

## Appendix A: Cost Data

A cost effectiveness analysis expresses the long-run cost of an alternative on a consistent basis using common benchmarks. For this Feasibility Study, the annualized sum of the capital and operations and maintenance (O&M) costs for each alternative were compared. The following procedure was used to determine the cost effectiveness of each alternative:

- Life-cycle costs for the project's capital, reoccurring, and O&M expenditures were developed using a 20-year project life.
- The total costs for each year were discounted to present-day (2004) dollars using a discount rate of 5.625 percent.
- The net present value of each alternative was calculated based on a 20-year project life and 5.625 percent discount rate.
- This net present value was then expressed on an annual basis by amortizing the value over 20 years at the above mentioned discount rate.

The baseline capital and O&M costs for each alternative were based on general project descriptions and the technical specifications presented in the Evaluation of Technologies section of the main report. Unit costs were determined based on previous cost estimates, several of which were obtained from projects located within the vicinity of the San Joaquin River. Other unit costs were obtained from vendors and other sources.

Several assumptions were made to extend the baseline costs over the life of the project. The main assumptions are as follows:

- Construction costs were grouped into a number of categories, including Site Work, Concrete, Masonry, Finishes, Equipment, Special Construction, Mechanical, and Electrical and Instrumentation. A number of project components will require replacement during the 20-year project life. It is assumed that the pump motor, impeller, and diffuser lateral pipe would each need replacement once, at 10 years of operation. The oxygen diffusers for the Speece Cone and U-tube would need to be replaced every 5 years.
- The total construction costs have a lump sum contingency of 35 percent. These fees apply to years during which construction or replacement occurs.
- Other project costs including engineering, permitting and construction services are included as percentages of Total Construction Costs (10 percent, 7 percent, and 10 percent respectively).
- Annual O&M costs include Equipment Maintenance, Monitoring and Adaptive Management, Oxygen Tank Supply (i.e., rental), Oxygen Supply and Power Costs. Equipment Maintenance and Monitoring and Adaptive Management were calculated as a percentage of the total estimated capital expenses (3 to 10 percent for Equipment Maintenance and 2 to 3 percent for Monitoring and Adaptive Management). Equipment Maintenance percentages were applied to the major mechanical and equipment components. Adaptive Management percentages are applied to the total capital cost of the project. Reoccurring capital expenses, such as replacements, are presented in an individual category and not lumped into Equipment Maintenance line items. Other items are calculated based on yearly cost per unit.
- Power costs were calculated by converting the horsepower (hp) for each alternative to kilowatts (kW), and assumed the device would operate 24 hours a day for 100 days.

## U-TUBE COSTS

The main difference in costs among Alternatives A through D is the cost of the vertical turbine pumps. This is due to the difference in hp requirements for either one or two U-tubes of different sizes. Different sizes of U-tubes requiring differing diameters of pipe connecting to the diffuser pipe. This diameter varies from 10 to 30 inches and thus, yields differing costs. The Mobilization/Demobilization costs for Alternative D are slightly higher compared to other alternatives due to costs associated with installation of the larger outer diameter of the connecting pipe. Replacement costs are the same for all alternatives. Power costs vary due to the differing requirements for each alternative; Alternative A is 22 hp (16.4 kW), Alternative B is 36 hp (26.8 kW), Alternative C is 45 hp (33.6 kW), and Alternative D is 100 hp. The costs of power for each alternative are summarized in Table A-1.

**Table A-1. Summary of U-Tube Power Costs.**

U-Tube Alternative	Power (hp)	Power (kW)	Power Usage (kW-hr)	Annual Power Cost
A	22	16.4	39,380	\$2,370
B	36	26.8	64,430	\$3,870
C	45	33.6	80,540	\$4,840
D	100	74.6	178,970	\$10,740

## SPEECE CONE COSTS

The main difference in Equipment costs for Alternatives A through C is the cost for the 60 hp vertical turbine pumps associated with Alternative A, the 240 hp pump for Alternative B, and the 690 hp pump for Alternative C. Power costs are presented below in Table A-2.

**Table A-2. Summary of Speece Cone Power Costs.**

Speece Cone Alternative	Power (hp)	Power (kW)	Power Usage (kW-hr)	Annual Power Cost
A	60	44.7	107,380	\$6,450
B	240	179.0	429,520	\$25,780
C	690	514.5	1,234,880	\$74,100

Costs for Alternative C are much higher than costs for Alternatives A and B due to the larger required pump and fish screen requirements.

## BUBBLE PLUME

The bubble plume alternatives can be divided into two categories, those using air and those using pure oxygen. Alternatives A and B which use air have power requirements, while Alternatives C and D run on pure oxygen and therefore do not require power. Alternative B requires almost twice the power as Alternative A. The additional cost is shown in Table A-3 below.

**Table A-3. Summary of Bubble Plume Power Costs.**

Speece Cone Alternative	Power (hp)	Power (kW)	Power Usage (kW-hr)	Annual Power Cost
A	47	35	62,640	\$4,000
B	87	65	116,330	\$6,980

The diffuser hose for Alternative A is almost twice as long as Alternative B with lengths of 11,000 and 6,000 feet respectively. The difference in length yields a much higher cost for Alternative A at \$1,034,000 and Alternative B costing \$564,000. However, for Alternatives C and D the costs are much lower (\$22,800 and \$9,600 for Alternative D) because of the shorter length requirements of 1,900 and 800 feet respectively.

The Annual Cost for each alternative was discounted to account for the “real” time value of money. The sum of the annual discounted costs over the 20-year life-cycle of the project was converted to the present value of the total cost over 20 years, including capital costs, O&M, and periodic replacements. This cost is summarized in Table A-4, followed by detailed cost sheets for each alternative.

**Table A-4. San Joaquin River Aeration Engineering Feasibility Study - Cost Summary.**

Type	Alternative	Total Capital Costs	Present Value Recurring Expenses	Annual O&M Costs	Combined Annual Project Costs	Annual Cost Oxygen (per Unit)
U-Tube	A	\$ 1,855,000.00	\$ 69,000.00	\$ 137,000.00	\$ 300,000.00	\$ 0.30
	B	\$ 1,996,000.00	\$ 69,000.00	\$ 143,000.00	\$ 318,000.00	\$ 0.32
	C	\$ 2,022,000.00	\$ 71,000.00	\$ 163,000.00	\$ 340,000.00	\$ 0.34
	D	\$ 2,823,000.00	\$ 133,000.00	\$ 223,000.00	\$ 473,000.00	\$ 0.47
Speece Cone	A	\$ 1,875,000.00	\$ 71,000.00	\$ 152,000.00	\$ 317,000.00	\$ 0.32
	B	\$ 2,041,000.00	\$ 69,000.00	\$ 160,000.00	\$ 339,000.00	\$ 0.34
	C	\$ 3,349,000.00	\$ 129,000.00	\$ 270,000.00	\$ 565,000.00	\$ 0.57
Bubble Plume	A	\$ 2,859,000.00	\$ 688,000.00	\$ 215,000.00	\$ 515,000.00	\$ 0.52
	B	\$ 1,818,000.00	\$ 379,000.00	\$ 136,000.00	\$ 322,000.00	\$ 0.32
	C	\$ 948,000.00	\$ 237,000.00	\$ 218,000.00	\$ 319,000.00	\$ 0.32
	D	\$ 465,000.00	\$ 98,000.00	\$ 178,000.00	\$ 226,000.00	\$ 0.23

Notes: Discount Rate = 0.05625

**PRELIMINARY COST ESTIMATE**

**U-TUBE ALTERNATIVE A - TWO 2' OUTER DIAMETER  
(1' OUTER RADIUS) U-TUBES X 150 FT HEIGHT**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CALIFORNIA BAY DELTA AUTHORITY  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUL 6, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Cut/Fill	CY	\$ 5	725	\$ 3,625
2	Removable Bollards	EA	\$ 300	6	\$ 1,800
3	Fencing	LS	\$ 6,500	1	\$ 6,500
4	6" AB	CY	\$ 36	50	\$ 1,800
5	3" AC	SF	\$ 5	1600	\$ 8,000
<b>Division 3 - Concrete</b>					
6	O <sub>2</sub> Tank Slab	CY	\$ 500	18	\$ 9,000
7	Building Slab	CY	\$ 500	10	\$ 5,000
8	Wet Well	LS	\$ 6,500	1	\$ 6,500
<b>Division 4 - Masonry</b>					
9	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
10					
10	Coatings	LS	\$ 20,000	1	\$ 20,000
<b>Division 11 - Equipment</b>					
11	Vertical Turbine Pumps and Appurtenances	EA	\$ 26,800	2	\$ 53,600
12	Drill & Prep 2' Diameter U-Tube Shaft	FT	\$ 340	300	\$ 102,000
13	U-Tube Casing Material (Assume Welded Steel, 1")	LB	\$ 1	73,800	\$ 73,800
14	Install U-Tube Casing	FT	\$ 50	300	\$ 15,000
15	Install Bottom Plug (concrete and mortar)	CY	\$ 500	6	\$ 3,000
16	Pump Water from Shaft and Prepare Casing	LS	\$ 12,000	2	\$ 24,000
17	Bubble Collector and Appurtenances	EA	\$ 8,000	2	\$ 16,000
18	Oxygen Diffuser	EA	\$ 1,000	2	\$ 2,000
19	Fish Screen (Barrel)	EA	\$ 240,000	1	\$ 240,000
<b>Division 13 - Special Construction</b>					
20	Pressure Gages/Transmitters	EA	\$ 1,500	4	\$ 6,000
21	Flow Meter (10" Mag)	EA	\$ 13,500	2	\$ 27,000
<b>Division 15 - Mechanical</b>					
22	O <sub>2</sub> Supply Line Piping and Appurtenances	LF	\$ 12	200	\$ 2,400
23	O <sub>2</sub> Control Valve and Equipment	EA	\$ 3,000	2	\$ 6,000
24	10" Pump Control Valve	EA	\$ 9,000	2	\$ 18,000
25	Isolation Valves	EA	\$ 3,000	3	\$ 9,000
26	16" Ductile Iron Pipe (Header)	\$/Dia-In 16	\$ 144	20	\$ 2,880
27	10" Ductile Iron Pipe (Supply)	\$/Dia-In 10	\$ 90	20	\$ 1,800
28	16" Ductile Iron Pipe (Exhaust)	\$/Dia-In 16	\$ 144	40	\$ 5,760
29	16" Flexible Piping	\$/Dia-In 16	\$ 144	60	\$ 8,640
30	Inner Piping System (8 Inch)	\$/Dia-In 8	\$ 72	300	\$ 21,600
31	HDPE Diffuser Pipe (Assume 24" Dia)	\$/Dia-In 24	\$ 18	800	\$ 14,400
32	Pressure Regulating Station	EA	\$ 8,000	4	\$ 32,000
33	Diffuser Supports	EA	\$ 150	80	\$ 12,000
34	Lateral Installation	LF	\$ 94	800	\$ 75,200
<b>Division 16 - Electrical and Instrumentation</b>					
35	Supply	LS	\$ 50,000	1	\$ 50,000
36	Control Systems and Instrumentation	LS	\$ 40,000	1	\$ 40,000
37	Control Wiring	LS	\$ 7,500	1	\$ 7,500
<b>Rounded Subtotal*</b>					\$ 1,032,000

<b>General Contractor Indirect Costs</b>					
	Construction Management (Contractor)		2.5%	\$ 1,032,000	\$ 25,800
	Mobilization/Demobilization	LS	\$ 22,500	1	\$ 22,500
Rounded Subtotal*					\$ 49,000

<b>Total Construction Costs</b>					\$ 1,081,000
Contingencies				35%	\$ 378,350
<b>TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES*</b>					\$ 1,460,000

<b>Other Project Costs</b>					
	Engineering/SDC			10.0%	\$ 146,000
	Permitting			7.0%	\$ 102,200
	Construction Services/Inspections			10.0%	\$ 146,000
Rounded Subtotal*					\$ 395,000
<b>TOTAL ESTIMATED CAPITAL COSTS</b>					\$ 1,855,000

<b>RECURRING CAPITAL EXPENSES</b>		<b>REPLACEMENT INTERVAL</b>			
	Pump Motor	10	yrs		\$ 5,000
	Impeller	10	yrs		\$ 5,000
	Diffuser Lateral	10	yrs		\$ 101,600
	Oxygen Diffuser	5	yrs		\$ 6,000
<b>Total Recurring Capital Expenses</b>					\$ 118,000

<b>ANNUAL OPERATIONS AND MAINTENANCE COSTS</b>					
	Equipment Maintenance (Equipment and Mechanical)			3.0%	\$ 12,660
	Monitoring and Adaptive Management			2.0%	\$ 37,100
	Oxygen Tank Rental	Month	\$ 750	12	\$ 9,000
	Oxygen Supply (10,800 lbs/day)	lbs	\$ 0.07	1,080,000	\$ 75,600
	Power Costs	kW-hr	\$ 0.06	39,380	\$ 2,370
<b>Total Annual O &amp; M Costs*</b>					\$ 137,000

\*Rounded up to the nearest \$1,000.

**U-TUBE ALTERNATIVE B - ONE 3.5' OUTER DIAMETER  
(1.75' OUTER RADIUS) U-TUBE X 220 FT HEIGHT**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CALIFORNIA BAY DELTA AUTHORITY  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUL 6, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Cut/Fill	CY	\$ 5	725	\$ 3,625
2	Removable Bollards	EA	\$ 300	6	\$ 1,800
3	Fencing	LS	\$ 6,500	1	\$ 6,500
4	9" AB	CY	\$ 36	50	\$ 1,800
5	3" AC	SF	\$ 5	1600	\$ 8,000
<b>Division 3 - Concrete</b>					
6	O <sub>2</sub> Tank slab	CY	\$ 500.0	18	\$ 9,000
7	Building slab	CY	\$ 500.0	10	\$ 5,000
8	Wet Well	LS	\$ 6,500.0	1	\$ 6,500
<b>Division 4 - Masonry</b>					
9	Split-block Masonry Building (20' x 20')	SF	\$ 250.0	400	\$ 100,000
<b>Division 9 - Finishes</b>					
10	Coatings	LS	\$ 20,000.0	1	\$ 20,000
<b>Division 11 - Equipment</b>					
11	Vertical Turbine Pumps and Appurtenances	EA	\$ 61,200	1	\$ 61,200
12	Drill & Prep 3.5' Diameter U-Tube Shaft	FT	\$ 720	220	\$ 158,400
13	Casing Material (Assume Welded Steel, 1")	LB	\$ 1	99,300	\$ 99,300
14	Install U-Tube Casing	FT	\$ 50	220	\$ 11,000
15	Install Bottom Plug (concrete and mortar)	CY	\$ 500	6	\$ 3,000
16	Pump Water from Shaft and Prepare Casing	LS	\$ 25,000	1	\$ 25,000
17	Bubble Collector and Appurtenances	EA	\$ 8,000	1	\$ 8,000
18	Oxygen Diffuser	EA	\$ 1,500	1	\$ 1,500
19	Fish Screen (Barrel)	EA	\$ 275,000	1	\$ 275,000
<b>Division 13 - Special Construction</b>					
20	Pressure Gages/Transmitters	EA	\$ 1,500	2	\$ 3,000
21	Flow Meter (18" Mag)	EA	\$ 16,800	1	\$ 16,800
<b>Division 15 - Mechanical</b>					
22	O <sub>2</sub> Supply Line Piping and Appurtenances	LF	\$ 12	100	\$ 1,200
23	O <sub>2</sub> Control Valve and Equipment	EA	\$ 3,000	1	\$ 3,000
24	18" Pump Control Valve	EA	\$ 24,000	1	\$ 24,000
25	Isolation Valves	EA	\$ 6,000	2	\$ 12,000
26	18" Ductile Iron Pipe	\$/Dia-In 18	\$ 162	40	\$ 6,480
27	18" Flexible Piping	\$/Dia-In 18	\$ 162	60	\$ 9,720
28	Inner Piping System (12 Inch)	\$/Dia-In 12	\$ 108	220	\$ 23,760
29	HDPE Diffuser Pipe (Assume 24" Dia)	\$/Dia-In 24	\$ 18	800	\$ 14,400
30	Pressure Regulating Station	EA	\$ 5,000	4	\$ 20,000
31	Diffuser Supports	EA	\$ 150	80	\$ 12,000
32	Lateral Installation (Within Water Column)	LF	\$ 94	800	\$ 75,200
<b>Division 16 - Electrical and Instrumentation</b>					
33	Supply	LS	\$ 50,000	1	\$ 50,000
34	Control Systems and Instrumentation	LS	\$ 30,000	1	\$ 30,000
35	Control Wiring	LS	\$ 5,000	1	\$ 5,000
<b>Rounded Subtotal*</b>					<b>\$ 1,112,000</b>

<b>General Contractor Indirect Costs</b>					
	Construction Management (Contractor)		2.5%	\$ 1,112,000	\$ 27,800
	Mobilization/Demobilization	LS	\$ 22,500	1	\$ 22,500
<b>Rounded Subtotal*</b>					<b>\$ 51,000</b>
<b>Total Construction Costs</b>					<b>\$ 1,163,000</b>
<b>Contingencies</b>					<b>\$ 407,050</b>
<b>TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES*</b>					<b>\$ 1,571,000</b>

<b>Other Project Costs</b>					
	Engineering/SDC		10.0%	\$ 157,100	
	Permitting		7.0%	\$ 109,970	
	Construction Services/Inspections		10.0%	\$ 157,100	
<b>Rounded Subtotal*</b>					<b>\$ 425,000</b>
<b>TOTAL ESTIMATED CAPITAL COSTS</b>					<b>\$ 1,996,000</b>

<b>RECURRING CAPITAL EXPENSES</b>					
	Pump Motor	10	yrs	\$ 5,000	
	Impeller	10	yrs	\$ 5,000	
	Diffuser Lateral	10	yrs	\$ 101,600	
	Oxygen Diffuser	5	yrs	\$ 4,500	
<b>Total Recurring Capital Expenses</b>					<b>\$ 117,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE COSTS</b>					
	Equipment Maintenance (Equipment and Mechanical)		3.0%	\$ 14,780	
	Monitoring and Adaptive Management		2.0%	\$ 39,920	
	Oxygen Tank Rental	Month	\$ 750	12	\$ 9,000
	Oxygen Supply (10,750 lbs/day)	lbs	\$ 0.07	1,075,000	\$ 75,250
	Power Costs	kW-hr	\$ 0.06	64,430	\$ 3,870
<b>Total Annual O &amp; M Costs*</b>					<b>\$ 143,000</b>

\*Rounded up to the nearest \$1,000.

**PRELIMINARY COST ESTIMATE**

**U-TUBE ALTERNATIVE C - ONE 4' OUTER DIAMETER  
(2' OUTER RADIUS) U-TUBE X 165 FT HEIGHT**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CALIFORNIA BAY DELTA AUTHORITY  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUL 6, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Cut/Fill	CY	\$ 5	725	\$ 3,625
2	Removable Bollards	EA	\$ 300	6	\$ 1,800
3	Fencing	LS	\$ 6,500	1	\$ 6,500
4	9" AB	CY	\$ 36	50	\$ 1,800
5	3" AC	SF	\$ 5	1600	\$ 8,000
6					
6	O <sub>2</sub> Tank slab	CY	\$ 500.0	18	\$ 9,000
7	Building slab	CY	\$ 500.0	10	\$ 5,000
8	Wet Well	LS	\$ 6,500.0	1	\$ 6,500
<b>Division 4 - Masonry</b>					
9	Split-block Masonry Building (20' x 20')	SF	\$ 250.0	400	\$ 100,000
<b>Division 9 - Finishes</b>					
10	Coatings	LS	\$ 20,000.0	1	\$ 20,000
<b>Division 11 - Equipment</b>					
11	Vertical Turbine Pumps and Appurtenances	EA	\$ 76,500	1	\$ 76,500
12	Drill & Prep 4' Diameter U-Tube Shaft	FT	\$ 510	165	\$ 84,150
13	Casing Material (Assume Welded Steel, 1")	LB	\$ 1	82,900	\$ 82,900
14	Install U-Tube Casing	FT	\$ 50	165	\$ 8,250
15	Install Bottom Plug (concrete and mortar)	CY	\$ 500	8	\$ 4,000
16	Pump Water from Shaft and Prepare Casing	LS	\$ 12,000	1	\$ 12,000
17	Bubble Collector and Appurtenances	EA	\$ 8,000	1	\$ 8,000
18	Oxygen Diffuser	EA	\$ 2,000	1	\$ 2,000
19	Fish Screen (Barrel)	EA	\$ 357,500	1	\$ 357,500
<b>Division 13 - Special Construction</b>					
20	Pressure Gages/Transmitters	EA	\$ 1,500	2	\$ 3,000
21	Flow Meter (12" Mag)	EA	\$ 13,500	1	\$ 13,500
<b>Division 15 - Mechanical</b>					
22	O <sub>2</sub> Supply Line Piping and Appurtenances	LF	\$ 12	100	\$ 1,200
23	O <sub>2</sub> Control Valve and Equipment	EA	\$ 3,000	1	\$ 3,000
24	18" Pump Control Valve	EA	\$ 24,000	1	\$ 24,000
25	Isolation Valves	EA	\$ 11,000	2	\$ 22,000
26	18" Ductile Iron Pipe	\$/Dia-In 18 LF	\$ 162	20	\$ 3,240
27	18" Flexible Piping	\$/Dia-In 18 LF	\$ 162	60	\$ 9,720
28	Inner Piping System (18 Inch)	\$/Dia-In 18 LF	\$ 162	165	\$ 26,730
29	HDPE Diffuser Pipe (Assume 24" Dia)	\$/Dia-In 24 LF	\$ 18	800	\$ 14,400
30	Pressure Regulating Station	EA	\$ 5,000	4	\$ 20,000
31	Diffuser Supports	EA	\$ 150	80	\$ 12,000
32	Lateral Installation (Within Water Column)	LF	\$ 94	800	\$ 75,200
<b>Division 16 - Electrical and Instrumentation</b>					
33	Supply	LS	\$ 50,000	1	\$ 50,000
34	Control Systems and Instrumentation	LS	\$ 30,000	1	\$ 30,000
35	Control Wiring	LS	\$ 5,000	1	\$ 5,000
<b>Rounded Subtotal*</b>					<b>\$ 1,128,000</b>

<b>General Contractor Indirect Costs</b>				
Construction Management (Contractor)		2.5%	\$ 1,128,000	\$ 28,200
Mobilization/Demobilization	LS	\$ 22,500	1	\$ 22,500
<b>Rounded Subtotal*</b>				<b>\$ 51,000</b>

<b>Total Construction Costs</b>	\$ 1,179,000
Contingencies	35% \$ 412,650

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES\* \$ 1,592,000**

<b>Other Project Costs</b>				
Engineering/SDC		10.0%	\$ 159,200	
Permitting		7.0%	\$ 111,440	
Construction Services/Inspections		10.0%	\$ 159,200	
<b>Rounded Subtotal*</b>				<b>\$ 430,000</b>

**TOTAL ESTIMATED CAPITAL COSTS \$ 2,022,000**

<b>RECURRING CAPITAL EXPENSES</b>				
Pump Motor	10	yrs	\$ 5,000	
Impeller	10	yrs	\$ 5,000	
Diffuser Lateral	10	yrs	\$ 101,600	
Oxygen Diffuser	5	yrs	\$ 6,000	
<b>Total Recurring Capital Expenses</b>				<b>\$ 118,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE COSTS</b>				
Equipment Maintenance (Equipment and Mechanical)			3.0%	\$ 12,370
Monitoring and Adaptive Management			2.0%	\$ 40,440
Oxygen Tank Rental	Month	\$ 750	12	\$ 9,000
Oxygen Supply (13,700 lbs/day)	lbs	\$ 0.07	1,370,000	\$ 95,900
Power Costs	kW-hr	\$ 0.06	80,540	\$ 4,840
<b>Total Annual O &amp; M Costs*</b>				<b>\$ 163,000</b>

\*Rounded up to the nearest \$1,000.

**U-TUBE ALTERNATIVE D - ONE 6' OUTER DIAMETER  
(3' OUTER RADIUS) U-TUBE X 115 FT HEIGHT**

**ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CALIFORNIA BAY DELTA AUTHORITY  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUL 6, 2004**

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Cut/Fill	CY	\$ 5	725	\$ 3,625
2	Removable Bollards	EA	\$ 300	6	\$ 1,800
3	Fencing	LS	\$ 6,500	1	\$ 6,500
4	9" AB	CY	\$ 36	50	\$ 1,800
5	3" AC	SF	\$ 5	1600	\$ 8,000
<b>Division 3 - Concrete</b>					
6	O <sub>2</sub> Tank Slab	CY	\$ 500	18	\$ 9,000
7	Building Slab	CY	\$ 500	10	\$ 5,000
8	Wet Well	LS	\$ 6,500	1	\$ 6,500
<b>Division 4 - Masonry</b>					
9	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
10	Coatings	LS	\$ 20,000	1	\$ 20,000
<b>Division 11 - Equipment</b>					
11	Vertical Turbine Pumps and Appurtenances	EA	\$ 76,500	2	\$ 153,000
12	Drill & Prep 6' Diameter U-Tube Shaft	FT	\$ 871	115	\$ 100,165
13	Casing Material (Assume Welded Steel, 1")	LB	\$ 1	87,300	\$ 87,300
14	Install U-Tube Casing	FT	\$ 50	115	\$ 5,750
15	Install Bottom Plug (concrete and mortar)	CY	\$ 500	25	\$ 12,500
16	Pump Water from Shaft and Prepare Casing	LS	\$ 35,000	1	\$ 35,000
17	Bubble Collector and Appurtenances	EA	\$ 8,000	1	\$ 8,000
18	Oxygen Diffusers	EA	\$ 3,000	1	\$ 3,000
19	Fish Screen (Barrel)	EA	\$ 500,000	1	\$ 500,000
<b>Division 13 - Special Construction</b>					
20	Pressure Gages/Transmitters	EA	\$ 1,500	2	\$ 3,000
21	Flow Meter (12" Mag)	EA	\$ 13,500	1	\$ 13,500
<b>Division 15 - Mechanical</b>					
22	O <sub>2</sub> Supply Line Piping and Appurtenances	LF	\$ 12	100	\$ 1,200
23	O <sub>2</sub> Control Valve	EA	\$ 3,000	2	\$ 6,000
24	20" Pump Control Valve	EA	\$ 28,000	2	\$ 56,000
25	Isolation Valves	EA	\$ 14,000	3	\$ 42,000
26	20" Ductile Iron Pipe (Header)	\$/Dia-In 20 LF	\$ 180	40	\$ 7,200
27	30" Ductile Iron Pipe (Collector/Disch)	\$/Dia-In 30 LF	\$ 270	20	\$ 5,400
28	20" Ductile Iron Pipe (Discharge)	\$/Dia-In 20 LF	\$ 180	21	\$ 3,780
29	20" Flexible Piping	\$/Dia-In 20 LF	\$ 180	120	\$ 21,600
30	Inner Piping System	\$/Dia-In 50 LF	\$ 450	60	\$ 27,000
31	HDPE Diffuser Pipe (Assume 24" Dia)	\$/Dia-In 20 LF	\$ 15	1600	\$ 24,000
32	Pressure Regulating Station	EA	\$ 5,000	8	\$ 40,000
33	Diffuser Supports	EA	\$ 150	160	\$ 24,000
34	Lateral Installation (Within Water Column)	LF	\$ 94	1600	\$ 150,400
<b>Division 16 - Electrical and Instrumentation</b>					
35	Supply	LS	\$ 50,000	1	\$ 50,000
36	Control Systems and Instrumentation	LS	\$ 30,000	1	\$ 30,000
37	Contol Wiring	LS	\$ 5,000	1	\$ 5,000
<b>Rounded Subtotal*</b>					<b>\$ 1,578,000</b>

<b>General Contractor Indirect Costs</b>					
	Construction Management (Contractor)		2.5%	\$ 1,578,000	\$ 39,450
	Mobilization/Demobilization	LS	\$ 28,000	1	\$ 28,000
<b>Rounded Subtotal*</b>					<b>\$ 68,000</b>

<b>Total Construction Costs</b>					
					\$ 1,646,000
<b>Contingencies 35%</b>					\$ 576,100
<b>TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES*</b>					<b>\$ 2,223,000</b>

<b>Other Project Costs</b>					
	Engineering/SDC		10.0%	\$	222,300
	Permitting		7.0%	\$	155,610
	Construction Services/Inspections		10.0%	\$	222,300
<b>Rounded Subtotal*</b>					<b>\$ 600,000</b>

<b>TOTAL ESTIMATED CAPITAL COSTS</b>					<b>\$ 2,823,000</b>
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RECURRING CAPITAL EXPENSES	REPLACEMENT INTERVAL				
Pump Motor	10	yrs	\$	12,000	
Impeller	10	yrs	\$	10,000	
Diffuser Lateral	10	yrs	\$	198,400	
Oxygen Diffuser	5	yrs	\$	9,000	
<b>Total Recurring Capital Expenses</b>					
<b>Rounded Subtotal*</b>					<b>\$ 230,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE COSTS</b>					
	Equipment Maintenance (Equipment and Mechanical)		3.0%	\$	12,060
	Monitoring and Adaptive Management		2.0%	\$	56,460
	Oxygen Tank Rental	Month	\$ 750	12	\$ 9,000
	Oxygen Supply (19,200 lbs/day)	lbs	\$ 0.07	1,920,000	\$ 134,400
	Power Costs	kW-hr	\$ 0.06	178,970	\$ 10,740
<b>Total Annual O &amp; M Costs*</b>					<b>\$ 223,000</b>

\*Rounded up to the nearest \$1,000.

**PRELIMINARY COST ESTIMATE**

**SPEECE CONE ALTERNATIVE A - LOW PRESSURE  
2 SPEECE CONES, TOP RADIUS=0.83', BOTTOM RADIUS=4.5'**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CAL-FED Bay Delta Authority  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUNE 24, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 1,800
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	20	\$ 720
4	3" AC	SF	\$ 5	300	\$ 1,500
<b>Division 3 - Concrete</b>					
5	O <sub>2</sub> Tank Slab	CY	\$ 500	15	\$ 7,500
6	Building Slab	CY	\$ 500	10	\$ 5,000
<b>Division 4 - Masonry</b>					
7	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
8	Coatings	LS	\$ 10,000	1	\$ 10,000
<b>Division 11 - Equipment</b>					
9	Vertical Turbine Pump and Appurtenances	EA	\$ 45,900	2	\$ 91,800
10	Speece Cone -15 ft height, 0.83 ft/4.5 ft radius	EA	\$ 35,000	2	\$ 70,000
11	Movable Equipment Platform	LS	\$ 220,000	1	\$ 220,000
12	Fish Screen	EA	\$ 240,000	1	\$ 240,000
<b>Division 15 - Special Construction</b>					
13	Pressure Gages/Transmitters	EA	\$ 1,500	4	\$ 6,000
14	Flow Meter (12" Mag)	EA	\$ 13,500	2	\$ 27,000
<b>Division 15 - Mechanical</b>					
15	O <sub>2</sub> Supply Piping and appertenances	LF	\$ 12	65	\$ 780
16	O <sub>2</sub> Control Valve	EA	\$ 2,500	2	\$ 5,000
17	12" Ductile Iron Pipe	\$/Dia-In 12 LF	\$ 108	60	\$ 6,480
18	Vent	\$/Dia-In 2 LF	\$ 6	30	\$ 180
19	12" Flexible Connection	\$/Dia-In 12 LF	\$ 108	60	\$ 6,480
20	Other Miscellaneous Piping	LS	\$ 4,500	1	\$ 4,500
21	Throttling Valve	EA	\$ 3,400	2	\$ 6,800
22	12" Pump Control Valve	EA	\$ 8,000	2	\$ 16,000
23	HDPE Diffuser Pipe	\$/Dia-In 20 LF	\$ 10	800	\$ 8,000
24	Diffuser Supports	EA	\$ 150	80	\$ 12,000
25	Diffuser in Speece-Cone for oxygen	LS	\$ 1,000	2	\$ 2,000
26	Lateral Installation	LF	\$ 94	800	\$ 75,200
<b>Division 16 - Electrical and Instrumentation</b>					
27	Supply	LS	\$ 50,000	1	\$ 50,000
28	Control Systems and Instrumentation	EA	\$ 40,000	1	\$ 40,000
29	Control Wiring	LS	\$ 12,000	2	\$ 24,000
<b>Rounded Subtotal*</b>					<b>\$ 1,046,000</b>

<b>General Contractor Indirect Costs</b>				
Construction Management (Contractor)	2.5%	\$ 1,046,000	\$	26,150
Mobilization	2.0%	\$ 1,046,000	\$	20,920
Rounded Subtotal*				\$ 47,000
<b>Total Construction Costs</b>				<b>\$ 1,093,000</b>
Contingencies				<b>35% \$ 382,550</b>
<b>TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES*</b>				<b>\$ 1,476,000</b>

<b>Other Project Costs</b>				
Engineering/SDC		10.0%	\$	147,600
Permitting		7.0%	\$	103,320
Construction Services/Inspections		10.0%	\$	147,600
Rounded Subtotal*				\$ 399,000
<b>TOTAL ESTIMATED CAPITAL COSTS</b>				<b>\$ 1,875,000</b>

RECURRING CAPITAL EXPENSES	REPLACEMENT INTERVAL			
Pump Motor	10	yrs	\$	10,000
Impeller	10	yrs	\$	10,000
Diffuser Lateral	10	yrs	\$	95,200
Diffusers in Speece (2X)	5	yrs	\$	6,000
<b>Total Recurring Capital Expenses</b>				<b>\$ 122,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE</b>				
Pumps		2.5%	\$	2,300
Pipes		1.0%	\$	2,680
Monitoring and Adaptive Management		2.0%	\$	37,500
Oxygen Tank Rental	Month	\$ 750.00	12	\$ 9,000
Oxygen Supply (13,333 lbs/day)	lbs	\$ 0.07	1,333,300	\$ 93,340
Power Costs	kW-hr	\$ 0.06	107,381	\$ 6,450
<b>Total Annual O &amp; M Costs*</b>				<b>\$ 152,000</b>

\*Rounded up to the nearest \$1,000.



**SPEECE CONE ALTERNATIVE B - PRESSURIZED**  
**2 SPEECE CONES, TOP RADIUS=0.83', BOTTOM RADIUS=4.5'**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CAL-FED Bay Delta Authority  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUNE 24, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 1,800
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	20	\$ 720
4	3" AC	SF	\$ 5	300	\$ 1,500
<b>Division 3 - Concrete</b>					
5	O <sub>2</sub> Tank Slab	CY	\$ 500	15	\$ 7,500
6	Building Slab	CY	\$ 500	10	\$ 5,000
<b>Division 4 - Masonry</b>					
7	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
8	Coatings	LS	\$ 10,000	1	\$ 10,000
<b>Division 11 - Equipment</b>					
9	Vertical Turbine Pump and Appurtenances	EA	\$ 105,000	2	\$ 210,000
10	Speece Cone -15 ft height, 0.83 ft/4.5 ft radius	EA	\$ 35,000	2	\$ 70,000
11	Movable Equipment Platform	LS	\$ 220,000	1	\$ 220,000
12	Fish Screen	EA	\$ 240,000	1	\$ 240,000
<b>Division 13 - Special Construction</b>					
13	Pressure Gages/Transmitters	EA	\$ 1,500	4	\$ 6,000
14	Flow Meter (12" Mag)	EA	\$ 13,500	2	\$ 27,000
<b>Division 15 - Mechanical</b>					
15	O <sub>2</sub> Supply Piping and Appurtenances	LF	\$ 12	65	\$ 780
16	O <sub>2</sub> Control Valve	EA	\$ 2,500	2	\$ 5,000
17	10" Ductile Iron Pipe	\$/Dia-In 10 LF	\$ 30	40	\$ 1,200
18	Vent	\$/Dia-In 2 LF	\$ 6	30	\$ 180
19	12" Ductile Iron Pipe	\$/Dia-In 10 LF	\$ 50	20	\$ 1,000
20	12" Flexible Connection	\$/Dia-In 12 EA	\$ 60	60	\$ 3,600
21	Other Misc Piping	LS	\$ 4,500	1	\$ 4,500
22	Throttling Valve	EA	\$ 3,400	2	\$ 6,800
23	12" Pump Control Valve	EA	\$ 8,000	2	\$ 16,000
24	HDPE Diffuser Pipe	\$/Dia-In 12 LF	\$ 9	800	\$ 7,200
25	Diffuser Supports	EA	\$ 150	40	\$ 6,000
26	Diffuser in Speece-Cone for oxygen	EA	\$ 1,000.00	2	\$ 2,000
27	Lateral Installation	LF	\$ 94	800	\$ 75,200
<b>Division 16 - Electrical and Instrumentation</b>					
28	Supply	LS	\$ 50,000	1	\$ 50,000
29	Control Systems and Instrumentation	LS	\$ 40,000	1	\$ 40,000
30	Control Wiring	LS	\$ 12,000	1	\$ 12,000
<b>Rounded Subtotal*</b>					<b>\$ 1,138,000</b>

<b>General Contractor Indirect Costs</b>			
Construction Management (Contractor)	2.5%	\$ 1,138,000	\$ 28,450
Mobilization/Demobilization	2.0%	\$ 1,138,000	\$ 22,760
<b>Rounded Subtotal*</b>			<b>\$ 52,000</b>

**Total Construction Costs** \$ 1,190,000  
Contingencies 35% \$ 416,500

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES\*** \$ 1,607,000

<b>Other Project Costs</b>			
Engineering/SDC	10.0%	\$ 160,700	
Permitting	7.0%	\$ 112,490	
Construction Services/Inspections	10.0%	\$ 160,700	
<b>Rounded Subtotal*</b>			<b>\$ 434,000</b>

**TOTAL ESTIMATED CAPITAL COSTS** \$ 2,041,000

<b>RECURRING CAPITAL EXPENSES</b>		<b>REPLACEMENT INTERVAL</b>	
Pump Motor (2X)	10 yrs	\$	14,000
Impeller	10 yrs	\$	10,000
Diffuser Lateral	10 yrs	\$	88,400
Diffusers in Speece (2X)	5 yrs	\$	6,000
<b>Total Recurring Capital Expenses</b>			<b>\$ 119,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE COSTS</b>			
Pumps	2.5%	\$	5,250
Pipes	1.0%	\$	3,650
Monitoring and Adaptive Management	2.0%	\$	40,820
Oxygen Tank Rental	Month	\$ 750	12 \$ 9,000
Oxygen Supply (10,737 lbs/day)	lbs	\$ 0.07	1,073,700 \$ 75,160
Power Costs	kW-hr	\$ 0.06	429,523 \$ 25,780
<b>Total O &amp; M Costs</b>			<b>\$ 160,000</b>

\*Rounded up to the nearest \$1,000.

**PRELIMINARY COST ESTIMATE**

**SPEECE CONE ALTERNATIVE C - PRESSURIZED**  
**1 SPEECE CONE, TOP RADIUS=1.8', BOTTOM RADIUS=9.4'**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN  
CAL-FED Bay Delta Authority  
SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY  
DATE: JULY 2, 2004 CHD: JUNE 24, 2004

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 1,800
2	Fencing	LS	6500	1	6500
3	9" AB	CY	\$ 36	20	\$ 720
4	3" AC	SF	\$ 5	300	\$ 1,500
<b>Division 3 - Concrete</b>					
5	O <sub>2</sub> Tank Slab	CY	\$ 500	15	\$ 7,500
6	Building Slab	CY	\$ 500	10	\$ 5,000
<b>Division 4 - Masonry</b>					
7	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
8	Coatings	LS	\$ 10,000	1	\$ 10,000
<b>Division 11 - Equipment</b>					
9	Vertical Turbine Pump and Appurtenances	EA	\$ 45,900	3	\$ 137,700
10	Speece Cone (30 ft height)	EA	\$ 80,500	2	\$ 161,000
11	Movable Equipment Platform	LS	\$ 220,000	1	\$ 220,000
12	Fish Screen (Barrel)	EA	\$ 500,000	1	\$ 500,000
<b>Division 13 - Special Construction</b>					
13	Pressure Gages/Transmitters	EA	\$ 1,500	4	\$ 6,000
14	Flow Meter (12" Mag)	EA	\$ 13,500	2	\$ 27,000
<b>Division 15 - Mechanical</b>					
15	O <sub>2</sub> Supply Piping and Appurtenances	LF	\$ 12	65	\$ 780
16	O <sub>2</sub> Control Valve	EA	\$ 2,500	2	\$ 5,000
17	24" Ductile Iron Pipe (Header)	\$/Dia-In 24	LF \$ 216	60	\$ 12,960
18	Vent	\$/Dia-In 2	LF \$ 6	30	\$ 180
19	24" Ductile Iron Pipe (Discharge)	\$/Dia-In 24	LF \$ 216	20	\$ 4,320
20	24" Flexible Connection	\$/Dia-In 24	EA \$ 216	60	\$ 12,960
21	Other Misc Piping	LS	\$ 4,500	1	\$ 4,500
22	Throttling Valve	EA	\$ 3,400	2	\$ 6,800
23	24" Pump Control Valve	EA	\$ 30,000	2	\$ 60,000
24	HDPE Diffuser Pipe	\$/Dia-In 12	LF \$ 9	1600	\$ 14,400
25	Diffuser Supports	EA	\$ 150	160	\$ 24,000
26	Diffuser in Speece-Cone for oxygen	EA	\$ 1,000	2	\$ 2,000
27	Lateral Installation	LF	\$ 94	1600	\$ 150,400
<b>Division 16 - Electrical and Instrumentation</b>					
28	Supply	LS	\$ 50,000	1	\$ 50,000
29	Control Systems and Instrumentation	LS	\$ 40,000	1	\$ 40,000
30	Control Wiring	LS	\$ 12,000	1	\$ 12,000
<b>Rounded Subtotal*</b>					<b>\$ 1,586,000</b>

<b>General Contractor Indirect Costs</b>			
Construction Management (Contractor)	2.5%	\$ 1,586,000	\$ 39,650
Mobilization/Demobilization	2.0%	\$ 1,586,000	\$ 31,720
<b>Rounded Subtotal*</b>			<b>\$ 72,000</b>

**Total Construction Costs** \$ 1,658,000  
Contingencies 35% \$ 580,300

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES\*** \$ 2,239,000

<b>Other Project Costs</b>			
Engineering/SDC	10.0%	\$ 223,900	
Permitting	7.0%	\$ 156,730	
Construction Services/Inspections	10.0%	\$ 223,900	
<b>Rounded Subtotal*</b>			<b>\$ 605,000</b>

**TOTAL ESTIMATED CAPITAL COSTS** \$ 2,844,000

RECURRING CAPITAL EXPENSES	REPLACEMENT INTERVAL		
Pump Motor	10 yrs	\$	18,000
Impeller	10 yrs	\$	10,000
Diffuser Lateral	10 yrs	\$	188,800
Diffusers in Speece (2X)	5 yrs	\$	6,000
<b>Total Recurring Capital Expenses</b>			<b>\$ 223,000</b>

<b>ANNUAL OPERATION AND MAINTENANCE COSTS</b>			
Pumps	2.5%	\$	3,443
Pipes	1.0%	\$	8,090
Monitoring and Adaptive Management	2.0%	\$	56,880
Oxygen Tank Rental	Month	\$ 750	12 \$ 9,000
Oxygen Supply (14,444 lbs/day)	lbs	\$ 0.07	1,444,400 \$ 101,110
Power Costs	kW-hr	\$ 0.06	1,234,879 \$ 74,100
<b>Total O &amp; M Costs*</b>			<b>\$ 253,000</b>

\*Rounded up to the nearest \$1,000.

**BUBBLE PLUME ALTERNATIVE A - AIR**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN

CAL-FED Bay Delta Authority

SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY

DATE: JULY 2, 2004

CHD: JUNE 24, 2004

**Construction Costs**

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 2,000
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	45	\$ 1,620
4	3" AC	SF	\$ 5	1600	\$ 8,000
<b>Division 3 - Concrete</b>					
5	Building Slab	CY	\$ 500	10	\$ 5,000
<b>Division 4 - Masonry</b>					
6	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
7	Coatings	LS	\$ 10,000	1	\$ 10,000
<b>Division 11 - Equipment</b>					
8	Compressor and Appurtenances	EA	\$ 26,000	1	\$ 26,000
<b>Division 15 - Mechanical</b>					
9	Distribution Line (10" HDPE) Dia 10	LF	\$ 5	5500	\$ 27,500
10	Air Bubble Diffuser	LF	\$ 12	5500	\$ 66,000
11	Diffuser Supports and Anchorage	EA	\$ 150	550	\$ 82,500
12	Diffuser Installation	LF	\$ 94	11000	\$ 1,034,000
13	Pressure Regulating Station	EA	\$ 5,000	27	\$ 135,000
<b>Division 16 - Electrical and Instrumentation</b>					
14	Supply	LS	\$ 50,000	1	\$ 50,000
15	Control Systems and Instrumentation	EA	\$ 35,000	1	\$ 35,000
16	Control Wiring	LS	\$ 5,500	1	\$ 5,500
<b>Rounded Subtotal*</b>					<b>\$ 1,595,000</b>

**General Contractor Indirect Costs**

Construction Management (Contractor)	2.5%	\$ 1,595,000	\$ 39,875
Mobilization	2.0%	\$ 1,595,000	\$ 31,900
<b>Rounded Subtotal*</b>			<b>\$ 72,000</b>

<b>Total Construction Costs</b>	\$ 1,667,000
Contingencies <b>35%</b>	\$ 583,450

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES\* \$ 2,251,000**

**Other Project Costs**

Engineering/SDC	10.0%	\$ 225,100
Permitting	7.0%	\$ 157,570
Construction Services/Inspections	10.0%	\$ 225,100
<b>Rounded Subtotal*</b>		<b>\$ 608,000</b>

**TOTAL ESTIMATED CAPITAL COSTS \$ 2,859,000**

**RECURRING CAPITAL EXPENSES**

**REPLACEMENT INTERVAL**

Air Bubble Diffuser	10 yrs	\$ 1,182,500
Compressor Motor	10 yrs	\$ 5,000

**Total Recurring Capital Expenses Rounded Subtotal\* \$ 1,188,000**

**TOTAL ANNUAL OPERATION AND MAINTENANCE COSTS:**

Equipment and Maintenance (Equipment and Mechanical)	10.0%	\$ 124,000
Monitoring and Adaptive Management	3.0%	\$ 86,000
Power Costs	kW-hr \$ 0.06	84,120 \$ 5,000

**Total Annual O & M Costs\* \$ 215,000**

\*Rounded up to the nearest \$1,000.

**BUBBLE PLUME ALTERNATIVE B - AIR**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN

CAL-FED Bay Delta Authority

SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY

DATE: JULY 2, 2004

CHD: JUNE 24, 2004

**Construction Costs**

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 2,000
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	45	\$ 1,620
4	3" AC	SF	\$ 5	1600	\$ 8,000
<b>Division 3 - Concrete</b>					
5	Building Slab	CY	\$ 500	10	\$ 5,000
<b>Division 4 - Masonry</b>					
6	Split-block Masonry Building (20' x 20')	SF	\$ 250	400	\$ 100,000
<b>Division 9 - Finishes</b>					
7	Coatings	LS	\$ 10,000	1	\$ 10,000
<b>Division 11 - Equipment</b>					
8	Compressor and Appurtenances	EA	\$ 52,000	1	\$ 52,000
<b>Division 15 - Mechanical</b>					
9	Distribution Line Dia 12	LS	\$ 6	3000	\$ 18,000
10	Air Bubble Diffuser	LF	\$ 12	3000	\$ 36,000
11	Diffuser Supports and Anchorage	EA	\$ 150	300	\$ 45,000
12	Diffuser Installation	LF	\$ 94	6000	\$ 564,000
13	Pressure Regulating Station	EA	\$ 5,000	15	\$ 75,000
<b>Division 16 - Electrical and Instrumentation</b>					
14	Supply	LS	\$ 50,000	1	\$ 50,000
15	Control Systems and Instrumentation	EA	\$ 35,000	1	\$ 35,000
16	Control Wiring	LS	\$ 5,500	1	\$ 5,500
<b>Rounded Subtotal*</b>					\$ 1,014,000

**General Contractor Indirect Costs**

Construction Management (Contractor)	2.5%	\$ 1,014,000	\$ 25,350
Mobilization	2.0%	\$ 1,014,000	\$ 20,280

Rounded Subtotal\* \$ 46,000

**Total Construction Costs** \$ 1,060,000

Contingencies **35%** \$ 371,000

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES** \$ **1,431,000**

**Other Project Costs**

Engineering/SDC	10.0%	\$ 143,100
Permitting	7.0%	\$ 100,170
Construction Services/Inspections	10.0%	\$ 143,100

Rounded Subtotal\* \$ 387,000

**TOTAL ESTIMATED CAPITAL COSTS** \$ **1,818,000**

**RECURRING CAPITAL EXPENSES**

**REPLACEMENT INTERVAL**

Air Bubble Diffuser	10	yrs	\$ 645,000
Compressor Motor	10	yrs	\$ 10,000

**Total Recurring Capital Expenses** Subtotal \$ **655,000**

**TOTAL ANNUAL OPERATION AND MAINTENANCE COSTS:**

Equipment and Maintenance (Equipment and Mechanical)	10.0%	\$ 71,500
Monitoring and Adaptive Management	3.0%	\$ 54,540
Power Costs	kW-hr \$ 0.06	155,710 \$ 9,350

**Total Annual O & M Costs\*** \$ **136,000**

\*Rounded up to the nearest \$1,000.

**BUBBLE PLUME ALTERNATIVE C - OXYGEN**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN

CAL-FED Bay Delta Authority

SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY

DATE: JULY 2, 2004

CHD: JUNE 24, 2004

**Construction Costs**

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 1,800
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	16	\$ 576
4	3" AC	SF	\$ 5	400	\$ 2,000
<b>Division 3 - Concrete</b>					
5	O <sub>2</sub> Tank Slab	CY	\$ 500	15	\$ 7,500
<b>Division 9 - Finishes</b>					
6	Coatings	LS	\$ 4,000	1	\$ 4,000
<b>Division 15 - Mechanical</b>					
7	Distribution Line	Dia 3 LF	\$ 2	1900	\$ 2,850
8	O <sub>2</sub> Supply Piping and Appurtenances	LF	\$ 12	30	\$ 360
9	O <sub>2</sub> Control Valve	EA	\$ 2,500	1	\$ 2,500
10	Pressure Regulating Station	EA	\$ 5,000	10	\$ 47,500
11	Air Bubble Diffuser	LF	\$ 12	1900	\$ 22,800
12	Diffuser Supports and Anchorage	EA	\$ 150	190	\$ 28,500
13	Diffuser Installation	LF	\$ 94	3800	\$ 357,200
<b>Division 16 - Electrical and Instrumentation</b>					
14	Supply	LS	\$ 25,000	1	\$ 25,000
15	Control Systems and Instrumentation	EA	\$ 15,000	1	\$ 15,000
16	Control Wiring	LS	\$ 3,500	1	\$ 3,500.00
<b>Rounded Subtotal*</b>					<b>\$ 528,000</b>

**General Contractor Indirect Costs**

Construction Management (Contractor)	2.5%	\$ 528,000	\$ 13,200
Mobilization	2.0%	\$ 528,000	\$ 10,560
Rounded Subtotal*			\$ 24,000

**Total Construction Costs** \$ 552,000  
**Contingencies** 35% \$ 193,200

**TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES\*** \$ **746,000**

**Other Project Costs**

Engineering/SDC	10.0%	\$ 74,600	
Permitting	7.0%	\$ 52,220	
Construction Services/Inspections	10.0%	\$ 74,600	
Rounded Subtotal*			\$ <b>202,000</b>

**TOTAL ESTIMATED PROJECT COSTS** \$ **948,000**

**RECURRING CAPITAL EXPENSES**

**REPLACEMENT INTERVAL**

Air Bubble Diffuser 10 yrs \$ **408,500**

**Total Recurring Capital Expenses\*** \$ **409,000**

**ANNUAL OPERATION AND MAINTENANCE COSTS**

Equipment and Maintenance (Equipment and Mechanical)	10.0%	\$ 94,800
Monitoring and Adaptive Management	3.0%	\$ 28,440
Oxygen Tank Rental	Month	\$ 750.00 12 \$ 9,000
Oxygen Supply	lbs	\$ 0.07 1,219,500 \$ 85,365

**Total Annual O & M Costs\*** \$ **218,000**

\*Rounded up to the nearest \$1,000.

**BUBBLE PLUME ALTERNATIVE D - OXYGEN**

**PRELIMINARY COST ESTIMATE**

ENGINEER'S COST OPINION: PRELIMINARY DESIGN

CAL-FED Bay Delta Authority

SAN JOAQUIN RIVER AERATION ENGINEERING FEASIBILITY STUDY

DATE: MAY 17, 2004

CHD: JUNE 1, 2004

**Construction Costs**

Item	Description	Unit	Unit Price	Quantity	Item Price
<b>Division 1 - General Requirements</b>					
<b>Division 2 - Site Work</b>					
1	Removable Bollards	EA	\$ 300	6	\$ 1,800
2	Fencing	LS	\$ 6,500	1	\$ 6,500
3	9" AB	CY	\$ 36	16	\$ 576
4	3" AC	SF	\$ 5	400	\$ 2,000
<b>Division 3 - Concrete</b>					
5	O <sub>2</sub> Tank Slab	CY	\$ 500	15	\$ 7,500
<b>Division 9 - Finishes</b>					
6	Coatings	LS	\$ 4,000	1	\$ 4,000
<b>Division 15 - Mechanical</b>					
7	Distribution Line	Dia 4 LF	\$ 2	800	\$ 1,600
8	O <sub>2</sub> Supply Piping and Appurtenances	LF	\$ 12	30	\$ 360
9	O <sub>2</sub> Control Valve	EA	\$ 2,500	1	\$ 2,500
10	Pressure Regulating Station	EA	\$ 5,000	4	\$ 20,000
11	Air Bubble Diffuser	LF	\$ 12	800	\$ 9,600
12	Diffuser Supports and Anchorage	EA	\$ 100	80	\$ 8,000
13	Diffuser Installation	LF	\$ 94	1600	\$ 150,400
<b>Division 16 - Electrical and Instrumentation</b>					
14	Supply	LS	\$ 25,000	1	\$ 25,000
15	Control Systems and Instrumentation	EA	\$ 15,000	1	\$ 15,000
16	Control Wiring	LS	\$ 3,500	1	\$ 3,500
<b>Rounded Subtotal*</b>					<b>\$ 259,000</b>

**General Contractor Indirect Costs**

Construction Management (Contractor)	2.5%	\$ 259,000	\$ 6,475
Mobilization	2.0%	\$ 259,000	\$ 5,180
<b>Rounded Subtotal*</b>			<b>\$ 12,000</b>
<b>Total Construction Costs</b>			<b>\$ 271,000</b>
Contingencies	35%		\$ 94,850
<b>TOTAL CONSTRUCTION COSTS WITH CONTINGENCIES*</b>			<b>\$ 366,000</b>

**Other Project Costs**

Engineering/SDC	10.0%	\$ 36,600	
Permitting	7.0%	\$ 25,620	
Construction Services/Inspections	10.0%	\$ 36,600	
<b>Rounded Subtotal*</b>			<b>\$ 99,000</b>
<b>TOTAL ESTIMATED PROJECT COSTS</b>			<b>\$ 465,000</b>

**RECURRING CAPITAL EXPENSES**

RECURRING CAPITAL EXPENSES	REPLACEMENT INTERVAL	
Air Bubble Diffuser	10 yrs	\$ 168,000
<b>Total Recurring Capital Expenses</b>		<b>\$ 168,000</b>

**ANNUAL OPERATION AND MAINTENANCE COSTS**

Equipment and Maintenance (Equipment and Mechanical)	10.0%	\$ 46,500	
Monitoring and Adaptive Management	3.0%	\$ 13,950	
Oxygen Tank Rental	Month	\$ 750.00	
Oxygen Supply	lbs	\$ 0.07	
<b>Total Annual O &amp; M Costs*</b>			<b>\$ 178,000</b>

\*Rounded up to the nearest \$1,000.