for the base case to less than 10 mgd and about 45 mgd for a fixed capital cost of 0 and $50 million, respectively.

The base-case relationship for the relative unit cost of making up a gap, shown in Figure E-2, assumed that this cost would be constant over the entire range of gap. It is plausible that, when the gap is relatively small (e.g., less than 15 percent of the maximum need for desalination water), the gap could be met with relatively inexpensive actions (such as additional rationing). Consequently, the unit cost of meeting such a gap would be relatively small. On the other hand, as the gap increases, more costly sources of water may have to be used, which would lead to higher unit costs.

Two scenarios regarding the relative unit cost of meeting a gap were analyzed. In Scenario 1, it was assumed that the unit cost of meeting a 15 percent gap would be about half the cost of meeting a 100 percent gap and the unit cost would rise to 95 percent when the gap reaches 30 percent. In Scenario 2, it was assumed that the unit cost of meeting a 30 percent gap would be about half the cost of meeting a 100 percent gap and the unit cost would rise to 95 percent when the gap reaches 60 percent. These relationships are presented in Figure E-8.

The results of this sensitivity analysis, shown in Figure E-9, suggest that the optimal capacity is moderately sensitive to the assumption of the relative unit cost of meeting a gap in a dry year. The optimal capacity is about 40 mgd for the base case, and about 35 mgd and 30 mgd for Scenarios 1 and 2, respectively.

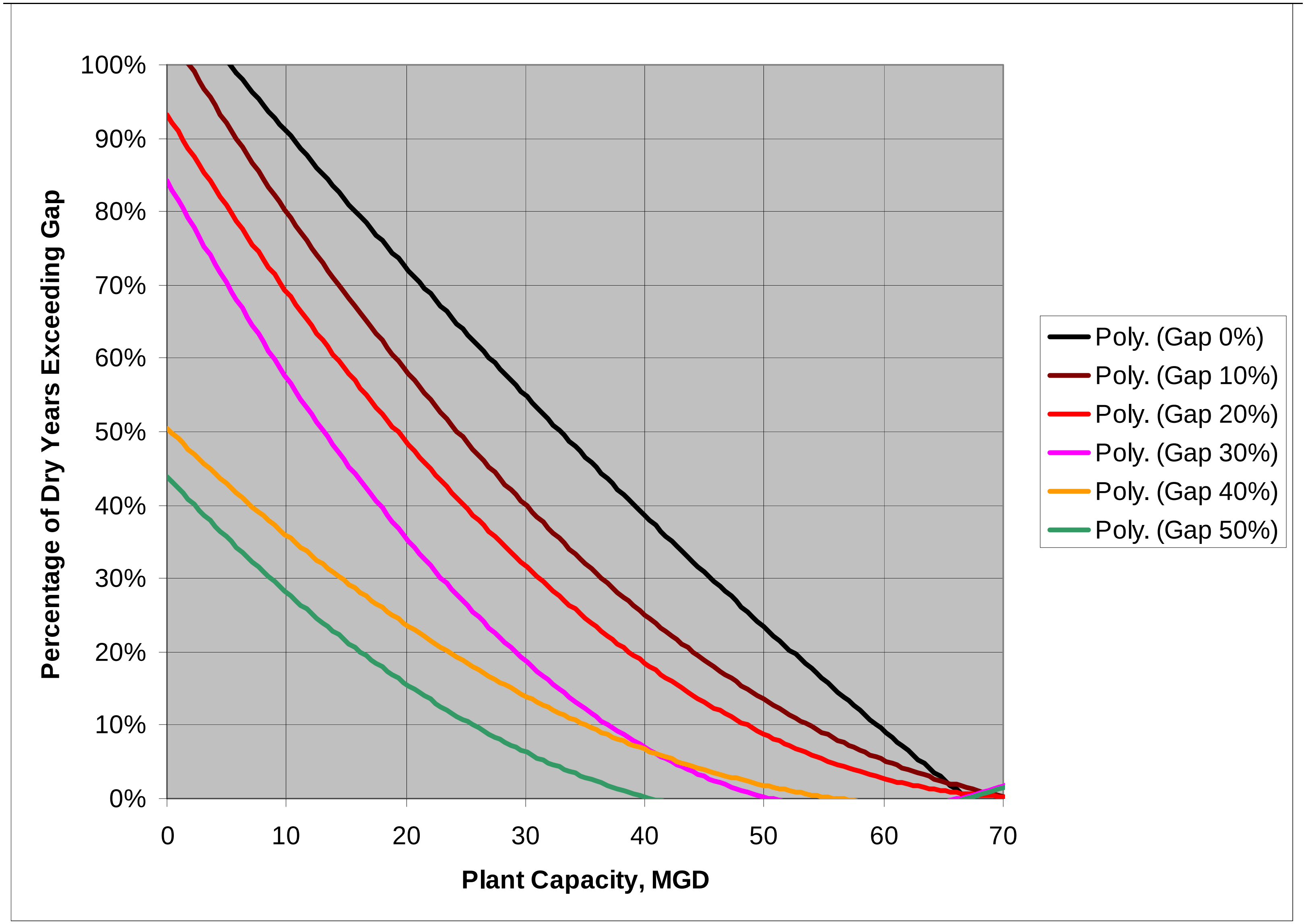


Figure E-1 Risk of Exceeding Gap for Given Capacity in a Dry Year

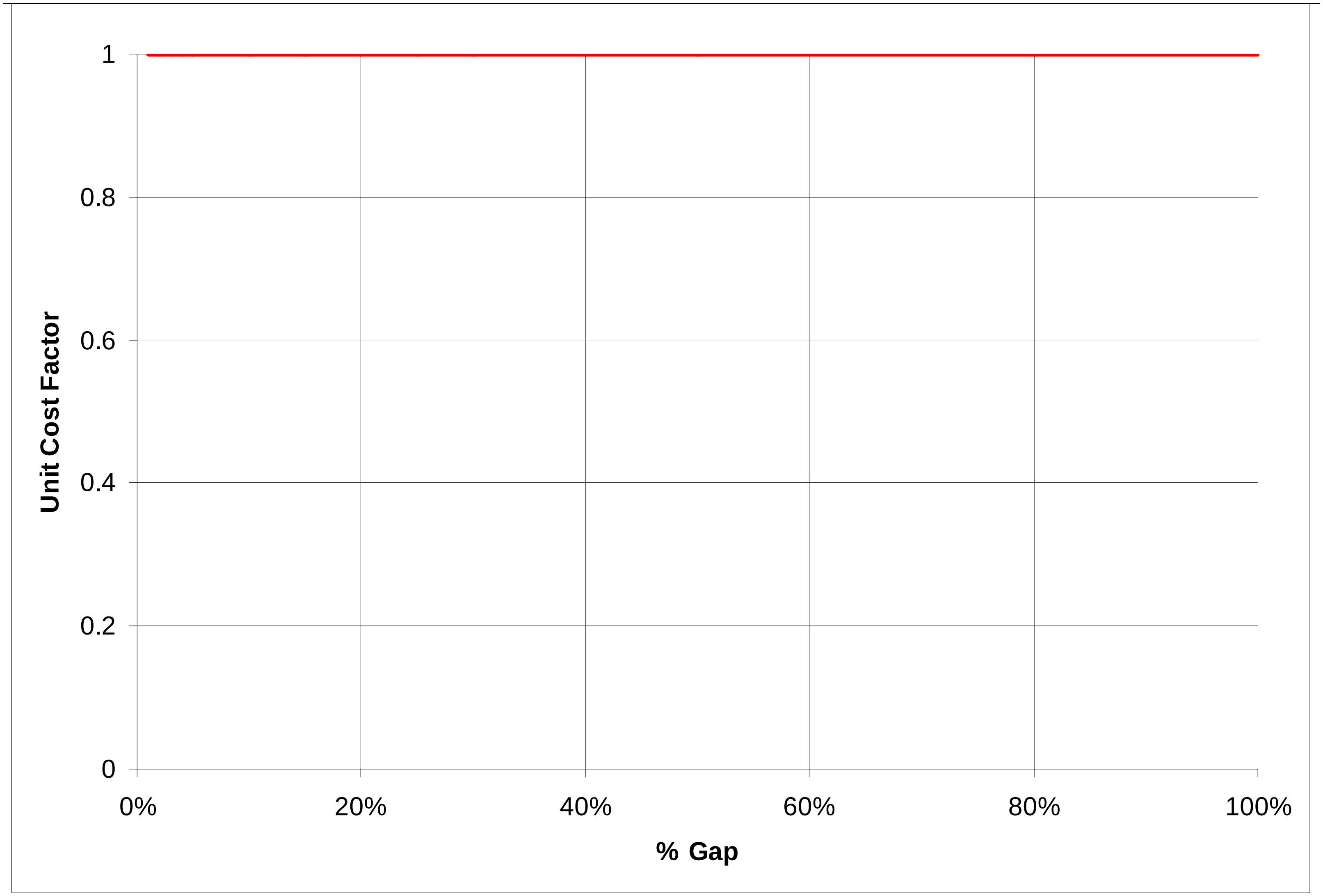


Figure E-2 Relative Unit Cost of Making Up Water Supply Gap (Base Case)

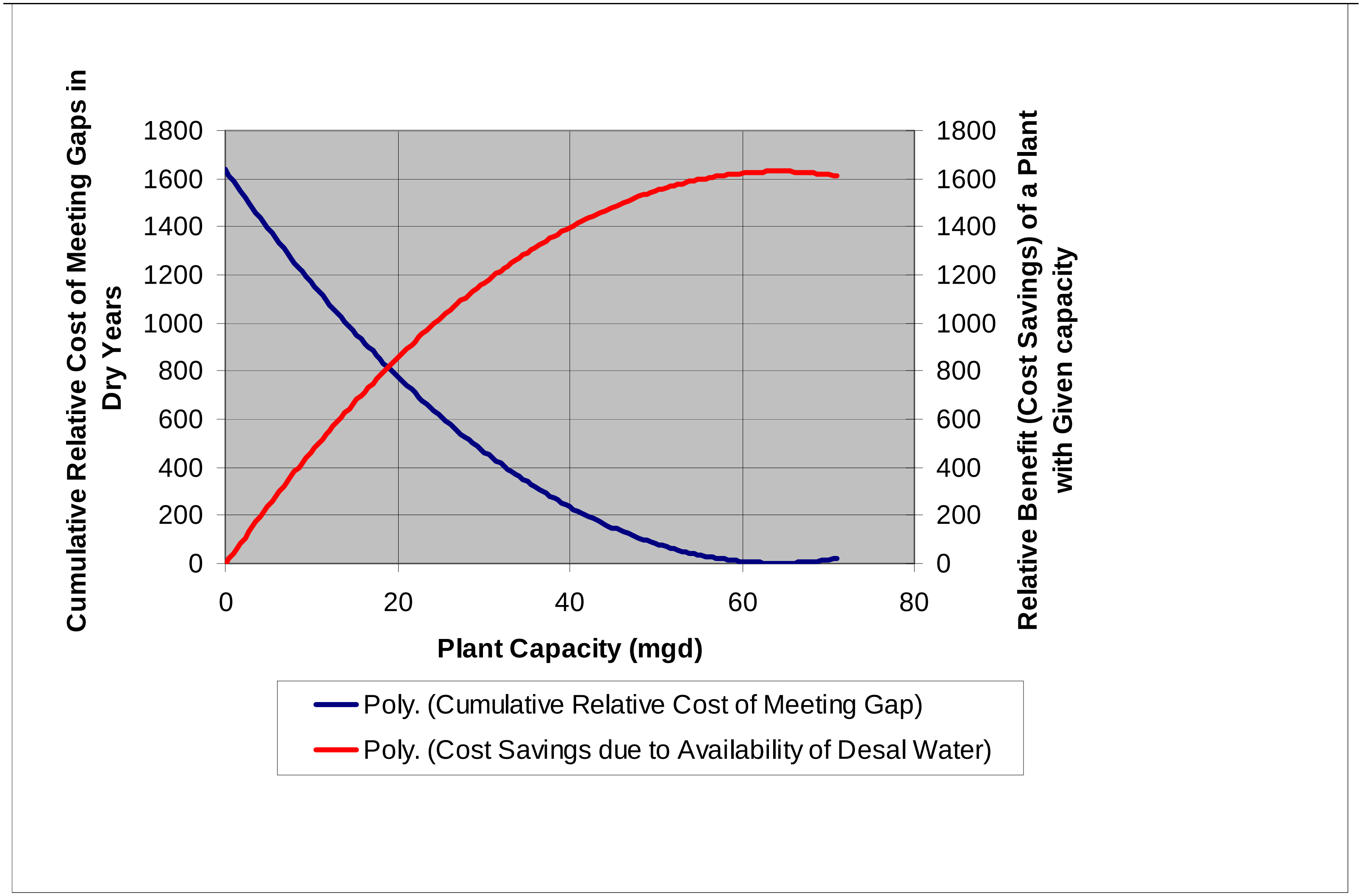


Figure E-3 Cumulative Relative Cost and Benefit as a Function of Plant Capacity

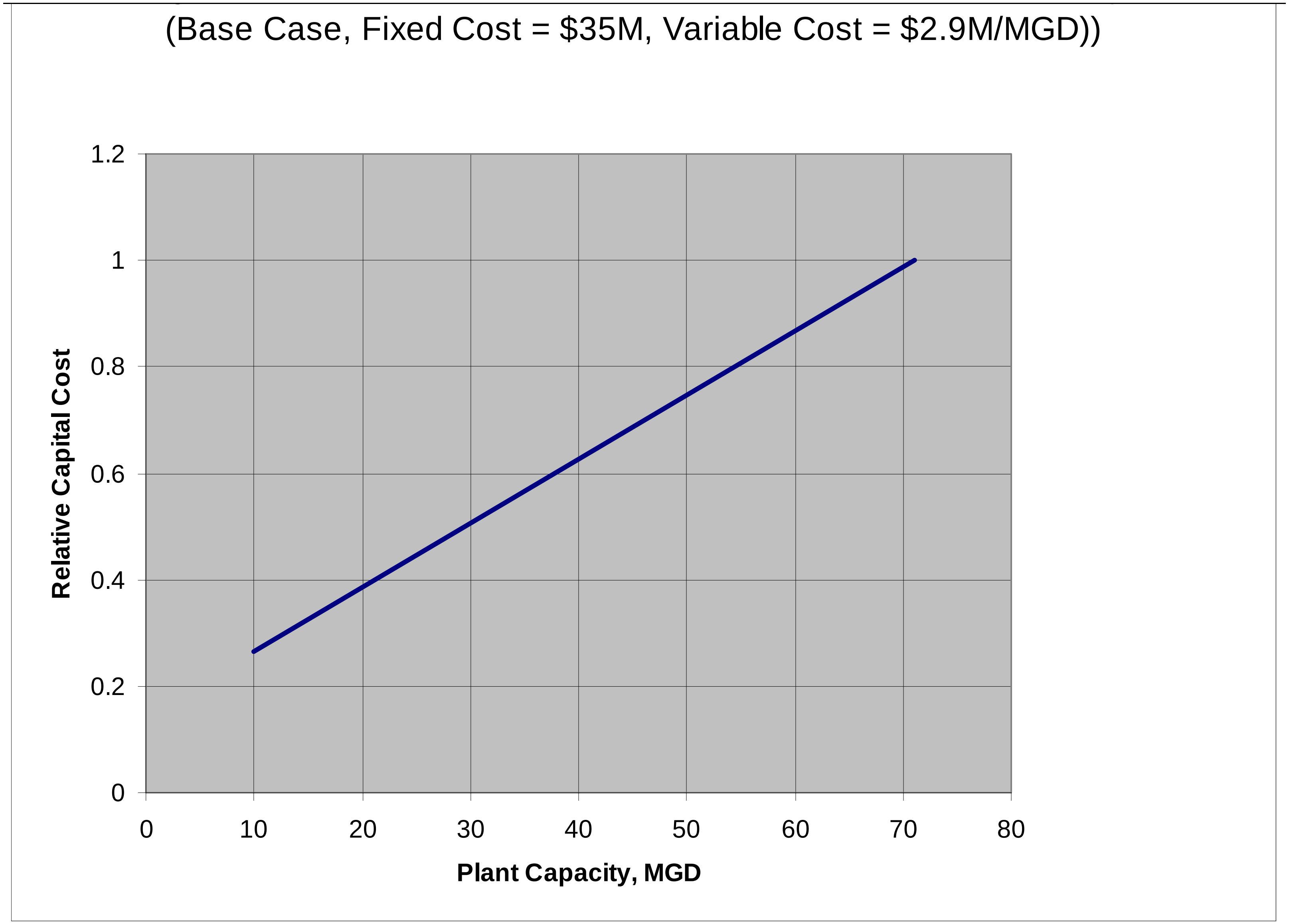


Figure E-4 Relative Capital Cost as a Function of Plant Capacity

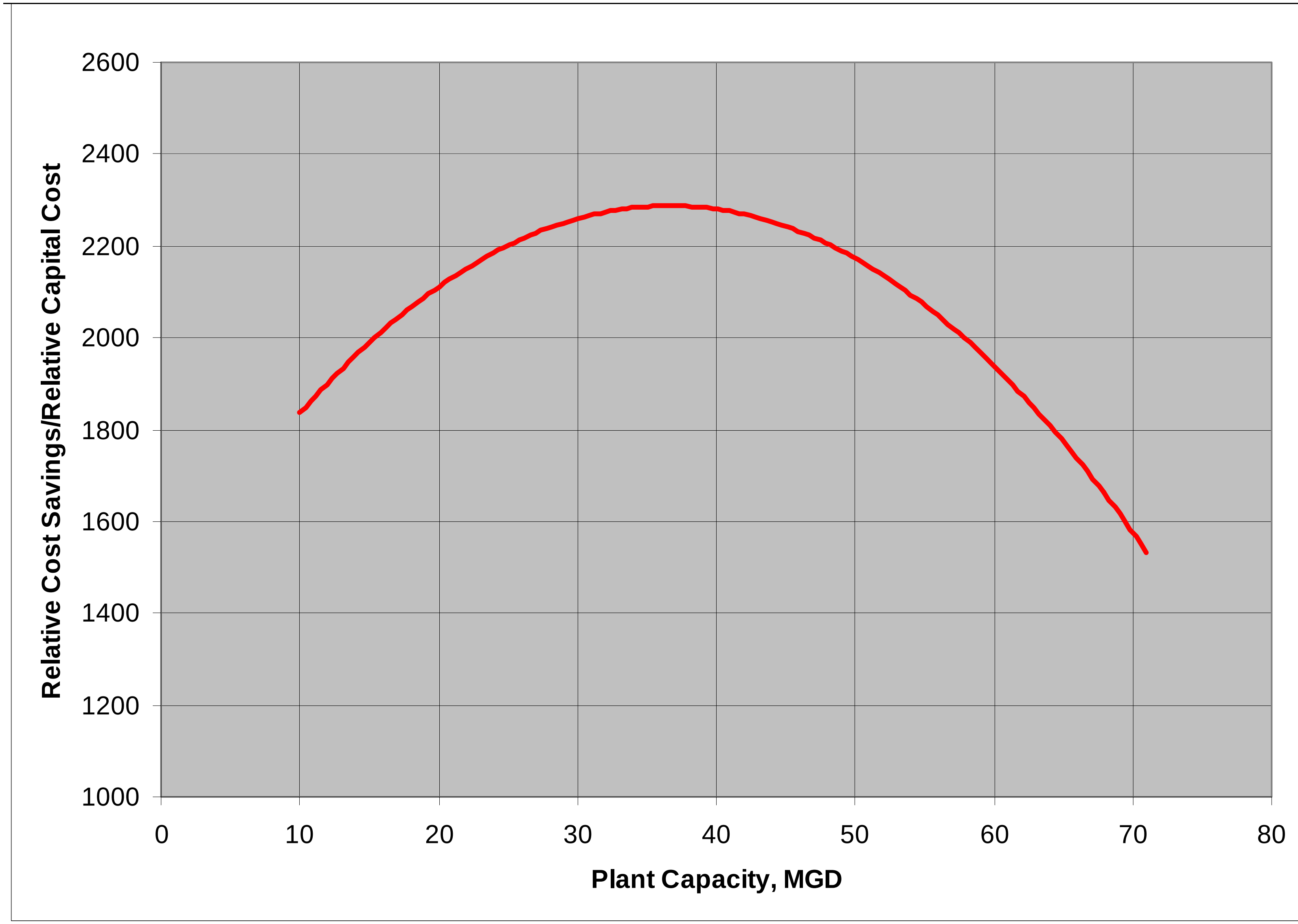


Figure E-5 Analysis of Optimal Plant Capacity (Base Case)

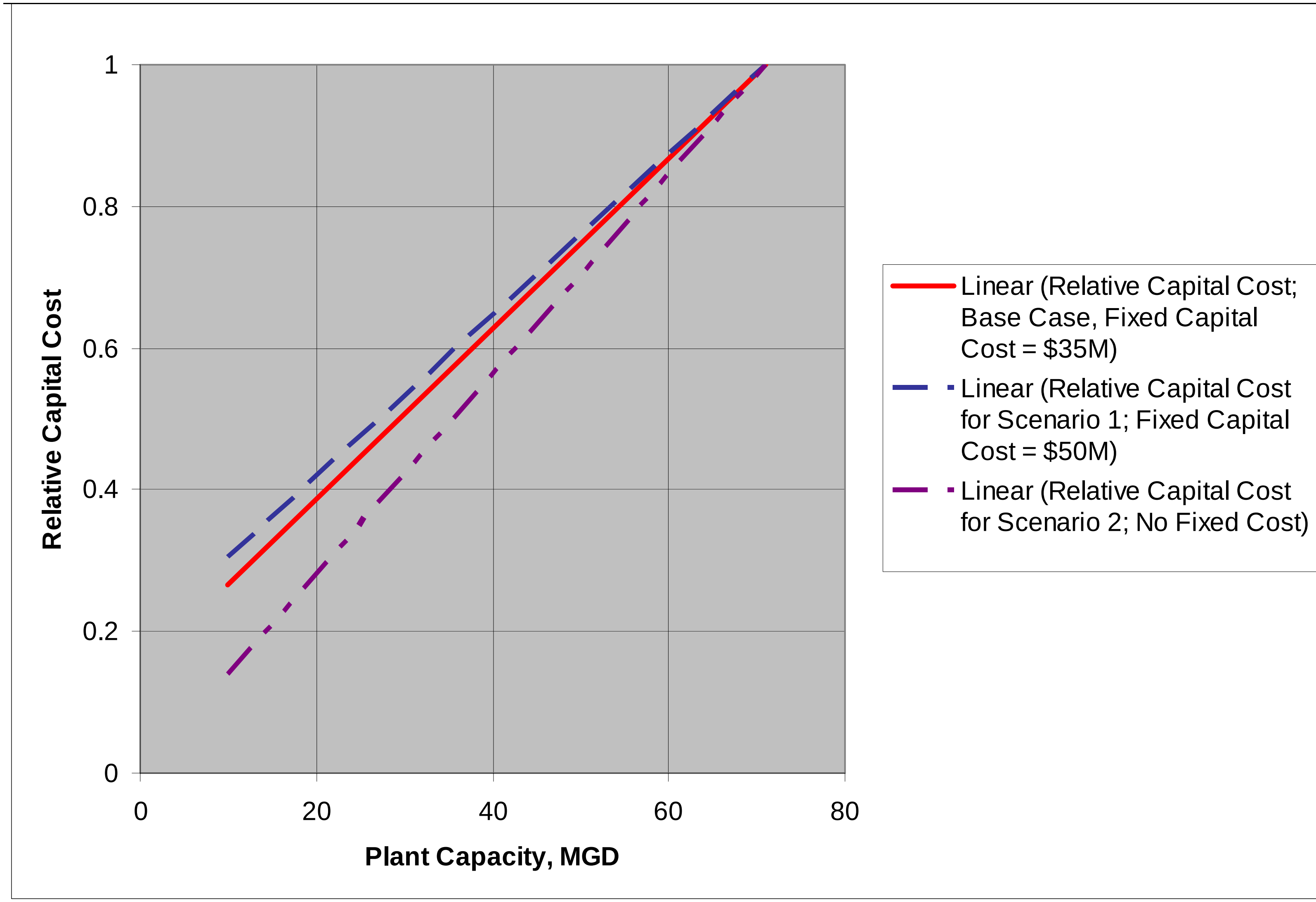


Figure E-6 Relative Capital Cost as a Function of Plant Capacity for Sensitivity Analysis

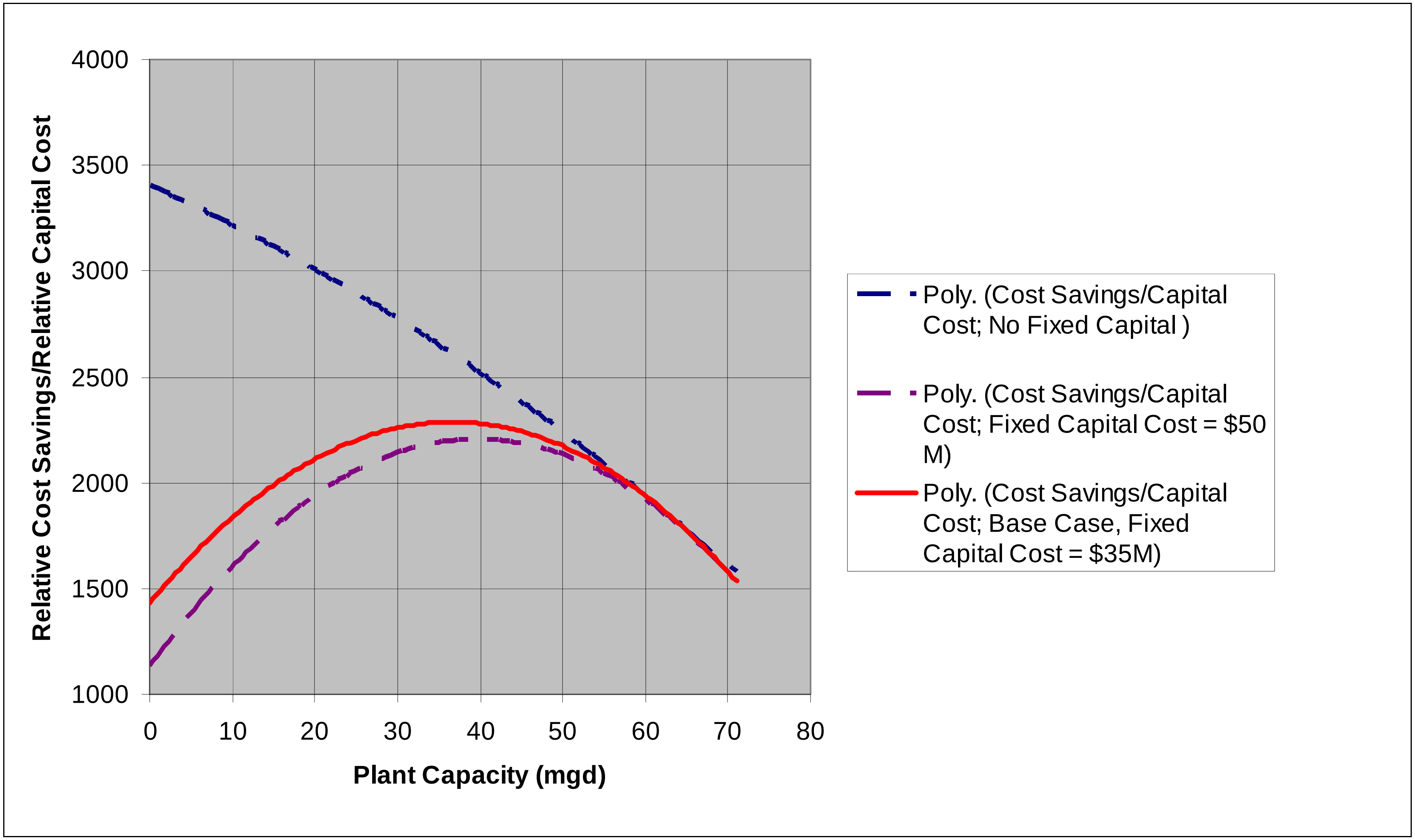


Figure E-7 Sensitivity Analysis of Relative Capital Cost

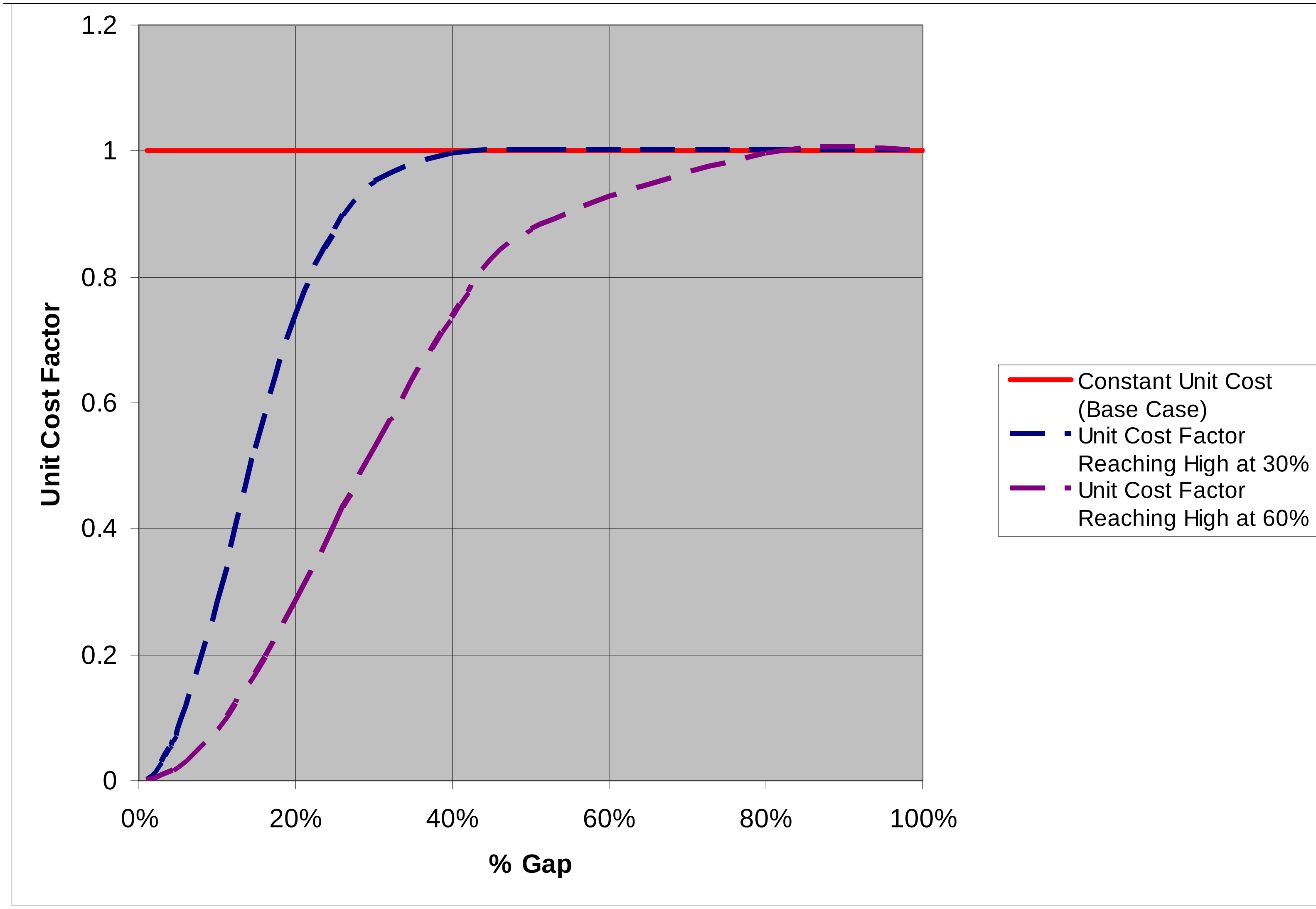


Figure E-8 Relative Unit Cost of Making Up Water Supply Gap

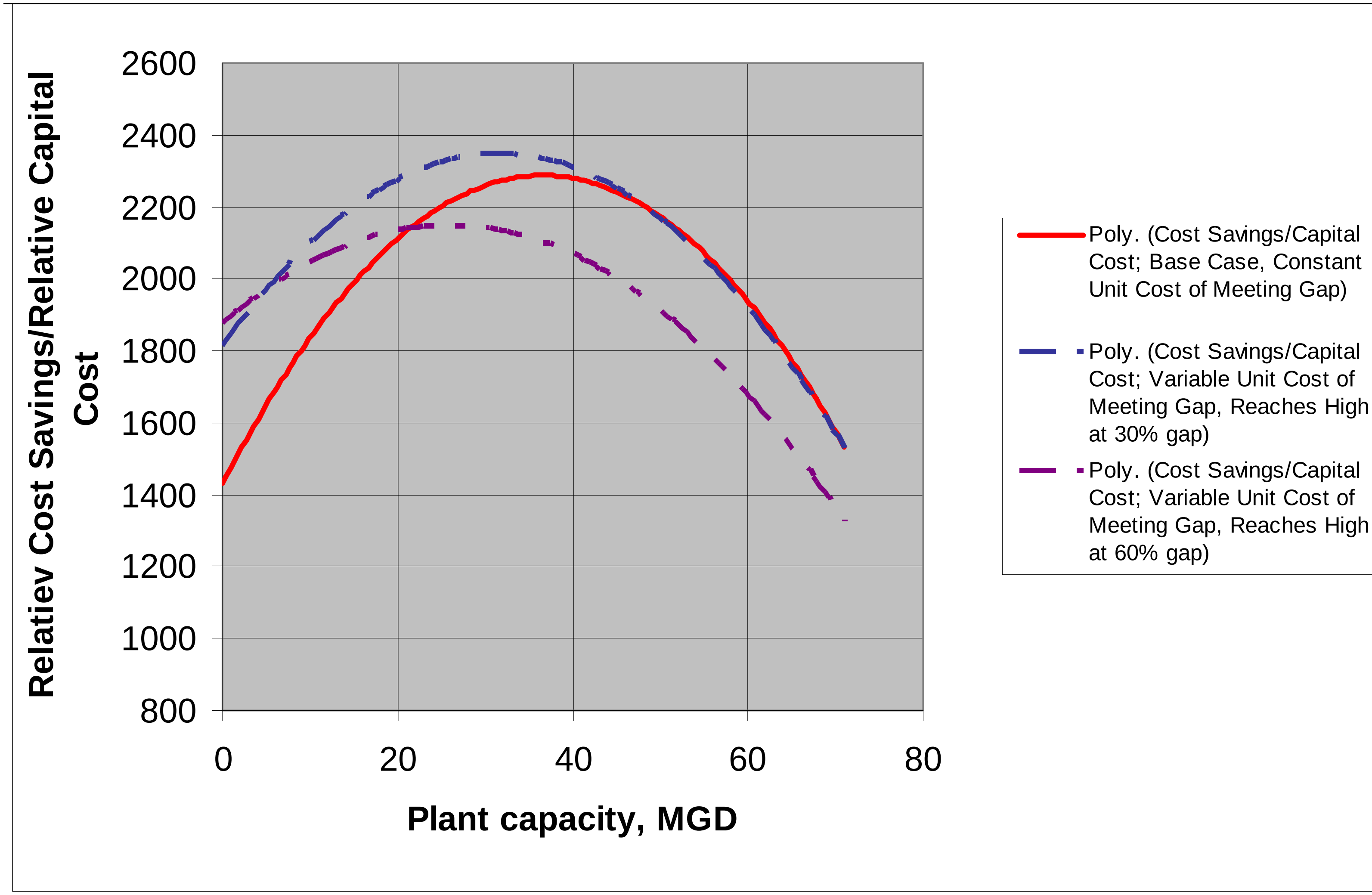
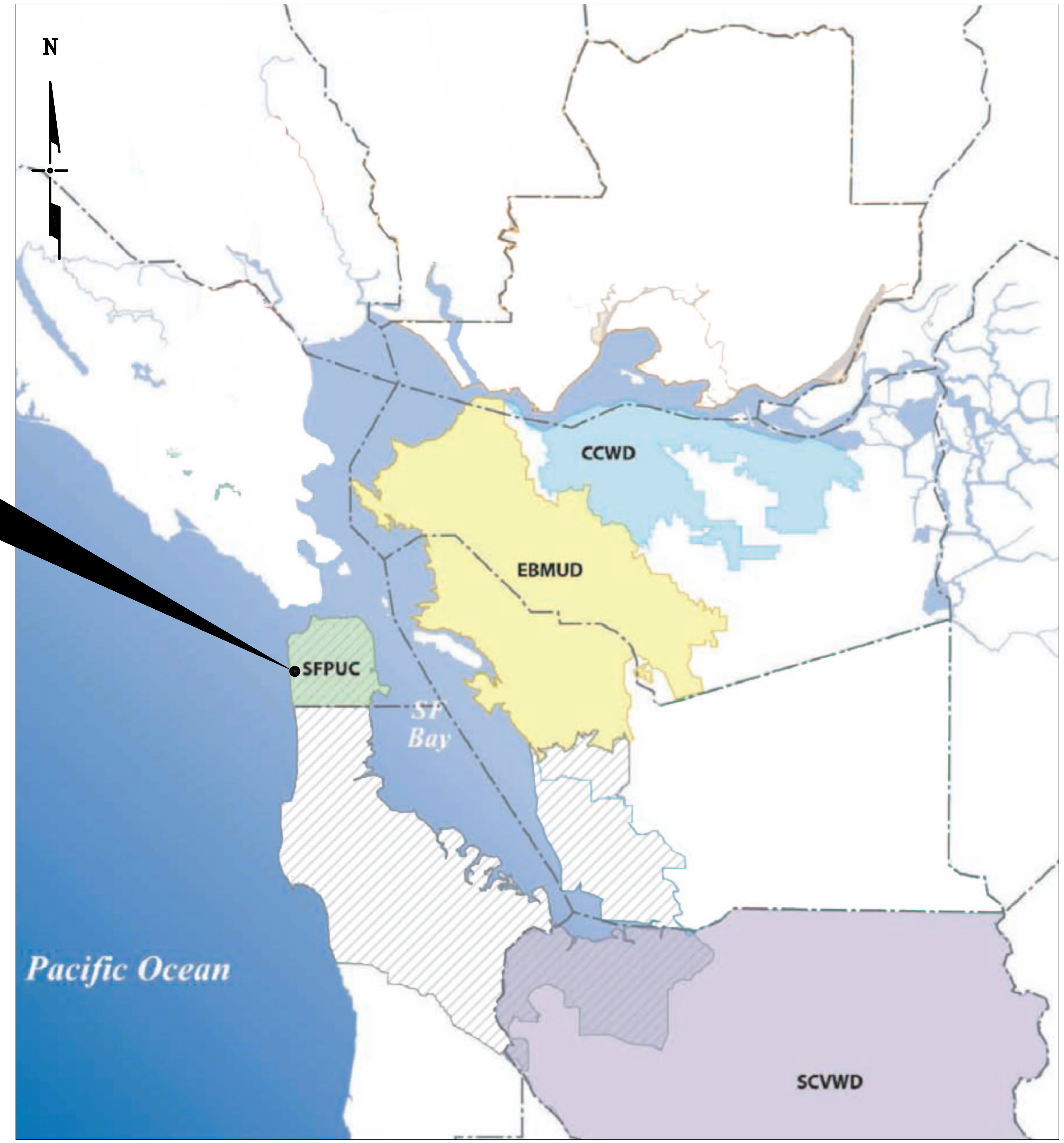


Figure E-9 Sensitivity Analysis of Unit Cost of Meeting Gap in a Dry Year

Appendix F
Preliminary Site Layout Technical Drawings

BAY AREA REGIONAL DESALINATION PROJECT
20 MGD SEAWATER RO PRELIMINARY DRAWINGS

POTENTIAL LOCATION OF SWRO TREATMENT PLANT IN OCEANSIDE



SCALE
N.T.S.

DRAWING INDEX

SHEET No. 1	PROCESS FLOW DIAGRAM
SHEET No. 2	SITE LAYOUT
SHEET No. 3	MID LEVEL PLAN – LAYOUT 1
SHEET No. 3A	MID LEVEL PLAN – LAYOUT 2
SHEET No. 4	LOWER LEVEL PLAN – LAYOUT 1
SHEET No. 4A	LOWER LEVEL PLAN – LAYOUT 2
SHEET No. 5	UPPER LEVEL PLAN – LAYOUT 1
SHEET No. 5A	UPPER LEVEL PLAN – LAYOUT 2
SHEET No. 6	BUILDING SECTION

CONTRA COSTA WATER DISTRICT

EBMUD

SFPUC
WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

Santa Clara Valley Water District

URS

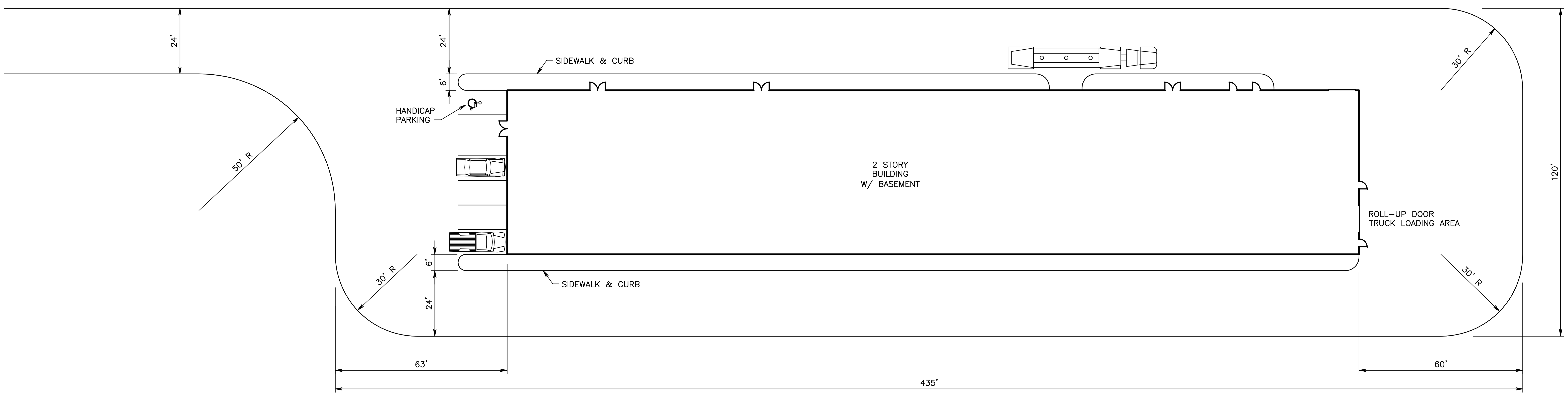
MCCOY 00306EB57808 J:\14573186\WATER\PLANS\G-00.DWG 10/24/2005 07:09 1.0000

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	SWRO 20 MGD PROCESS FLOW DIAGRAM	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	1

URS

PLOT INFO: MCCOY J:\26814534\WATER\PLANS\20MGD\DWG_1.DWG 02/16/07 7:34AM LTS: 1 PSLTS: 1



GENERAL SITE PLAN REQUIREMENTS

0 20 40 60 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534	URS
SUBJECT SWRO 20 MGD SITE LAYOUT	DATE	11/10/06	
DRAWN BY JDMc CHECKED BY JMC	DRAWING	2	

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	SWRO 20 MGD MID LEVEL PLAN – LAYOUT 1	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	3

URS

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534	URS
SUBJECT SWRO 20 MGD LOWER LEVEL PLAN – LAYOUT 1	DATE	11/10/06	
DRAWN BY JDMc CHECKED BY JMC	DRAWING	4	

PLOT INFO: MCCOY J:\26814534\WATER\PLANS\20MGD\DWG3_4_5.DWG 02/16/07 7:35AM LTS: 1 PSLTS: 1

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	SWRO 20 MGD LOWER LEVEL PLAN – LAYOUT 2	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	4A

URS

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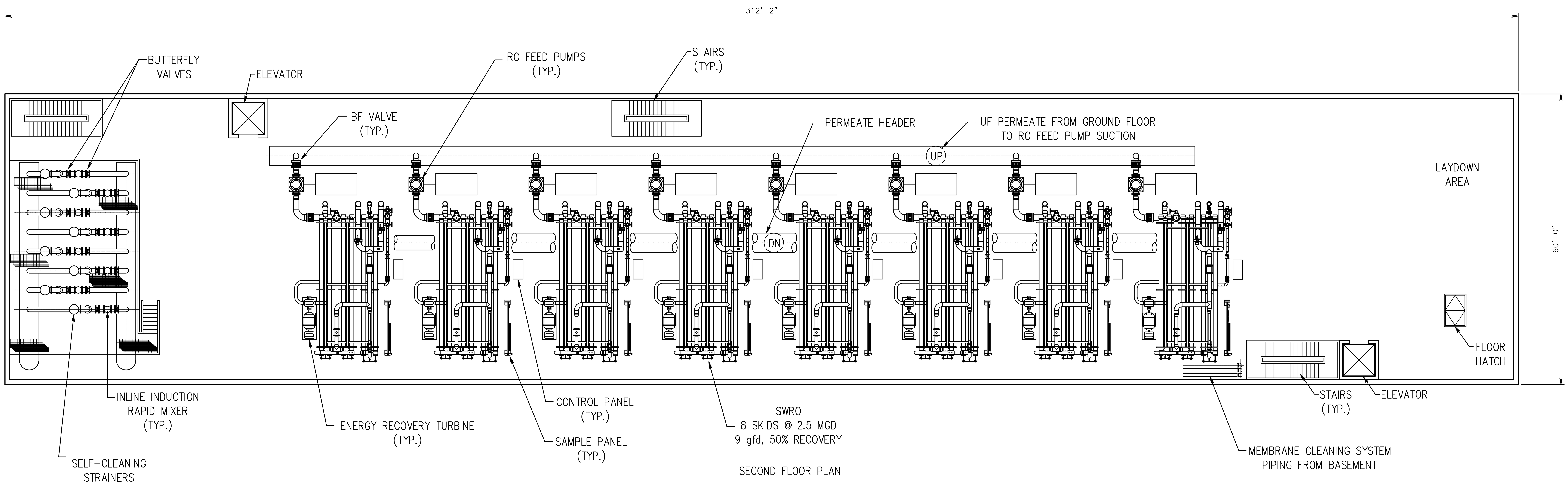


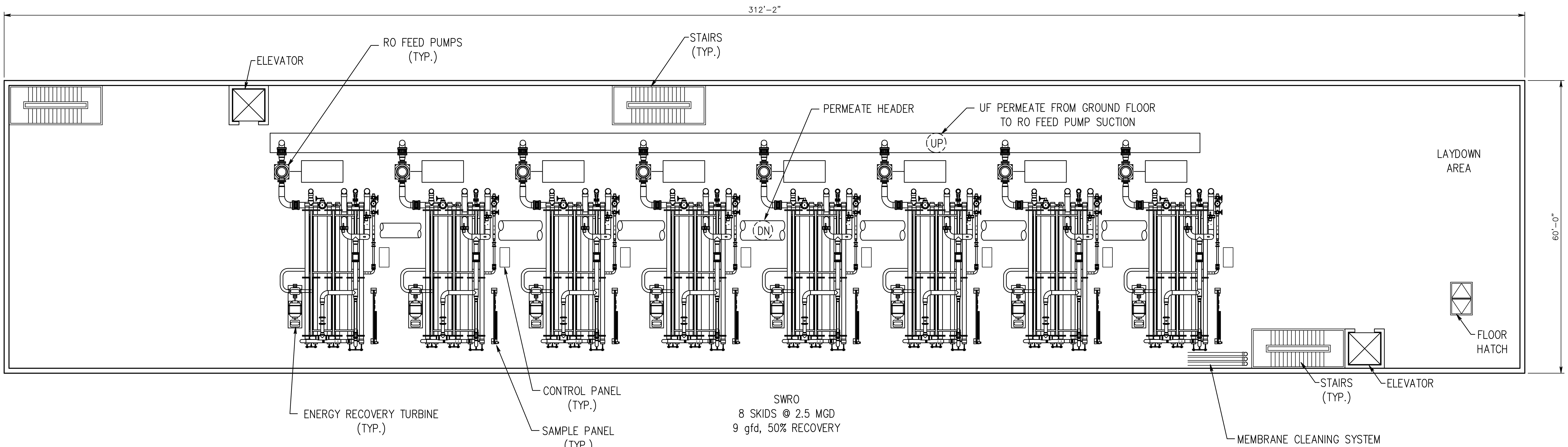
SECOND FLOOR PLAN

0 10 20 30 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534	URS
SUBJECT SWRO 20 MGD UPPER LEVEL PLAN – LAYOUT 1	DATE	11/10/06	
DRAWN BY JDMc CHECKED BY JMC	DRAWING	5	



SECOND FLOOR PLAN

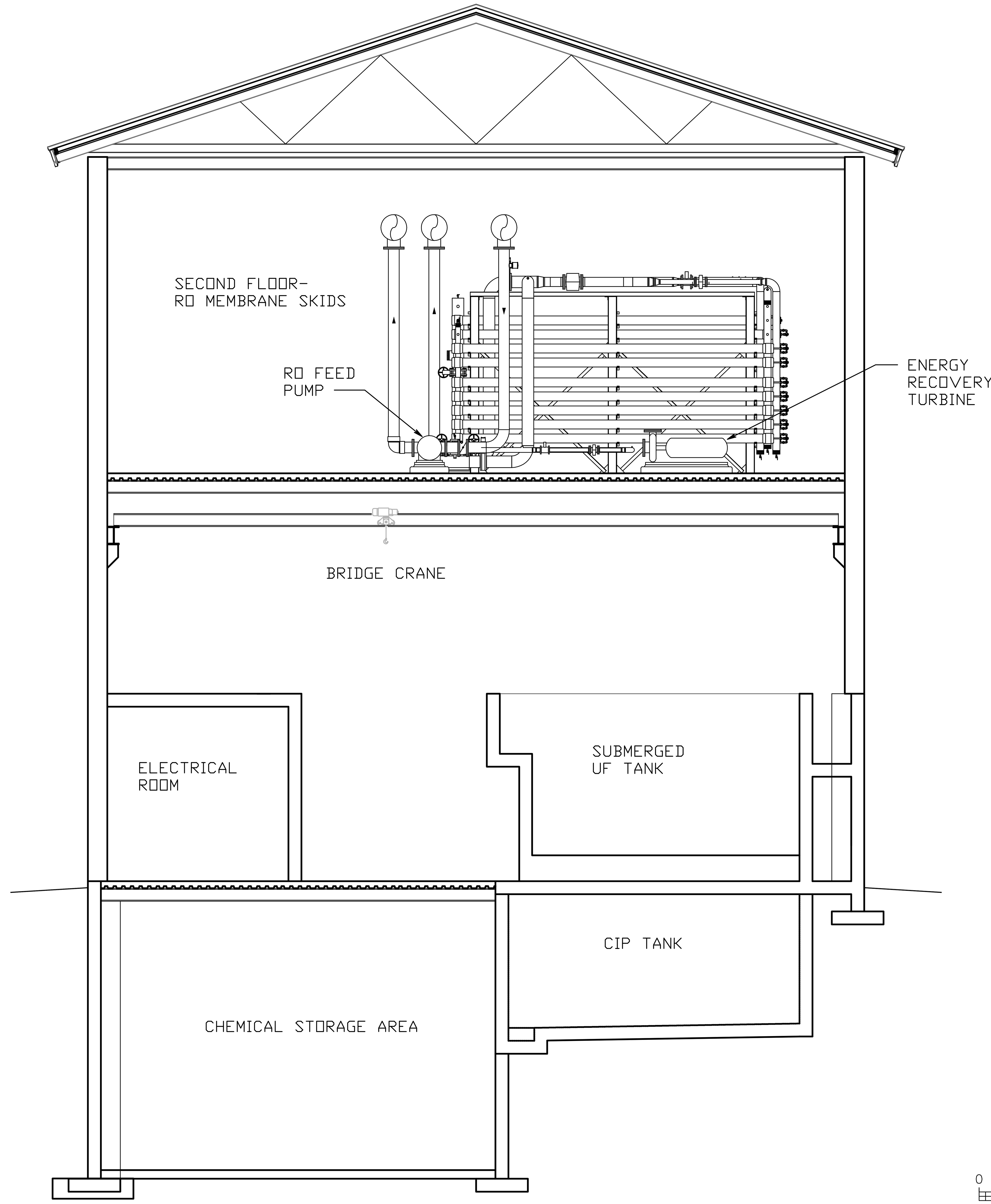
0 10 20 30 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	SWRO 20 MGD UPPER LEVEL PLAN – LAYOUT 2	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	5A

URS



0 5 10 15
Scale

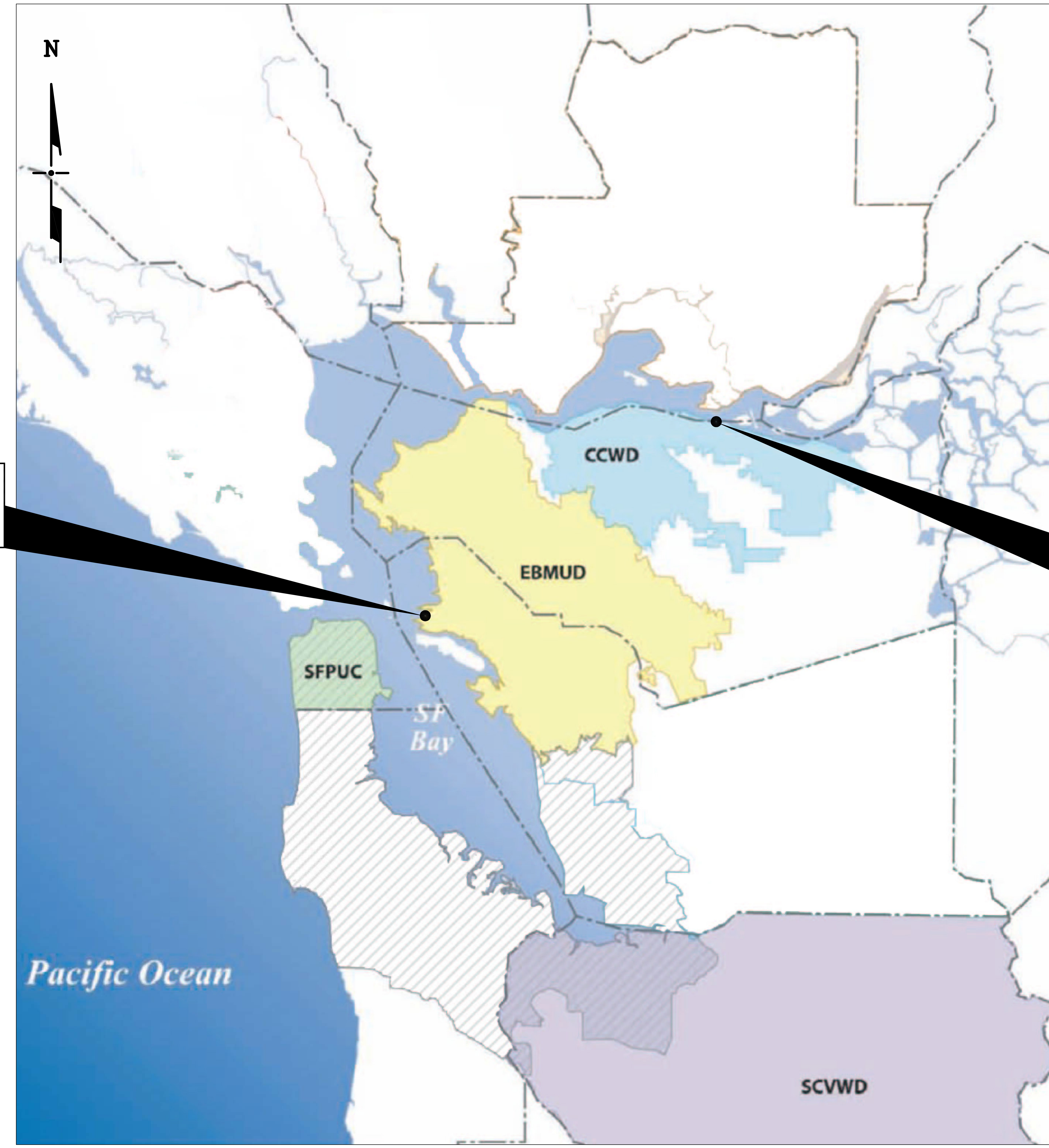
THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 20 MGD WATER PRODUCTION UTILIZING SINGLE PASS SWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	SWRO 20 MGD BUILDING SECTION	DATE	11/10/06
DRAWN BY KY	CHECKED BY JMC	DRAWING	6

URS

BAY AREA REGIONAL DESALINATION PROJECT
65 MGD BRACKISH WATER RO PRELIMINARY DRAWINGS



SCALE
N.T.S.

DRAWING INDEX

SHEET No. 7	PROCESS FLOW DIAGRAM
SHEET No. 8	SITE LAYOUT
SHEET No. 9	RAW WATER INTAKE PUMPS (135 MGD)
SHEET No. 10	STRAINER AND RAPID MIX BUILDING (130 MGD)
SHEET No. 11	FLOCCULATION AND DAF (130 MGD)
SHEET No. 12	SUBMERGED UF BUILDING PLAN
SHEET No. 12S	SUBMERGED UF SYSTEM SECTION
SHEET No. 13	RO TREATMENT BUILDING

CONTRA COSTA WATER DISTRICT

EBMUD

SFPUC
WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

Santa Clara Valley Water District

URS

THIS DRAWING ILLUSTRATES A PRELIMINARY PROCESS SCHEMATIC SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	BWRO 65 MGD PROCESS FLOW DIAGRAM	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	7

URS

PLOT INFO: MCCOY J:\26814534\WATER\PLANS\65MGD\DWG_7.DWG 02/16/07 7:38AM LTS: 1 PSLTS: 1

ACREAGE: 18.46 Ac.
AREA = 670' X 1200'

0 40 80 120 FT.
Scale

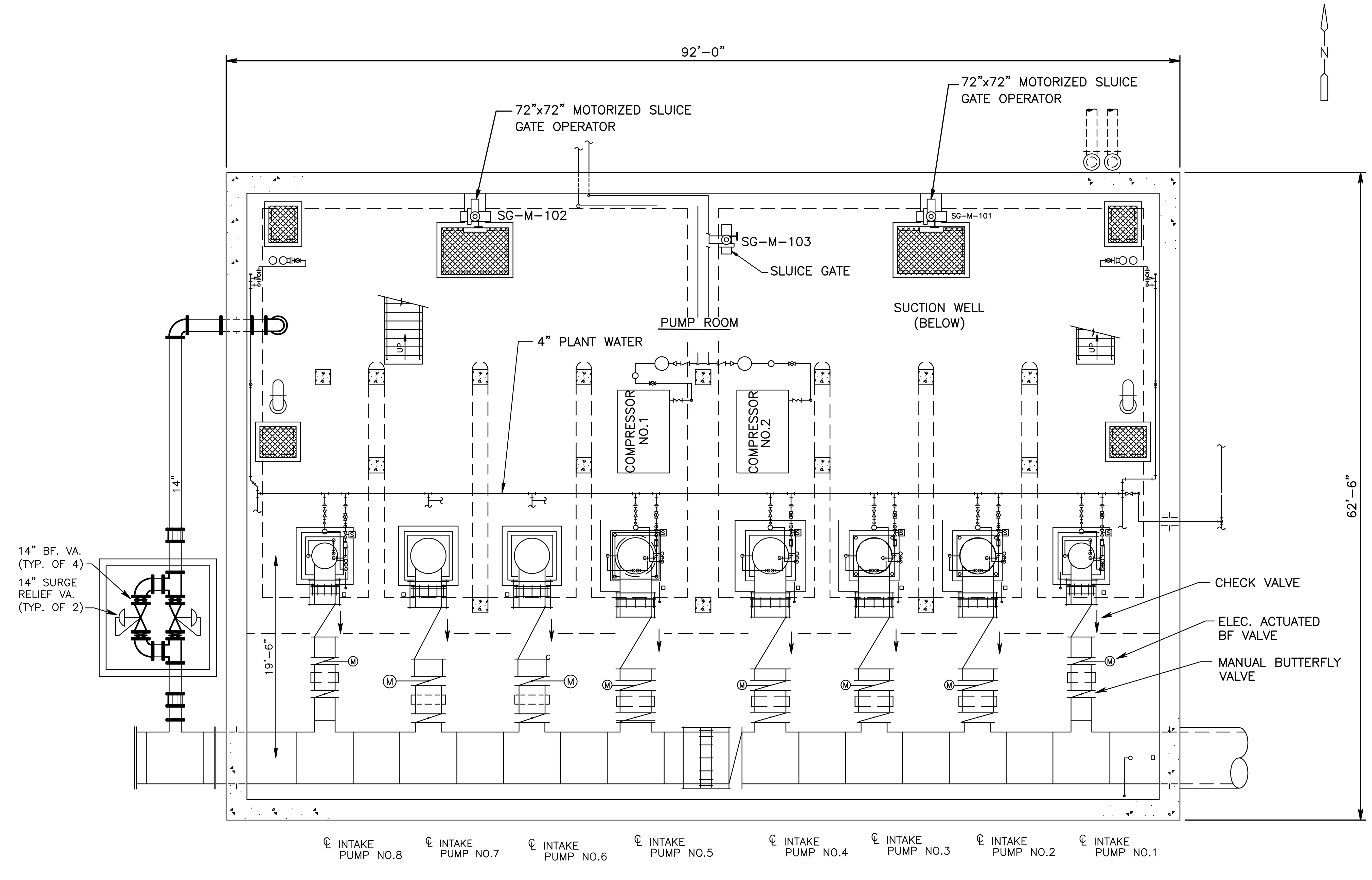
THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

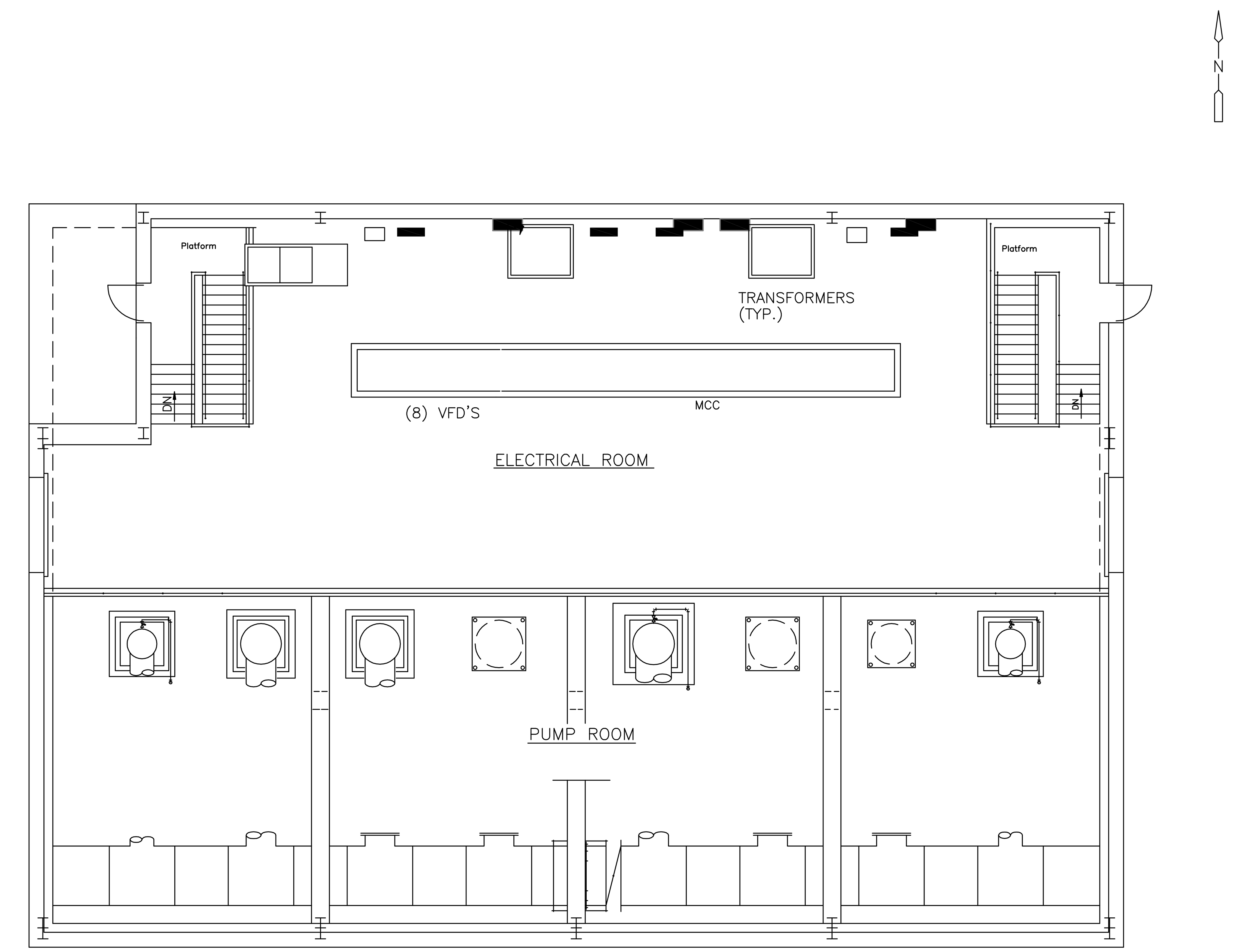
PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	BWRO 65 MGD SITE LAYOUT	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	8

URS

PLOT INFO: MCCOY J:\26814534\WATER\PLANS\65MGD\DWG_8.DWG 02/16/07 7:38AM LTS: 1 PSLTS: 1



PLAN



MEZZANINE FLOOR PLAN

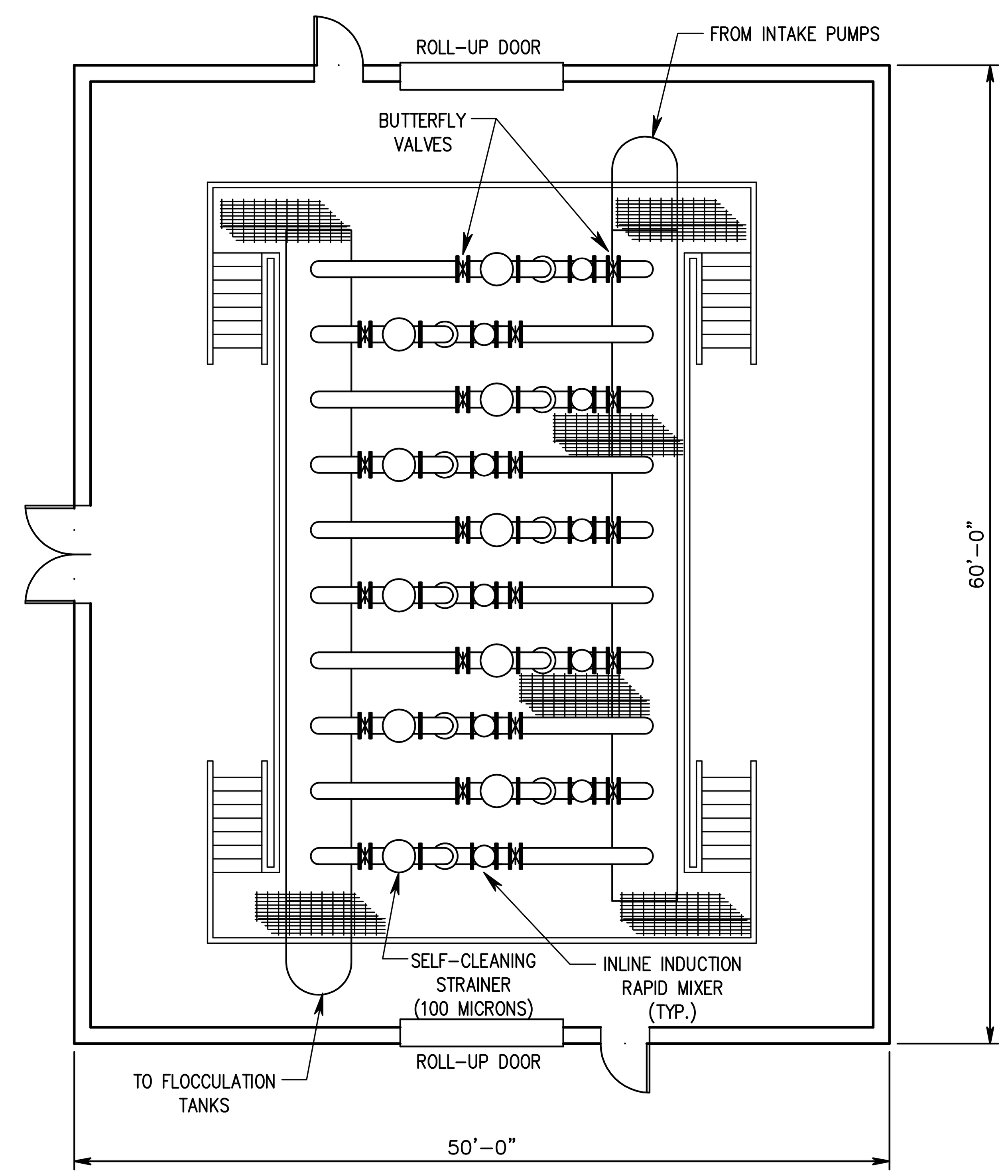
0 8 16 24 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	BWRO 65 MGD RAW WATER INTAKE PUMPS (135 MGD)	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	9

URS



0 8 16 24 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

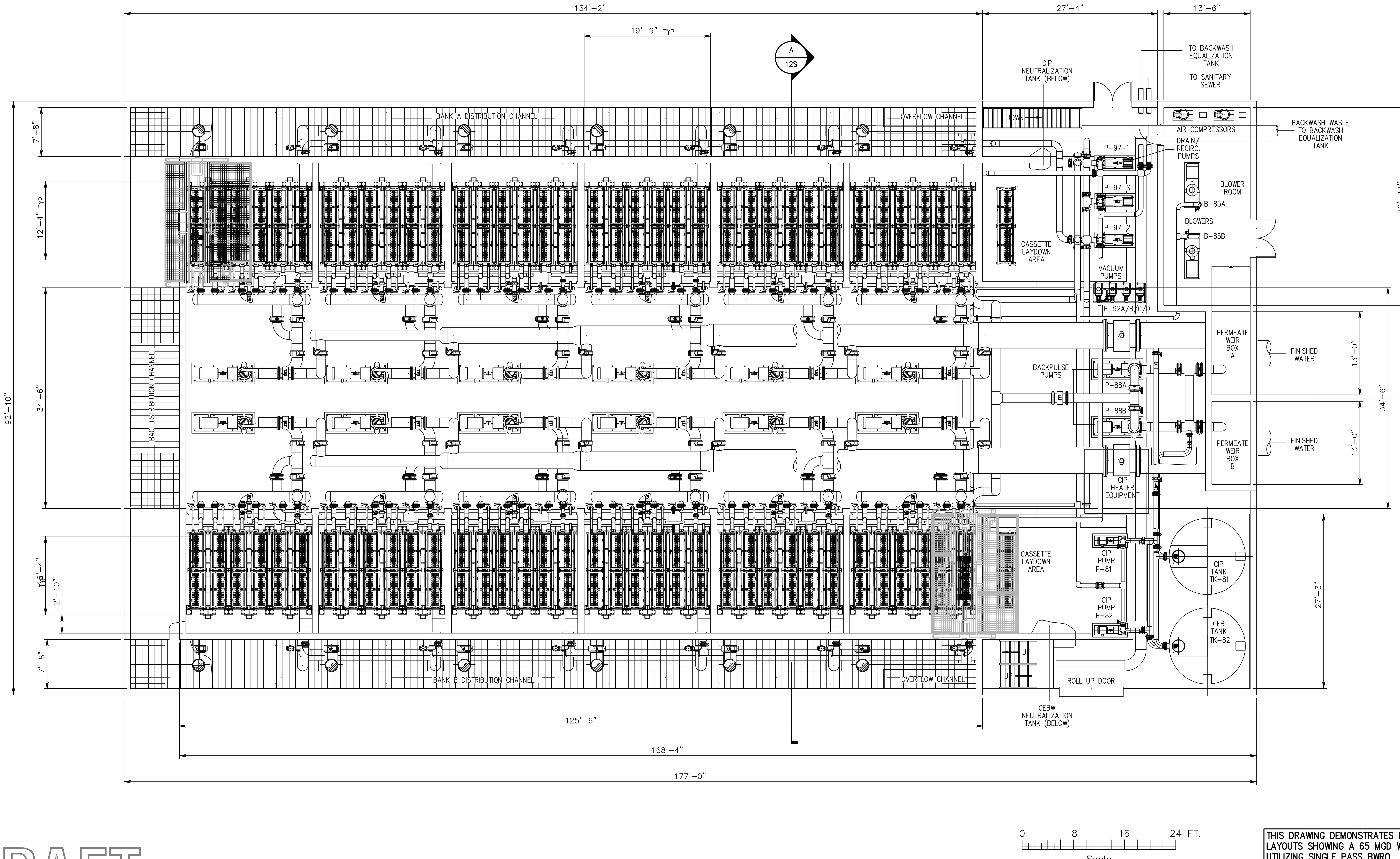
PROJECT BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534	URS
SUBJECT BWRO 65 MGD STRAINER AND RAPID MIX BUILDING (130 MGD)	DATE	11/10/06	
DRAWN BY JDMc CHECKED BY JMC	DRAWING	10	

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	BWRO 65 MGD FLOCCULATION AND DAF (130 MGD)	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	11

URS



THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

PROJECT	BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534
SUBJECT	BWRO 65 MGD SUBMERGED UF BUILDING PLAN	DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	12

URS

TYPICAL SECTION OF SUBMERGED UF SYSTEM

A

SCALE: 1/4" = 1'-0"
SHT. 12

0 4 8 12 FT.
Scale: 1/4" = 1'-0"

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

DRAFT

PROJECT BAY AREA REGIONAL DESALINATION PROJECT		JOB NO	26814534
SUBJECT BWRO 65 MGD SUBMERGED UF SYSTEM SECTION		DATE	11/10/06
DRAWN BY JDMc	CHECKED BY JMC	DRAWING	12S

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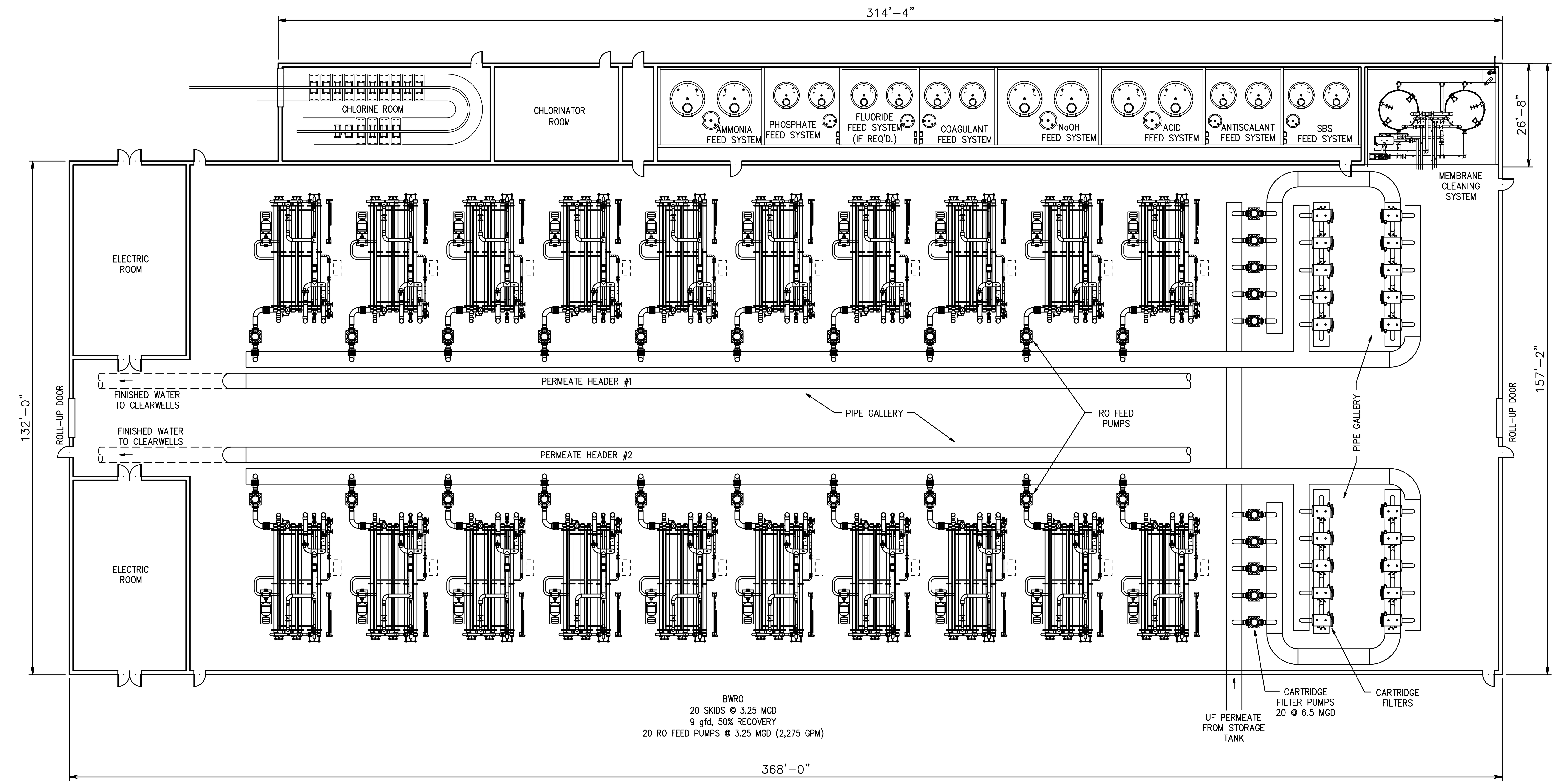


DRAFT

0 16 32 48 FT.
Scale

THIS DRAWING DEMONSTRATES ROUGH BUILDING LAYOUTS SHOWING A 65 MGD WATER PRODUCTION UTILIZING SINGLE PASS BWRO

PROJECT BAY AREA REGIONAL DESALINATION PROJECT	JOB NO	26814534	URS
SUBJECT BWRO 65 MGD RO TREATMENT BUILDING	DATE	11/10/06	
DRAWN BY JDMc CHECKED BY JMC	DRAWING	13	

PLOT INFO: MCCOY J:\26814534\WATER\PLANS\65MGD\DWG_13.DWG 02/16/07 7:40AM LTS: 1 PSLTS: 1

Appendix G

Wet Year Market Assessment Customer Survey Questionnaire

Bay Area Regional Desalination Project
Wet Year Market Assessment

Customer Survey Questionnaire

Water Needs

Do you have a current or future projected water supply shortage? If the shortage is expected in the future, when (what year) do you anticipate the need for additional water supply?

How much (in mgd) is the current or projected shortage?

Water Supply Timing/Flexibility

In what types of years (wet or dry) do you project a water supply shortage?

Is there any flexibility in timing the use of supplemental water supply? Examples include additional groundwater recharge using supplemental supplies during wet years to provide drought protection.

Does the supply need to be continuous and reliable or can the supply be interruptible given special arrangements?

Water Quality Requirements

Would a supplemental supply need to meet any special water quality requirements? If yes, please identify the water quality requirements.

Do any of your customers have specific water quality needs?

Do your water supply sources meet your current and future water quality needs? Are you pursuing ways to improve the quality of your water sources?

Water Transmission Requirements

Who is your water supplier?

Who do you supply water to?

How is water delivered currently to your system? (major transmission lines)

Do you have interties with any neighboring cities or water agencies?

Price

What is the cost range of your treated water?

What is the breakdown of your cost range (e.g., groundwater pumping charge, transmissions, treatment, distribution)?

Would you consider an alternate source of water if the cost was lower or competitive?

Would you be willing to pay a premium for ultra-pure water (e.g., for industrial applications)?

General Interest & Institutional Feasibility

Are you interested in pursuing opportunities to receive water supply from the Bay Area Regional Desalination Project?

Water Use Pattern

What is your water use pattern? Please fill in the table below.

Wet Year (af/yr)		**Normal Year** (af/yr)		**Dry Year** (af/yr)	
Jan (mgd avg)		Jan (mgd avg)		Jan (mgd avg)	
Feb (mgd avg)		Feb (mgd avg)		Feb (mgd avg)	
Mar (mgd avg)		Mar (mgd avg)		Mar (mgd avg)	
Apr (mgd avg)		Apr (mgd avg)		Apr (mgd avg)	
May (mgd avg)		May (mgd avg)		May (mgd avg)	
June (mgd avg)		June (mgd avg)		June (mgd avg)	
July (mgd avg)		July (mgd avg)		July (mgd avg)	
Aug (mgd avg)		Aug (mgd avg)		Aug (mgd avg)	
Sept (mgd avg)		Sept (mgd avg)		Sept (mgd avg)	
Oct (mgd avg)		Oct (mgd avg)		Oct (mgd avg)	
Nov (mgd avg)		Nov (mgd avg)		Nov (mgd avg)	
Dec (mgd avg)		Dec (mgd avg)		Dec (mgd avg)	

Appendix H

Public Outreach Materials

Bay Area Regional Desalination Project Fact Sheet

BAY AREA REGIONAL
Desalination Project

The Bay Area's four largest water agencies, Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District, are jointly exploring developing regional desalination facilities that would benefit the 5.4 million Bay Area residents and businesses served by these agencies.

Desalination removes salts from the ocean or brackish water to produce fresh water through distillation or filtration. The Bay Area Regional Desalination Project would provide an additional water source, diversify the area's water supply, and foster long-term regional sustainability. The project could consist of one or more desalination facilities, with an ultimate total capacity of up to 65 million gallons per day. The four partner agencies are focusing on optimizing technologies that minimize power requirements and environmental effects.

Three sites identified as possible locations

Goals and Benefits

- Provide additional sources of water during emergencies such as earthquakes or levee failures.
- Provide a supplemental water supply source during extended droughts.
- Allow other major facilities, such as treatment plants, water pipelines, and pump stations, to be taken out of service for maintenance or repairs.
- Reduce costs and minimize environmental impacts by leveraging existing water infrastructure as a regional partnership.

What's Been Done to Date

In May 2003, the partner agencies initiated a pre-feasibility study to determine if there were fatal environmental or technical flaws for a regional facility to serve all four partners. The study concluded there are at least three locations in the Bay Area where a regional desalination facility could be located. The agencies then conducted further analysis of these sites to better define project facilities, conveyance options, and institutional issues.

Project Partners

EBMUD

SFPUC Water Wastewater Power

Contra Costa Water District

Santa Clara Valley Water District

Fall 2006

Current Status

The agencies are now conducting a feasibility study to refine the institutional, technical, environmental and scientific merits of a regional facility. Public presentations and informational materials are being provided in Fall 2006 to let people know what's been done and next steps.

Next Steps

The agencies are planning to implement a pilot facility in 2007. The proposed pilot facility will be located in Contra Costa County to test pretreatment options, membrane performance, and approaches for brine disposal. Based on the results of the feasibility study and pilot study, the four partner agencies will determine the next step in proceeding with the comprehensive environmental study required for a full-size regional desalination facility.

Schedule

Pre-Feasibility Studies	2003 – 2005
Feasibility Study	2005 – 2006
Pilot Testing	2007 – 2008
Environmental Study	2009
Design	2010
Plant Construction	2012

Funding and Costs

The pre-feasibility studies were funded by the four partner agencies with costs shared equally (split four ways). The feasibility study is being funded by a grant administered by the California Department of Water Resources (DWR) through Proposition 50 — the Water Security, Clean Drinking Water, Coastal and Beach Protection Act passed by voters in 2002. The feasibility study costs $500,000, and the DWR grant represents 50% of the study estimate. In June 2006, the agencies were awarded an additional grant for close to $1 million for a pilot study. The complete pilot study is estimated to cost about $2 million.

Contact Us

We appreciate your interest in the Bay Area Regional Desalination Project.

Visit our website: www.RegionalDesal.com. To contact us, please email info@RegionalDesal.com.

Here are the ways you can stay involved:

- **Provide us your contact information (address and e-mail) to receive project updates and meeting notices.**
- **Attend a public meeting or presentation. Meetings will be noticed through the web site and other means.**

Open House Notification Materials

public meeting

title **San Francisco Bay Regional Desalination Project Feasibility Study**

who Santa Clara Valley Water District

what Public Open House

when Wednesday, October 11, 2006 7p.m.-8:30 p.m.

where Santa Clara Valley Water District Board Room
5700 Almaden Expressway
San Jose , CA 95118

why Santa Clara Valley Water District, San Francisco Public Utilities Commission, East Bay Municipal Utilities District and Contra Costa Water District invite you to a meeting regarding the feasibility of a proposed regional desalination facility to serve the San Francisco Bay area. These four agencies serve over 5.4 million Bay Area residents and businesses. The goal and benefits of the San Francisco Bay Area Regional Desalination Project are to provide an additional source of water during emergencies such as earthquakes or levee failures, provide a supplemental water supply source during extended droughts, allow other major facilities, such as treatment plants, water pipelines, and pump stations, to be taken out of service for maintenance or repairs, and to increase supply reliability. The agencies welcome your thoughts about the feasibility of a regional desalination facility. Public input is very important and will be reviewed and considered as we move forward.

For more information about this meeting or this project, contact Project Manager and Senior Engineer Pam John at (408) 265-2607, ext. 3003.

www.RegionalDesal.com

Santa Clara Valley Water District[SM]

2 column x 6 (3.75 x 6) • SJ Mercury

BAY AREA REGIONAL Desalination Project

You are invited to attend an upcoming public forum to learn about the Bay Area Regional Desalination Project.

The Bay Area's four largest water agencies, Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District, are jointly exploring regional desalination facilities that would benefit the 5.4 million Bay Area residents and businesses served by these agencies.

The goal and benefits of the San Francisco Bay Area Regional Desalination Project are to provide an additional source of water during emergencies such as earthquakes or levee failures, provide a supplemental water supply source during extended droughts, allow other major facilities, such as treatment plants, water pipelines, and pump stations, to be taken out of service for maintenance or repairs, and to increase supply reliability.

The partner agencies welcome your thoughts about the feasibility of a regional desalination facility. We encourage you and other representatives from your organization to attend either of the following meetings:

Public Open House

Wednesday, October 11, 2006
7pm – 8:30pm
Santa Clara Valley Water District Board Room
5700 Almaden Expressway, San Jose

Presentation at the Bay Area Water Forum Meeting

Monday, October 30, 2006 *(note change from tentative date of Oct. 23)*
10:30am – 1:30pm (presentation at 11am)
Harris State Office Building, 1515 Clay St., Oakland

Please visit our project web site, www.RegionalDesal.com, for more information and dates of future public forums. If you have any questions or comments, please email info@RegionalDesal.com.

Santa Clara Valley Water District
MEDIA ADVISORY

What: Public open house meeting on the feasibility of a four-county water-desalination plant project

When: 7-8:30 p.m., Wednesday, Oct. 11

Where: Santa Clara Valley Water District, 5700 Almaden Expressway (one block south of Blossom Hill Road), San Jose

Why: To inform the community of the feasibility project currently under way, and to solicit community reaction and ideas

Contact: Mike Di Marco, (408) 314-0559

Regional desalination plant eyed as potential emergency source of water for Santa Clara County

SAN JOSE — The Santa Clara Valley Water District is participating in a regional study to determine whether building a desalination plant in the Bay Area could keep water taps flowing in Santa Clara County during an emergency.

The California Department of Water Resources has awarded a $250,000 grant to a regional consortium comprised of the Santa Clara Valley Water District, San Francisco Public Utilities Commission, East Bay Municipal Utility District and Contra Costa Water District to evaluate the feasibility of a regional desalination facility in the Bay Area. The grant represents half the cost of the feasibility study.

The Department of Water Resources has also notified the four-agency partnership that it will grant almost $1 million towards building a $1.9 million small-scale desalination pilot plant.

The partnership is evaluating desalination as an additional source of water during emergencies, such as earthquakes or levee failures. In addition, desalination is being evaluated as a potential supplemental source of water during extended droughts and for its ability to increase water supply reliability.

The regional desalination facility could supplement the water needs of more than 5 million households and businesses served by the consortium.

Pooling the four agencies' resources and leveraging their existing water infrastructure is expected to reduce potential environmental effects of a desalination plant and reduce energy demands that would be required for four separate desalination projects within a small geographic area.

Over the past three years, the four agencies conducted a pre-feasibility study to rule out any environmental or technical flaws that could doom a regional plant. The pre-feasibility study concluded that there are at least three locations in the Bay Area suitable for a regional desalination plant.

The Santa Clara Valley Water District manages Santa Clara County's wholesale drinking water resources, coordinates flood protection for its 1.7 million residents and provides stewardship for the county's 10 reservoirs and more than 800 miles of streams.

www.valleywater.org

Open House Exhibit Boards

BAY AREA REGIONAL Desalination Project

Welcome

A partnership between:

CONTRA COSTA WATER DISTRICT

EBMUD

SFPUC
WATER
WASTEWATER
POWER

Santa Clara Valley Water District

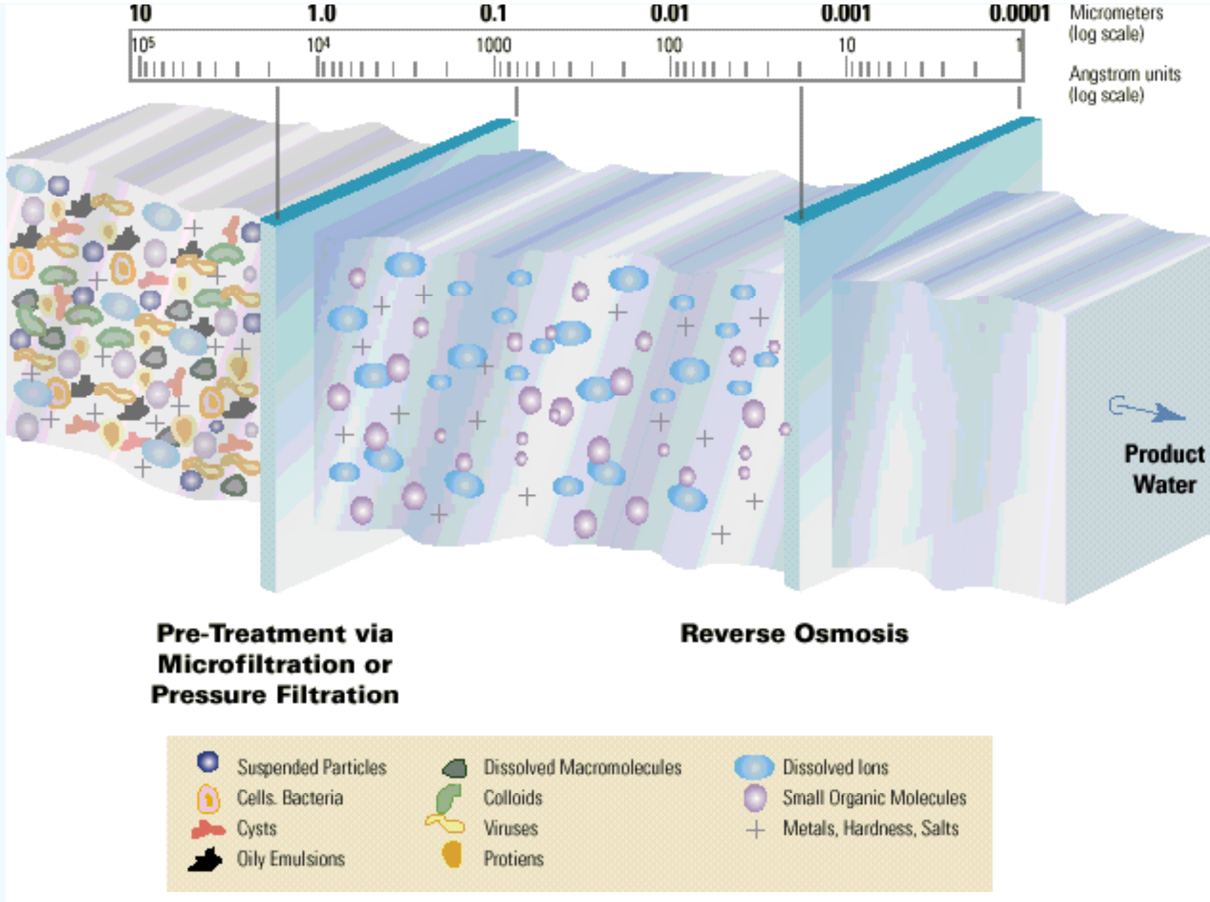
How to Participate

- Talk to Staff
- Write Down Your Comments
- **Visit Our Website:** www.RegionalDesal.com
- **Email Us:** info@RegionalDesal.com

What is Desalination?

Some Facts:

- Removes salts from the ocean or brackish water to produce fresh water through distillation or filtration
- NOT a new technology!
- 1,500 plants in the USA
- Over 15,000 plants worldwide
- 60% are seawater desalination plants



CONTRA COSTA WATER DISTRICT

SFPUC WATER WASTEWATER POWER

EBMUD

Santa Clara Valley Water District

How Does Reverse Osmosis Work?

Reverse osmosis (RO) is a water treatment process in which seawater or brackish water is forced through a semi-permeable membrane that has very small holes.

The membrane blocks impurities, including salts, that are too big to pass, thereby creating freshwater.

Brine, the concentrated salt water that is left behind, is diluted and discharged.

Water Quality

Desalination produces high quality drinking water

- Intake screening protects fish and removes large particles
- Pretreatment filtration removes sediments, bacteria and viruses
- Solids are sent to a landfill
- Reverse osmosis (RO) desalination removes salts and other dissolved contaminants
    - First pass RO removes 99.6%
    - Second pass RO removes 99.9%
- Post treatment adds minerals to match the taste of existing water
- Approximately 100 compounds require monitoring per State and Federal regulations
- Tests show desalinated water exceeds State and Federal water quality requirements

Project Description

- **The Bay Area's four largest water agencies** — the Contra Costa Water District, the East Bay Municipal Utility District, the San Francisco Public Utilities Commission, and the Santa Clara Valley Water District — are jointly exploring a regional desalination project that would provide an additional water source, diversify the area's water supply, and foster long-term regional sustainability
- **The Bay Area Regional Desalination project** could consist of one or more desalination facilities, with an ultimate total capacity of up to 65 million gallons per day
- **The four partner agencies** are focusing on optimizing technologies that minimize power requirements and environmental effects

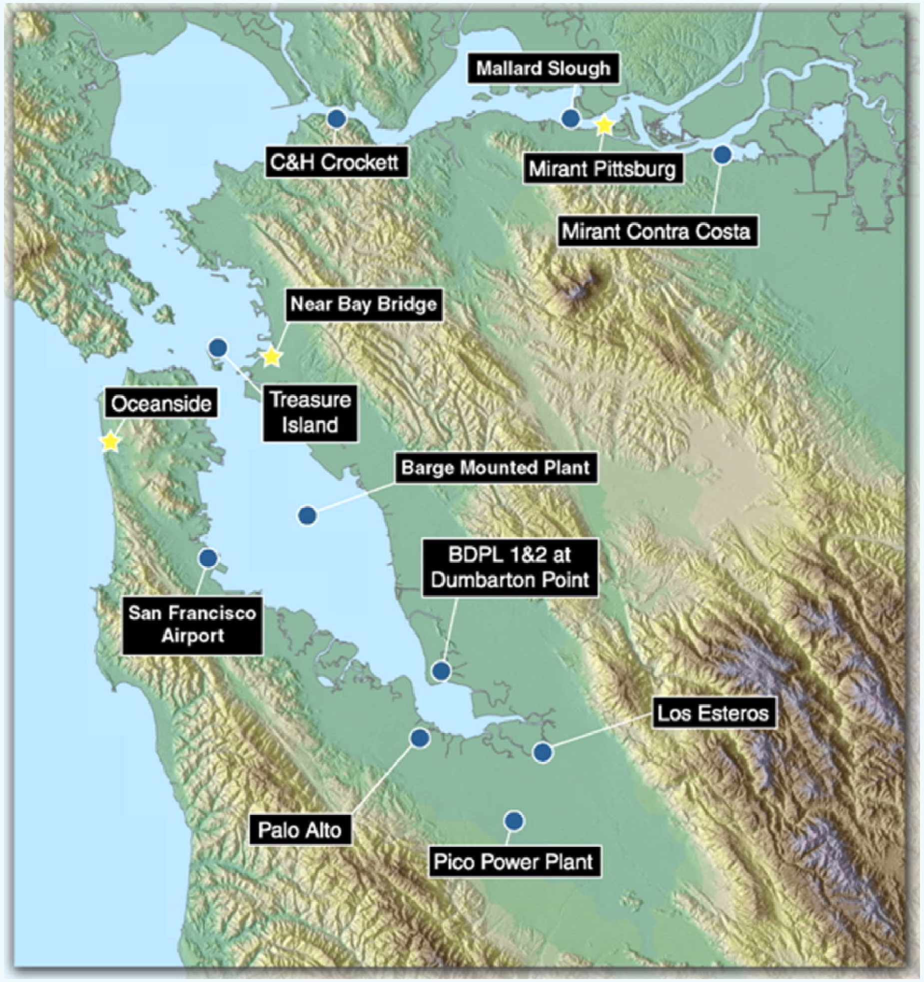
Goals and Benefits

- **Provide additional sources of water** during emergencies such as earthquakes or levee failures
- **Provide a supplemental water supply** source during extended droughts
- **Allow other major facilities**, such as treatment plants, water pipelines, and pump stations, to be taken out of service for maintenance or repairs
- **Reduce costs and minimize environmental impacts** by leveraging existing water infrastructure as a regional partnership

Potential Issues

- **Water Rights**
  - Challenges and cost to establish new or modify existing rights
  - Complexities in facilitating partner exchanges and transfers
- **CEQA/Permitting Issues**
  - Wide range of studies and permits, potentially high mitigation costs
- **Power Costs**
  - Rising energy costs could reduce desalination appeal
- **Brine Discharge**
  - Potential for outfall, permitting and environmental issues

Locations Identified in Pre-Feasibility Studies



Possible Sites Evaluated Further

Oceanside

Pros:

- Existing outfall structure
- May be easiest to permit

Cons:

- Source water quality most saline
- Need to construct intake structure
- No near economical energy source

Cost: $2700/acre-ft

Oakland Bay Bridge

Pros:

- Large site
- Existing outfall structure
- Close to EBMUD transmission facilities

Cons:

- Need to construct intake structure
- Not near economical energy source
- Source water quality more saline

Cost: $2500/acre-ft

East Contra Costa

Pros:

- Large site
- Existing intake and outfall structures at power plants
- Low salinity source water
- Economical energy source
- Close to CCWD and EBMUD transmission facilities

Cons:

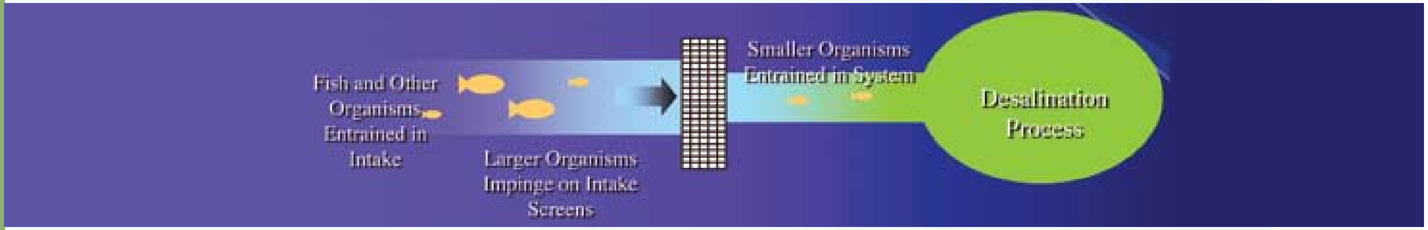
- Need water rights for consumptive use
- More stringent discharge standards in Delta

Cost: $500–$1200/acre-ft

Environmental Issues

Source Water Intake Issues

- Intakeof water removes small organisms (entrainment)
- Suction at intake can pin fish to the screen (impingement)
- Protective screens installed near intake can minimize these impacts



Brine Discharge Issues

- Concentrated saltwater called brine is a by-product of desalination
- 40–50% of intake water becomes brine
- Brine is usually discharged back into receiving water through an existing industrial or wastewater outfall, where it is mixed with the existing outfall's water
- This results in water with similar salinity to the receiving water but fewer contaminants such as heavy metals that are removed during pretreatment
- Testing is conducted on the brine mixture to determine what effects, if any, it could have on the quality of the receiving water and on the aquatic life in that water

Schedule

We are here ⇨

Pre-Feasibility Studies	2003 – 2005
Feasibility Study	2005 – 2006
Pilot Testing	2007 – 2008
Environmental Study	2009
Design	2010
Plant Construction	2012

Funding and Costs

- The pre-feasibility studies were funded by the four partner agencies with costs shared equally (split four ways)
- The feasibility study is being funded by a grant administered by the California Department of Water Resources (DWR) through Proposition 50 — the Water Security, Clean Drinking Water, Coastal and Beach Protection Act passed by voters in 2002
- The feasibility study costs $500,000, and the DWR grant represents 50% of the study estimate. In June 2006, the agencies were awarded an additional grant for close to $1 million for a pilot study
- The complete pilot study is estimated to cost about $2 million

Possible Cost Scenarios

Plant Configuration	East Contra Costa Site (ECC)				Near Bay Bridge Site (NBB)		Oceanside Site	
	All Year Operation		Dry-Years Operation Only		Dry-Years Operation Only		Dry-Years Operation Only	
	Wet Year	Dry Year	Wet Year	Dry Year	Wet Year	Dry Year	Wet Year	Dry Year
10MGD ECC all years, 55 MGD ECC dry years only	$486	$586	$0	$1,179				
25MGD ECC dry years only, 40 MGD NBB dry years only			$0	$1,303	$0	$2,527		
35MGD ECC dry years only, 30 MGD Oceanside dry years only			$0	$1,266			$0	$2,694

Appendix I

Detailed Scope for Environmental Impact Analysis

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I.1 INTRODUCTION

This section discusses the environmental review and permitting steps that would be required to establish a desalination plant at the East Contra Costa site. Construction and operation of the plant would require compliance with CEQA along with several other environmental laws, rules, and regulations. An Environmental Impact Report (EIR) and various technical reports would have to be prepared. The technical reports would be prepared to both support the EIR and to support obtaining various permits and approvals associated with the BARDP. One of the agencies would perform the role of the lead CEQA agency.

It is likely that the BARDP would require a permit from the USACE under Section 404 of the federal Clean Water Act. It is expected that the USACE would serve as the federal lead agency for compliance with federal laws and regulations, such as Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, and NEPA. The agencies' roles in assisting the USACE in compliance with these laws and regulations are described in greater detail below.

I.2 PROJECT UNDERSTANDING

The agencies would develop a narrative that would describe the background information and process that has led to the agencies' determination of investigating the use of desalination as an option for supplementing current water supply.

I.3 CEQA COMPLIANCE APPROACH

In general, the approach for CEQA compliance would involve the development of an EIR, the development of various focused technical studies to support the EIR, and the involvement of the public in the decision-making process. The technical studies would be designed to both provide analyses and supportive documentation to the statements made in the EIR and provide adequate information for obtaining any necessary permits and complying with all applicable local, state, and federal environmental regulations. For example, most outfall analyses are performed for worst-case conditions using average flows. However, a more realistic methodology that captures the seasonal variability of the Bay will be more defensible to agencies such as NOAA Fisheries, which may review and comment on the Draft EIR and may also need to approve the project under Section 7 of the Endangered Species Act. With this in mind, a probabilistic method that will incorporate the variability into the result would be a more appropriate methodology.

The individual tasks for completing the EIR are described below.

I.4 ENVIRONMENTAL IMPACT REPORT

I.4.1 Task 1: EIR Scoping

To initiate the CEQA process, a Notice of Preparation (NOP) would be prepared and sent to the State Clearinghouse and to the applicable federal, state, and local agencies and others on the agencies' mailing list to inform them of the project and EIR preparation and to solicit comments on the scope of the environmental analysis.

The NOP would contain the following information:

- Brief description of the proposed project
- Map showing the location of the proposed project
- Relevant environmental issues
- Probable environmental effects
- Dates and locations of scoping meetings

Scoping meetings would be conducted: one for the resource agencies and one for the general public.

After the NOP review period (30 days), the agencies would review responses to the NOP as well as the comments received at the scoping meetings. The issues identified by the agencies and the public would be summarized.

Based on the agency and public scoping meetings and review of the NOP responses, the agencies would finalize the EIR scope, as necessary.

I.4.2 Task 2: Prepare Administrative Draft EIR (ADEIR)

An Administrative Draft EIR (ADEIR) would be prepared that will meet the requirements of CEQA. The basic components of the EIR are described below.

I.4.2.1 Project Description

A detailed project description of the proposed BARDP would include a description of the precise location and boundaries of the project; a statement of objectives of the project; a general description of the project's technical, economic, and environmental characteristics; the intended uses of the EIR; the agencies that are expected to use the EIR in their decision-making; the permits and other approvals required to implement the project; and the related environmental review and consultation requirements.

I.4.2.2 Environmental Setting, Impacts, and Mitigation Measures

The main body of the EIR would focus on the environmental resources of the project area, including air quality, biological resources, and the other topics listed below, and how the proposed project could potentially affect these resources.

Impacts associated with construction and operation of the desalination plant and appurtenant facilities, as well as any required system upgrades, would be assessed.

If any significant impacts are identified, mitigation measures will be recommended to reduce the impacts to less than significant. The BARDP is committed to minimizing the environmental footprint of the regional desalination project. To this end, the EIR will investigate best available technologies for use of renewable energy sources, processes efficiency to minimize energy consumption, alternative means for brine disposal and/or brine reuse, and other potential mitigation measures.

The specific issues to be addressed for each environmental topic are described below.

Aesthetics

Specific objectives of the aesthetics task would be to identify visual resources of the project site; conduct visual impact analyses of the project facilities; and provide recommendations concerning design features to minimize adverse visual impacts. Major issues would be the size and scale of project facilities with respect to surrounding facilities and structures, and the degree to which the project has the potential to dominate the surrounding landscape. The existing visual setting of the project area would be described. This would include identification of any scenic resources that may be present. The impact of constructing the desalination and appurtenant facilities to any identified scenic resources would be determined, and mitigation to reduce any potentially significant impacts would be recommended.

Air Quality

The objectives of the air quality task would be to describe the existing climate and air quality of the project area, identify key components of the project that would cause impacts to air quality, determine significant impacts on air quality, and develop mitigation measures for significant impacts. A qualitative analysis of construction related air quality impacts would be conducted using the Bay Area Air Quality Management District CEQA guidelines.

Biological Resources

The biological resources section would primarily summarize the information, assessments, and conclusions of several of the technical reports described below.

The most applicable marine biological baseline data would be used to describe the environmental setting. These sources would include technical reports prepared by local, state, and federal agencies, and information available from organizations such as the San Francisco Estuary Institute and the Regional Monitoring Program.

The existing environment would be characterized qualitatively and quantitatively. The qualitative descriptions would include preparation of general descriptions of habitat types with tables that would list sensitive species that are known to occur, or that have the potential to occur, in the project area. Distribution maps may be prepared for key species or communities as needed to illustrate proximity to project components.

The environmental setting would be described in terms of habitat types present, including special aquatic sites such as mudflats and wetlands, and communities and species present, including plankton, benthos, fish, birds, and marine mammals.

The principal issues are effects of intake location, design and operation, biofouling control measures, and discharge dispersion/dilution. Construction impacts are also an important consideration. Some of the key biological resources that could be affected are fish species such as Delta smelt, chinook salmon, and longfin smelt. Impact concerns regarding juvenile life stage of these species would focus on 1) intake location, 2) intake design, 3) intake operation, 4) mitigation of intake entrainment, 5) discharge characteristics, 6) effluent dispersion and dilution, and 7) construction.

During the preparation of the impact analysis, appropriate resource management agencies would be contacted to discuss the potential occurrence of sensitive biological resources and agency concerns over impacts that the proposed project may have on these sensitive resources. These agencies include the USFWS, CDFG, NOAA Fisheries, and other agencies. These discussions would also help to develop recommended actions to avoid sensitive areas, focus the impact analysis, and develop mitigation measures, if necessary.

The general approach to address biological effects would include the following.

Intake Location. The location of an intake structure is of concern with regard to the potential impacts of its design, construction, and operation. The magnitude and significance of potential adverse effects can be minimized if consideration is given to intake location during facilities design. A first-order priority would be given to obtaining data on biological resources that would have a bearing on the effects of alternate intake locations.

Intake Design and Operation. Marine organisms that are entrapped and entrained by an intake structure would likely experience 100 percent mortality. Thus, the intake design would be evaluated in terms of the potential effects on the species populations subject to losses. The potentially affected organisms include phytoplankton, zooplankton, ichthyoplankton, fish eggs and larvae, and juvenile and adult fishes. The analysis would estimate quantities of each organisms lost per year and correlate them to equivalent adults using life tables; the value of adults to their respective populations and to humans (economic value) would then be assessed. For purposes of the biological analysis, it would be assumed that intake design would follow CDFG fish screening criteria and other low-velocity design considerations.

Effluent Characteristics, Dispersion, and Dilution. Impacts on organisms in the receiving water of the brine discharge would be assessed. Potential impacts of the effluent would depend upon its constituents, their concentration and temperature, and dispersion and dilution characteristics.

Results of the dispersion and dilution modeling (described below under a Technical Study task) would determine which elements of the marine biota would be at potential risk of effects from the effluent. Potential impacts would be evaluated based on a review of applicable information on acute and chronic toxicity.

Construction. Construction impacts could result from trenching or dredging the channel for offshore intake pipelines, intake structures, anchoring barges, backfilling over pipes, or driving piles. The effects of benthic habitat loss, smothering, and turbidity in the water column would be assessed, as well as the potential effects of providing new types of habitats.

Terrestrial, Wetlands, and Special-Status Species. The objective of the terrestrial biological resources, wetlands, and special-status species evaluation would be to describe the existing biological resources that may be affected by the proposed project (including ancillary facilities). Issues that would be emphasized in the analysis include sensitive species, sensitive habitats, wetlands, and special-status species and habitats.

Mitigation. Potential mitigation measures would be identified. These measures may include intake location and design considerations (such as existing intake use), biofouling control measures, combined outfall discharge, minimizing turbidity during construction, construction during months of lower environmental sensitivity, using existing infrastructure, and other measures to reduce or eliminate any identified significant project impacts, if possible.

Cultural Resources

In conformance with the requirements of CEQA, the EIR would include an analysis of potential effects to cultural resources that might occur in the project area. Cultural resources include prehistoric and historic archaeological sites, historic architectural and engineering remains, historic landscapes, and sites of significance to traditional Native American or other ethnic lifeways. The cultural resources section would primarily summarize the information, assessments, and conclusions of the technical report described below.

Energy

A technical report would be prepared to thoroughly assess the effects of the proposed project on energy resources. This section of the EIR would summarize the information in the technical study to include the existing energy supplies in the project area; the project's effects to energy supplies and energy resources; a determination of whether the project would contribute to a wasteful, inefficient, and unnecessary consumption of energy; and any appropriate mitigation measures to reduce potential impacts. This section would also evaluate "green" energy alternatives.

Geology and Soils

The geology and soils section would address the applicable elements of the CEQA Checklist in Appendix G of the CEQA Guidelines and would primarily summarize the information, assessments, conclusions, and mitigation of the technical report described below.

Hazards and Hazardous Materials

Chemicals would be used and stored at the desalination plant. These chemicals and their storage and handling procedures would be described. Potential impacts associated with their storage and use would be identified. Potential impacts associated with transporting the chemicals to the plant site would also be assessed. Mitigation measures would be recommended to reduce any identified significant impacts.

The desalination plant may be sited where hazard materials are stored and used or have been stored and used in the past. A Phase One Environmental Site Assessment (described as a technical report below) would provide material that would be summarized in this section of the EIR.

Hydrology and Water Quality

Technical studies would be conducted to assess hydrological and water quality impacts associated with construction and operation of the intake and outfall structures. The results of these studies would be summarized in this section of the EIR.

Preliminary water quality objectives for the desalination product water would be developed. The product water quality objectives would be developed based on current and potential drinking water regulations and on existing water quality among the agencies.

The impact of source water quality on finished water quality and brine reject water would be evaluated. The analysis would also include a discussion of the ability of the RO process to filter out pollutants from the product water. The generic desalination systems and their inflow and outflow streams in terms of pre-treatment, treatment, and post-treatment that are required to achieve the product water quality objectives would be discussed. This evaluation would ascertain the need for a desalination pilot plant or the need to conduct bench tests.

In addition, the proposed composition of the intake structure screen, as well as the maintenance procedures for the intake, would be evaluated to determine if it would release metals into the

Bay. The impact to water quality from construction of the new intake structure would be assessed.

Elements of the proposed project may occur in the Federal Emergency Management Agency (FEMA) 100-year floodplain. It is assumed that the desalination plant would be constructed such that the facility is protected from flood damage and does not exacerbate flood hazards or is out of the 100-year floodplain. Therefore, an analysis would need to be conducted to analyze tide levels and 100-year storm flows to determine the impact of a proposed facility on the floodplain. The facility would need to meet all National Flood Insurance Program requirements and the standards of the applicable county's floodplain management ordinance.

Potential effects to the surface hydrology of the proposed project site and vicinity due to construction of the desalination plant would also be assessed. Potential impacts to water quality resulting from construction and operation of the desalination plant would be described, and mitigation measures would be recommended to reduce any identified significant impacts.

Land Use and Planning

A technical report would be prepared to thoroughly assess the effects of the proposed project on land use planning and growth inducement. The land use and planning section of the EIR would summarize the information in the technical report, including a description of existing land uses at and adjacent to the proposed project site, potential natural buffer zones and sensitive land uses, and whether the project may affect existing and planned land uses in or around the project vicinity.

Noise

The noise analysis would focus on effects of project-related noise on sensitive receptors, such as residences, schools, churches, hospitals, and recreation areas. Noise from construction activities and operation of the desalination plant would be evaluated to determine if it would result in a significant noise impact to sensitive receptors. No baseline measurements or modeling would be necessary or conducted. If significant noise impacts to sensitive receptors are identified, mitigation measures to reduce those impacts would be recommended.

Population and Housing

A technical report would be prepared to thoroughly assess the effects of the proposed project on land use planning and growth inducement. This section of the EIR would summarize the information and analyses contained in the technical report to address the applicable items of the CEQA Checklist in Appendix G of the CEQA Guidelines.

Public Services

Existing levels of community services including schools, law enforcement, emergency medical, and fire protection would be described for those services potentially demanded by the project facilities and during construction by the work crews. The EIR would assess the project's effects on the staffing, equipment, and facilities of the existing community services.

Recreation

The recreation analysis would describe recreation opportunities of the area of the proposed project site and assess the potential impacts of the proposed project.

Transportation and Traffic

The transportation and traffic analysis would assess the effects of construction- and operation-related project traffic on the existing transportation and traffic infrastructure. No traffic counts or modeling would be conducted. Issues to be addressed in the analysis include:

- Potential traffic impacts to the local roadway system caused by construction-related project traffic
- Potential traffic impacts to the local roadway system caused by operation-related project traffic
- Potential effects to local transportation systems caused by disruption of the roadway network caused by construction of ancillary facilities such as pipelines

If significant transportation or traffic impacts are identified, then mitigation measures would be recommended to reduce those impacts.

Utilities and Service Systems

The proposed project may result in the expansion of existing utilities and service systems. This section of the EIR would describe the existing wastewater and water supply systems that may be used for operations of the desalination plant, the effects of the proposed project on these systems, and any applicable mitigation measures that may be employed, if necessary, to reduce these potential effects. In addition, the effects of the proposed project on landfills that would serve to dispose of solid wastes generated by the desalination plant operations would be analyzed and described.

I.4.2.3 Alternatives

In addition to the "No Project" alternative, the EIR would analyze other build alternatives. In accordance with CEQA, the alternatives would focus on avoiding or reducing the significant impacts (if any) of the proposed project, while feasibly attaining most of the project objectives. Other alternatives may be developed during the scoping process. If so, they may be included for examination in the EIR if the agencies determine that this action is warranted.

A comparative evaluation of each alternative would be provided for each environmental topic. The Alternatives analysis would be less detailed than the analysis of the proposed project, but would include quantitative information where such information would assist in comparing impacts. A summary matrix comparing the project and alternatives would be provided.

The Alternatives section of the EIR would also include a discussion of alternatives considered but not brought forward for detailed analysis. This discussion would summarize alternatives considered by the agencies in the *Bay Area Regional Desalination Project Pre-Feasibility Study* (URS 2003) that were not among the three top-ranked site locations.

I.4.2.4 Growth-Inducing Impacts

A technical report would be prepared to thoroughly assess the effects of the proposed project on land use planning and growth inducement. The discussion of growth-inducing impacts in the EIR would focus on removal of an impediment to growth (e.g., establishment of essential public service to an area or the increase of that public service). It would also focus on the planning tools and processes that are in place in the agencies' service areas that help govern growth. Although the proposed project, as currently envisioned, would only serve water to the BARDP partner agencies during dry and critically dry years, it is possible that the proposed project could be used to supplement other agencies or private customers during normal and wet years. As such, a discussion of potential growth inducing impacts would be warranted.

I.4.2.5 Other CEQA Considerations

Cumulative Impacts

The EIR would discuss whether the incremental effects of the proposed project in combination with other projects in the region would result in cumulatively considerable impacts. This section would be focused on cumulative effects to biological resources, water quality, energy, population, housing, and growth inducement. The effects from other planned projects with the potential for overlapping impacts would be considered. Other planned projects in the region that would result in the removal of an impediment to growth would be addressed. If necessary, feasible mitigation measures would be proposed to reduce the effects of the identified cumulative impacts.

Significant Irreversible Changes

This section of the EIR would focus on the use of non-renewable resources for the project.

Impacts Found Not to Be Significant

Any impacts of the project found not to be significant would be discussed briefly in this section.

I.4.3 Task 4: Prepare Draft EIR and Mitigation Monitoring and Reporting Program

This task would include the following subtasks:

- Revising the ADEIR in response to comments from agency staff.
- Completing final revisions to the ADEIR and preparing the public Draft EIR.
- Preparing a Mitigation Monitoring and Reporting Program that identifies the timing, reporting methods, responsibility, compliance verification and monitoring performance standards.

I.4.4 Task 5: Prepare Draft Reponses to Comments and Final EIR

Following the close of the public review period and receipt of all comments on the Draft EIR, the comments would be reviewed and approaches for developing key responses would be made by the applicable staff of the agencies.

A Final EIR Addendum would be prepared that would consist of 1) the Responses to Comments and 2) revisions to the Draft EIR to reflect these responses.

I.5 NATIONAL ENVIRONMENTAL POLICY ACT

The proposed project would require a permit from the USACE under Section 404 of the federal Clean Water Act. In applying for a Section 404 permit, the agencies would intend for the USACE to serve as the lead Federal Agency for the proposed project. In this role, the USACE would need to comply with NEPA. Also, if federal funding were obtained for the proposed project then the federal agency administering the funding would be required to comply with NEPA. An Environmental Assessment or Environmental Impact Statement (EIS) would be required to comply with NEPA. If either of these documents would be prepared, the agencies would integrate this NEPA document and the NEPA process into the EIR and CEQA process (e.g., prepare a joint document).

Under NEPA, the scope of the alternatives analysis described above would be increased. Each alternative, including the No Project alternative, would be analyzed as rigorously as the proposed project. The technical reports would also analyze the alternatives as rigorously as the proposed project. Mitigation measures would be proposed for all alternatives. Other NEPA components would also be included in the joint NEPA/CEQA document, such as a “Purpose and Need” statement and an environmental justice analysis.

A socioeconomic analysis and environmental justice analysis would be integrated into the Land Use Planning and Growth Inducement Technical Report. The environmental justice analysis would be adequate to comply with Executive Order 12898. These analyses would be summarized in the NEPA aspect of the NEPA/CEQA joint document.

If an EIS is prepared, many of the steps in the EIS NEPA process would be integrated into the EIR CEQA process. For instance, the Notice of Intent to prepare an EIS would be prepared and released in conjunction with the Notice of Preparation and the scoping process, and scoping meeting(s) under NEPA would correspond with the scoping process under CEQA.

I.6 TECHNICAL STUDIES

Technical studies would be required to support the CEQA and NEPA documents and the environmental permit applications and/or approvals such as the NPDES permit from the Regional Water Quality Control Board (RWQCB) and endangered species consultation with USFWS and NOAA Fisheries. These studies would focus on locating the desalination plant at the East Contra Costa site, but the studies would provide enough information to support the CEQA alternatives analysis described above. These studies are described below.

I.6.1 Dilution Modeling of Brine Discharge Through Outfall

One of the main concerns regarding the desalination project is the disposal of the brine concentrate. The efficiency of desalination can be approximated as 50 percent or more, depending on the source water; in other words, 50 gallons of potable water are produced for every 100 gallons of seawater. The remaining seawater consists of brine and solid waste. The brine solution generally has twice the salinity of the source water.

Discharge of liquid brine waste from desalination operations is regulated under the 1987 amendments to the Clean Water Act, through the NPDES administrated by the state’s nine RWQCBs. The key parameters that will be of concern to the RWQCB are:

- Dilution by the outfall
- Near-field/far-field mixing in the Bay
- Concentration of pollutants of concern

The objective of this task is to assess the impacts of discharging brine via an outfall into a receiving water body. Depending on the BARDP site, the brine could be combined with existing wastewater treatment effluent, cooling water or diluted with raw water before discharged.

Approach

To assess the impacts of discharging brine concentrate, dilution modeling of the discharge needs to be performed. However, to properly evaluate the dilution of such a discharge, the variability of several parameters needs to be considered and incorporated in the modeling. These parameters include both discharge parameters such as flow and discharge density (salinity and temperature) and environmental parameters such as current speed and stratification. The variability in discharge parameters is important because the traditional flows at the proposed project site vary during the day, whereas the brine concentrate flows may remain fairly constant. Therefore, the density of the discharge can vary during the day and in some cases vary from positively buoyant to negatively buoyant. In addition, the variability of estuarine stratification and current speed due to changing tides require assessing a wide range of model scenarios to capture any uncertainty associated with the modeling.

The modeling will result in series of dilution estimates for the various discharge and environmental parameters.

Specific tasks include the following.

I.6.1.1 Task 1: Compile Input Data

The modeling requires data on both the receiving water and the proposed outfall. The data needed for the receiving water include current speed and direction (tidal driven), salinity, and temperature. These parameters will have both daily and seasonal variations. Therefore, sufficient data to capture this variability must be compiled. The data needed for the proposed outfall include a time series of hourly flow rates during both wet and dry conditions, and the salinity (TDS), temperature, and concentrations of constituents of concern of the existing effluent.

I.6.1.2 Task 2: Develop Scenarios to Be Modeled

The compilation of input data would drive the scenarios chosen for modeling. It is likely that the scenarios would include both wet weather flow and dry weather flow through the outfall and high Delta discharge and low Delta discharge scenarios to capture the seasonal variation of the receiving water density.

These scenarios would include intraday variability in both tidal currents in the receiving water and wastewater effluent flow rates.

I.6.1.3 Task 3: Use Dilution Model to Assess Different Scenarios

Plume modeling is most often performed using an accepted model that has undergone rigorous review and testing. Several standard plume models have been approved for use by the U.S. Environmental Protection Agency (USEPA). The most recent USEPA model is the Visual Plumes (VP) model.

VP creates predictions for dilution, rise, diameter, and other plume variables. The Brooks algorithm is retained for predicting far-field centerline dilution and waste field width.

To assess the different scenarios developed under Task 2, a statistical method must be used, such that the variability of the input data is portrayed in the modeling. There are many methods to evaluate such variability including decision path and Monte Carlo.

This task would identify the dilution of the outfall discharge under various scenarios and determine whether any scenarios do not meet the RWQCB’s 10:1 dilution standard.

I.6.1.4 Task 4: Assess Operational Adjustments to Improve Dilution as Mitigation

After the modeling is performed, operational adjustments that might lead to better dilution would be considered. These operational adjustments may be considered as mitigation measures and might include premixing the brine with some additional source water for added dilution, or varying the brine discharge rate to coincide with the variations in the effluent discharge. A maximum of three operational adjustments would be considered for the scenarios where sufficient dilution was not achieved. This task would not be needed if the modeling shows that the outfall discharge meets all regulatory standards.

I.6.1.5 Task 5: Assess Water Quality Impacts

The San Francisco Estuary Institute regularly monitors a multitude of constituents in water at stations throughout the Bay as part of the RMP. Average, minimum, and maximum concentrations will be calculated from the RMP data, and these data will be used to estimate the concentrations in the brine that would be discharged from the desalination plant. The desalination plant would take in Bay water, remove all suspended solids, and generate a brine that concentrates all the dissolved constituents into approximately half the volume of water.

The brine could be mixed with an existing discharger’s effluent and discharged to the Bay through their existing outfall, or the brine could be directly discharged into the Bay. RO brine concentrations (or brine/effluent concentrations) will be compared to water quality criteria, and mass loadings to the Bay will be calculated.

Theoretically, the RO brine would concentrate all the dissolved constituents into approximately half the water volume resulting in brine that has twice the dissolved concentration of the Bay water pumped into the plant. This approach would assume that the desalination plant would be operating at 100 percent capacity and would therefore be a conservative assumption.

Estimated brine concentrations will be compared to the lowest of the applicable California Toxics Rule Criteria and the Basin Plan WQOs. Brine concentrations will also be compared to the EPA National Recommended Ambient Water Quality Criteria when no California Toxics Rule criteria or Basin Plan WQOs exist.

The analytical methods, assumptions, and data used in assessing brine discharge impacts for both the pilot and full-scale desalination plant operations would be documented in a technical report. This information will be supplemented though conducting a literature review of other studies pertaining to impacts of brine discharges on water quality and aquatic life.

I.6.2 Fisheries Studies

It is recommended that entrainment sampling be conducted during the pilot plant operation at the intake both in the day and night during two seasons over a period of one year (4 four sampling events). Entrained fish eggs and larvae would be sampled by diverting water from the intake pipe, downstream of the positive barrier fish screen, into entrainment abundance sampling equipment. The diverted intake water would be discharged into a 363-µm mesh plankton net. Sample volume and flow rate will be recorded by a flow meter installed within the seawater intake line.

Source water sampling would be conducted four times during the study, concurrent with the intake entrainment sampling. This source water sampling will provide data to be used for empirical transport modeling and proportional entrainment estimates.

The protocols for collecting plankton samples during the entrainment study would be designed to provide useful data on vulnerability of different species and sizes of ichthyoplankton to entrainment through the aquatic filter barrier. The protocols also serve to reduce damage to organisms during sampling to facilitate taxonomic identification and processing.

Numbers of each species entrained into the seawater intake system during operation of the pilot plant and predicted entrainment assuming full-scale plant operations, with 95 percent confidence bounds, would be presented based on results of on the entrainment sampling results. The entrainment results would also include the calculation of equivalent adult losses, fecundity hindcast estimates, and the empirical transport model calculations of proportional entrainment impacts to local populations. The analytical methods, assumptions, and data used in assessing entrainment impacts for both the pilot and full-scale desalination plant operations would be documented in a technical report. This information will be supplemented though conducting a literature review of other studies pertaining to impacts of intakes on aquatic life.

I.6.3 Hazardous Materials (Phase One Environmental Site Assessment)

To support the preparation of the EIR and any permitting related to working and constructing the desalination plant in industrial areas where soil contamination may be present, a Phase One Environmental Site Assessment would be conducted. This investigation and the resulting report would be prepared to meet American Society for Testing and Materials standards. The purpose of this investigation would be to identify contamination sites that could be affected by the proposed project. The Phase One Environmental Site Assessment would also identify potential contaminants for the site(s) that should be investigated with field sampling.

I.6.4 Land Use Planning and Growth Inducement

A technical report would be prepared to support parts of the land use and planning section, the population and housing section, and the growth inducement assessment of the EIR. This report would determine if the proposed project would conflict with any applicable land use plans, policies, or regulations of a jurisdictional agency; and if or how the proposed project would indirectly result in the inducement of population growth in the region. This report would also address the incremental effects of the proposed project in combination with other projects in the region that would result in cumulatively considerable impacts as they relate to growth inducement.

The land use analysis would incorporate land use and zoning maps for the project area and the project's relationship with existing plans and policies. Background research would include a review of land use plans, coastal planning documents, area plans, zoning maps, resource management plans, and other relevant documents. Social resources data would be summarized in map and text forms. Land ownership status, existing land uses, General Plan land uses, and Williamson Act Lands would be evaluated. Conflicts with the current land use or any adopted plans in the area would be identified and discussed.

The analysis of growth inducement would focus on the effects of the removal of an impediment to growth (e.g., establishment of essential public service to an area or the increase of that public service). It would also focus on the planning tools and processes that are in place in the agencies' service areas that help govern growth.

The report would propose potential mitigation measures to lessen the impacts to land use, population, housing, or growth inducement, if desired. Mitigation measure may include new zoning ordinances or policies within the various jurisdictions affected by the proposed project.

I.6.5 Biological Assessment

To support the USACE's compliance with Section 7 of the federal Endangered Species Act, the agencies would prepare a Biological Assessment. The Biological Assessment would describe the potential of federally listed species to be affected by the construction and operations of the proposed project. Minimization, avoidance, and/or compensation measures would be described. The preparation of the Biological Assessment would be directed by early coordination with the USFWS and NOAA Fisheries to determine the best approach to determining effects and appropriate minimization, avoidance, and/or compensation measures. The fisheries studies described above would be used to support conclusions and measures as they relate to federally listed species analyzed in those studies. Depending on the proposed footprint of the desalination plant, protocol-level surveys may be necessary for various species to support the analyses and reporting in the Biological Assessment. The Biological Assessment would also contain analyses of impacts due to harassment to marine mammals protected under the Marine Mammal Protection Act, if applicable, to obtain a harassment permit from NOAA Fisheries.

I.6.6 Cultural Resources

To support the USACE's compliance with Section 106 of the National Historic Preservation Act, the agencies would prepare a Cultural Resources Technical Report. Preparation of this report would include the reporting of the results of background research, field surveys, and consultation with the appropriate Native American groups. The report would also include an Area of Potential Effects map, conclusions of potential effects to resources protected under the National Historic Preservation Act, and mitigation measures, if applicable. This report would also include any additional necessary material to support the Cultural Resources section of the EIR. If necessary, recommended mitigation measures could range from project facility design or location modification to avoid or protect the resource, to data recovery through archaeological excavation or other methods.

The project site would be characterized with regard to known and potential cultural resources through a literature search followed by an intensive pedestrian reconnaissance of those areas that have the potential to contain cultural resources. Archival data would be provided by the California Native American Heritage Commission and the Northwest Information Center of the California Historical Resources Information System.

Coordination with Native American groups or individuals identified by the Native American Heritage Commission would occur. A pedestrian archaeological survey would be made for all areas that have the potential to contain prehistoric or historic cultural resources.

I.6.7 Geotechnical Report

The Geotechnical Technical Report would be prepared with the objectives of evaluating the geological risks associated with seismic shaking from events along proximate faults, seismic-related ground failure, and impacts generated by expansive soils and/or liquefaction of soils that would be expected from development at each of the alternative sites under consideration. Potential impacts due to low slope stability (landslides) would also be analyzed. Both the probability of potential effects of geological hazards on the physical integrity of project facilities as well as the potential impact of the proposed project on its geological environment would be examined for inclusion in the EIR. Attention would be given to the possibility that existing potentially adverse conditions in and around the sites may be exacerbated by project implementation. Finally, appropriate mitigation measures would be recommended based on geotechnical and earthquake engineering input.

I.6.8 Energy Report

The Energy Technical Report would contain a thorough analysis of the projected energy expenditures to operate the desalination plant. The report would include calculations of energy use and energy costs. Several energy sources would also be described, and the associated price differences of these sources would be compared. The study would also investigate best available technologies for use of renewable energy sources and processes efficiency to minimize energy consumption. The report would support conclusions as to whether the proposed project would result in a wasteful, inefficient, and unnecessary consumption of energy. If applicable, mitigation measures would be suggested to reduce any potential impacts.

I.7 PERMITTING

Major permits or approvals that will likely be required for the BARDP include:

- NPDES Permit from the San Francisco RWQCB
- Section 401 Water Quality Certification from the San Francisco RWQCB
- Section 404 Permit from the USACE
- Permit from the BCDC

- Consultation with the USFWS and NOAA Fisheries in accordance with Section 7 of the Federal Endangered Species Act
- Consultation with CDFG through the Federal Endangered Species Act Section 7 consultation process for state-listed threatened or endangered species
- Permit from the State Lands Commission if a portion of the project is on state land

Information gathered from the environmental impact analyses and technical studies discussed above would be used in these permit applications.

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