

## **Appendix C of the Aerojet OU-5 Record of Decision**

### **Detailed Description and Cost Data for Groundwater Alternatives ( from the Aerojet Perimeter Groundwater OU Feasibility Study, February 2005)**

Detailed capital, operation and maintenance (O&M), monitoring, and present worth cost estimates for each alternative are included in this Appendix. Capital cost details are provided for the years in which capital costs are projected to occur.

In accordance with EPA guidance, the cost estimates for each alternative are order-of magnitude estimates and are generally accurate within the +50%/-30% range specified in the guidance. The accuracy of the estimates is subject to substantial variation because details of the specific design will not be known until any remedy is implemented. For example, the actual site conditions, project scope and schedule, design details, competitive market conditions, changes during construction, labor and equipment rates, and other variables are not known.

Furthermore, the selection of technologies or process options is not intended to limit flexibility during remedial design. The selection provides a basis for estimating costs. Remedial design efforts might reveal possible cost savings as a result of value engineering studies and reduce the cost of implementing the remedy. In addition treatment technologies for removal of NDMA and perchlorate that were in the developmental and full scale testing phases during preparation of this OU RI/FS may be substantially more proven at the time of design, incorporated into the remedy and provide significant cost savings.

Wherever possible, actual capital and O&M costs from construction and operation of existing monitor wells, extraction wells, conveyance piping, groundwater treatment facilities, and treated groundwater surface water discharge facilities for the GET systems at Aerojet were used for these cost estimates. Unit rates in the various cost estimates are based on a combination of Aerojet's past experience in actual construction and start-up of remediation facilities, EMSI's and its subcontractor's past experience in design and construction of remediation facilities and professional judgment, and vendor bids for costs that are not available from past experience.

Specific examples for various unit rates contained in the cost estimates include:

- Costs to secure site access to construct wells, permit wells, secure permits, and address CEQA issues are based on past experience in completing these activities.
- Surveying costs are based on an approximate going rate of \$125/hr for a 2-person survey crew, including equipment and transportation costs.

- Extraction well drilling, downhole piping, pump and wellhead piping, aquifer pump testing and data reduction, extraction well sampling, wellhead site improvements and service road, and startup/troubleshooting are all based on Aerojet's experience in constructing numerous similar facilities at the Aerojet Sacramento Site.
- Unit costs for pumps, electrical cable, well vaults, flow meters, miscellaneous piping, fencing, and process piping and supports are based on past experience of EMSI and Aerojet engineering and construction staff and past quotes from vendors.
- Electrical disconnect switches, buried electrical cable, pull boxes, motor starters, controls, and instrumentation costs are based on the past experience of Mitchell Engineering, a subconsultant to both EMSI and Aerojet for electrical and instrumentation/controls engineering design and services during construction as well as Mitchell Engineering's review of the latest version of the Means Electrical Construction Cost Guide for verification of some electrical-related equipment unit rates.
- Conveyance piping costs were estimated on a per lineal foot basis based on actual groundwater and water piping project construction costs for piping associated with the Aerojet GETs E and F and ARGET facilities and piping projects in the Sacramento area. Specifically, unit costs shown in the following table were used. The source of these unit costs is Appendix E of the Western Groundwater Operable Unit Remedial Investigation/Feasibility Study (EMSI, Aerojet, and HSI Geotrans, 1999).

<u>Pipe Diameter (inches)</u>	<u>Estimated Construction Cost (\$/lineal foot)</u>
6 and 8	100
10 and 12	140
16	175
20	225
24	260
30	300

Open field areas on Aerojet site                      \$8 per inch-diameter

- The unit rate for a packed-column air stripper is based on past unit rates for air strippers provided to Aerojet by DEI Systems of Salt Lake City, UT. Specifically, the most recent unit rate for an air stripper of similar size (9 ft diameter x 43 ft height) and capability, including blower and appurtenances, purchased by Aerojet in late 2002 for the White Rock North Dump (WRND) South-Central plume AKT-1 location was \$88,000. Unit rates of \$100,000 (at GET A) and \$125,000 (at GET E/F and ARGET) were used for air stripper estimates to account for any

changes that might be specific to a packed column air stripper considered for a different location than WRND.

- Cost estimates for LPGAC equipment, specifically a pair of 12-foot diameter contactors operated in series, and associated bag pre-filters and backwashing facilities were obtained from USFilter. O&M costs for LPGAC are based on an influent TCE concentration of 5 ug/L, USFilter's GAC isotherm that predicts 0.0118 pounds of LPGAC usage per 1,000 gallons of groundwater treated, and a unit cost of \$0.75 per pound of either virgin coal or reactivated coconut GAC.
- For ion exchange, capital cost estimates for ion exchange contactors were provided by USFilter. For flows less than 1,000 gpm, installed costs for a 10-foot diameter system (2 contactors in series) would be approximately \$150,000. For flows between 1,000 and 2,500 gpm, a 12-foot diameter system would be required (\$175,000 installed). Ion exchange resin replacement costs for Aerojet are currently \$167 per acre foot of groundwater treated.
- Capital costs for expansion of the biological reduction process at GET E/F to accommodate flow from Zone 2 were derived by escalating the 1999 costs (\$5.5M) to construct the current 5,300 gpm system using Engineering News Records' Construction Cost Index and then proportioning the costs based on flowrate. O&M costs for the biological reduction process at GET E/F are currently \$87 per acre foot.
- Capital and O&M cost estimates for new UV/oxidation equipment were based on recent quotes received by Aerojet by Wedeco for addition of UV/oxidation equipment at the GET A, B, and ARGET treatment facilities.
- General contractor installation, electrical/instrumentation & control, and startup/troubleshooting unit rates are all based on Aerojet's recent experience with general contractor, electrical/instrumentation & control, and startup/troubleshooting costs associated with the expansion of the GET E/F 5,300 gpm groundwater treatment facility expansion, adjusted to account for the respective estimated flowrate associated with any potential smaller new or expansion of existing groundwater treatment facility, using the professional judgment of EMSI.

Because of Aerojet's history of contracting directly with equipment manufacturers and various general civil/sitework, concrete, mechanical, and electrical/I&C contractors as compared to contracting to a general contractor who would then contract for and markup the cost of equipment and subcontractors, the 10 percent "Contractor Markup, Mob/demob, Insurance" indirect cost at the bottom of the Capital Cost estimates was only multiplied by the estimated cost of equipment and materials that would be supplied by a contractor (i.e., not contracted directly by Aerojet).

- Extraction and recharge well maintenance costs are based on Aerojet experience with rehabilitating the current wells on the Sacramento Site.
- Electrical utilities unit rate is the current rate per kilowatt-hour (kwh) paid by Aerojet to the Sacramento Municipal Utility District (SMUD). Electrical use costs are derived by taking the running horsepower or kilowatt use for a piece of equipment, multiplying by the number of hours per year and multiplying by the rate per kilowatt-hour. For most of the extraction wells and GET treatment facilities, Aerojet has actual electrical use records. Where available, actual use was included in the cost estimates.
- Equipment maintenance and equipment replacement unit rates of 3 percent of equipment capital costs are average industry-wide standards that are used in operation and maintenance costs estimates and budgeting. The capital costs for equipment (and associated installation) that is expected to have a life of approximately 10 years (such as extraction well, booster, and transfer pumps; and flow meters at extraction wellheads) were used as the basis.
- Monitoring costs are based on Aerojet's actual costs for analysis of environmental samples at their in-house laboratory. The unit rate for monitoring varies depending on the analyses being performed by the laboratory. Specifically, costs for monitoring are based on current Aerojet-Sacramento facility costs for the PCD Exhibit IV and VI requirements for groundwater monitoring on a per-sample basis for labor and equipment. Following are per sample analytical costs: VOCs (\$50 each), SVOCs (\$225 each), perchlorate (\$50 each), and NDMA (\$60 each).

# **Detailed Cost Estimates**

## **Alternative Z1-2**

**Capital Cost Estimate**  
**Alternative Z1-2: Contain and Remediate Zone 1 Groundwater**

**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost	
<b>Estimated Capital Costs:</b>					
<b>Demolition of Existing GET D</b>					
Demo GET D treatment facility and above ground piping	1	LS	50,000	50,000	
Subtotal - Demo GET D				50,000	
<b>Extraction Wells [4 new wells, 3 locations]</b>					
Surveying	2.0	day	1,000	2,000	
Secure well permit	4	ea	1,000	4,000	
Secure permanent easement	4	LS	1,000	4,000	
Extraction wells - drilling and development	<u>No. Wells</u>				
Layer C	2	200	ft	250	100,000
Layer D	2	250	ft	250	125,000
Aquifer pumping test and data reduction	4	LS	6,000	24,000	
Well pump discharge piping, 3" SS threaded	900	lin ft	40	36,000	
Pumps, incl. elec. cable	4	ea	25,000	100,000	
Wellhead vault: H-20 traffic rated	4	ea	5,000	20,000	
Flow meter	4	ea	1,500	6,000	
Misc. wellhead piping and valves	4	ea	400	1,600	
Electrical disconnect switch at well vault	4	ea	500	2,000	
Installation (pump, wellhead piping/valves)	4	LS	2,000	8,000	
One-time initial extraction well sampling	4	ea	650	2,600	
Power service drop	2	ea	5,000	10,000	
Buried electrical power (480v, 3-phase)	2,600	lin ft	15	39,000	
Buried instrumentation and control wiring	6,300	lin ft	7	44,100	
Electrical pull boxes every 400'	23	ea	500	11,500	
Motor starters for wells	4	ea	1,500	6,000	
Controls for well pumps	4	ea	500	2,000	
Service road to extraction wells	2,350	lin ft	10	23,500	
Subtotal - Extraction Wells				571,000	
<b>Piping</b>					
Secure easements	1	LS	5,000	5,000	
Surveying	3	day	1,000	3,000	
Single-walled piping system (open field)					
8"	5,150	lin ft	64	329,600	
10"	1,700	lin ft	80	136,000	
Single-walled piping system (in street)					
8"	1,200	lin ft	120	144,000	
Connections to exist 10" and 20" pipelines	2	LS	2,000	4,000	
Subtotal - Untreated Groundwater Piping				622,000	
<b>Treatment at Modified ARGET Treatment Facility: approximately 3,560 gpm total flow</b>					
Approximately 1,120 gpm from extraction wells 4325, 4330, 4335 and GET D extraction wells conveyed via 10" secondary contained pipeline. This flow would be "pretreated" for perchlorate removal and UV/ox or HiPOx for VOCs reduction and 1,4-dioxane removal.					
Approximately 2,440 gpm from extraction wells North and Southwest of the American River conveyed via 20" pipe to ARGET. This flow would be combined with the "pretreated" flow and treated via air stripping for VOCs removal.					
Slab on grade for ion exchange system (48'x30'x1.5')	1,440	sq ft	20	28,800	
Transfer pumping w/ variable frequency drive	1	ea	25,000	25,000	
Bag pre-filters	2	ea	13,000	26,000	
Ion exchange contactors and valving (12' dia system) up to 2,500 gpm capacity	1	ea	175,000	175,000	
In-plant piping, valving	1	LS	10,000	10,000	
Instrumentation and control/telemetry	1	LS	20,000	20,000	
Electrical	1	LS	10,000	10,000	
General contractor installation (interconnecting piping, valving only)	1	LS	20,000	20,000	
Startup/troubleshooting	1	LS	5,000	5,000	
Subtotal - Treatment				320,000	
<b>Estimated Construction Costs - Subtotal</b>				<b>1,563,000</b>	
General Contractor Markup, Mob/demob, Insurance	% of equipment		10	50,000	
Engineering, Permitting and Construction Management	%		15	234,000	
Regulatory Oversight	%		2.5	39,000	
<b>Estimated Project Capital Costs - Subtotal</b>				<b>1,886,000</b>	
Contingency	%		15	283,000	
<b>Estimated Project Capital Costs - Total</b>				<b>2,170,000</b>	

**Estimated Annual Operation, Maintenance, and Monitoring Costs  
Alternative Z1-2: Contain and Remediate Zone 1 Groundwater**

**PGOU FS**

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost (\$/yr)
<b>Estimated O&amp;M Costs</b>					
<b>New perchlorate treatment via ion exchange at approximately 1,120 gpm</b>					
<b>Existing UV/oxidation treatment for 1,4-dioxane removal and VOCs pretreatment at approximately 1,120 gpm</b>					
<b>Removal/polishing of VOCs via existing air stripping process at approximately 3,560 gpm</b>					
Extraction well maintenance		15	ea	200	3,000
Electric utilities:					
Existing containment extraction wells	8	1,289,651	kwh	0.075	96,700
4580 estimate	1	98,002	kwh	0.075	7,400
New C1 extraction well:	1	73,501	kwh	0.075	5,500
New C2 extraction well:	1	147,002	kwh	0.075	11,000
New D1 extraction well:	1	214,378	kwh	0.075	16,100
New D2 extraction well:	1	153,127	kwh	0.075	11,500
New 5020:	1	64,681	kwh	0.075	4,900
New 5105:	1	54,391	kwh	0.075	4,100
Transfer pump from influent tank (assume 34 running hp)	1	219,524	kwh	0.075	16,500
UV/oxidation pretreatment (1,120 gpm)	55 kw	481,800	kwh	0.075	36,100
Air stripper blower, effluent transfer pump, misc. power	52 kw	455,520	kwh	0.075	34,200
Ion exchange resin replacement (1,120 gpm)		1,807	acre-ft	167	301,700
UV lamp replacement		157	ea	125	19,600
Hydrogen peroxide use (assume 12 mg/L, 35% solution)		5,952	gal	3	17,900
Materials and expendables (assume same as 2003 ARGET actuals)		1	LS	45,000	45,000
Equip Maintenance (@ % of new equipment capital)		139,000	%	3	4,200
Equipment Replacement (@ % of new equipment capital)		139,000	%	3	4,200
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 ARGET actuals)		1	year	17,000	17,000
Subtotal - Operation and Maintenance					657,000
Contingency (scope)					65,700
<b>Estimated O&amp;M Costs - Total</b>					<b>723,000</b>
<b>Estimated Monitoring Costs</b>					
Monitoring:					
Monitoring and extraction wells		1	LS	147,000	147,000
ARGET treatment		1	LS	30,000	30,000
<b>Estimated Monitoring Costs - Total</b>					<b>177,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>900,000</b>

**Non-Discounted Constant Dollar Cost Estimate**  
**Alternative Z1-2: Contain and Remediate Zone 1 Groundwater**

Time until RAOs achieved = 151 years (reduce TCE to less than 5 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2135	130	220,000	900,000	1,120,000	126,460,000
2136	131		900,000	900,000	127,360,000
2137	132		900,000	900,000	128,260,000
2138	133		900,000	900,000	129,160,000
2139	134		900,000	900,000	130,060,000
2140	135		900,000	900,000	130,960,000
2141	136		900,000	900,000	131,860,000
2142	137		900,000	900,000	132,760,000
2143	138		900,000	900,000	133,660,000
2144	139		900,000	900,000	134,560,000
2145	140	610,000	900,000	1,510,000	136,070,000
2146	141		900,000	900,000	136,970,000
2147	142		900,000	900,000	137,870,000
2148	143		900,000	900,000	138,770,000
2149	144		900,000	900,000	139,670,000
2150	145		900,000	900,000	140,570,000
2151	146		900,000	900,000	141,470,000
2152	147		900,000	900,000	142,370,000
2153	148		900,000	900,000	143,270,000
2154	149		900,000	900,000	144,170,000
2155	150	730,000	900,000	1,630,000	145,800,000
2156	151		900,000	900,000	146,700,000

Capital Cost Estimate

Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater

PGOU FS

Description	Quantity	Units	Unit Rate	Estimated Cost	
<b>Estimated Capital Costs:</b>					
<b>Demolition of Existing GET D</b>					
Demo GET D treatment facility and above ground piping	1	LS	50,000	50,000	
Subtotal - Demo GET D				50,000	
<b>Extraction Walls [4 wells, 3 locations]</b>					
Surveying	2.0	day	1,000	2,000	
Secure well permit	4	ea	1,000	4,000	
Secure permanent easement	4	LS	1,000	4,000	
Extraction wells - drilling and development	<u>No. Wells</u>				
Layer C	2	200	ft	250	100,000
Layer D	2	250	ft	250	125,000
Aquifer pumping test and data reduction	4	LS	6,000	24,000	
Well pump discharge piping, 3" SS threaded	900	lin ft	40	36,000	
Pumps, incl. elec. cable	4	ea	25,000	100,000	
Wellhead vault: H-20 traffic rated	4	ea	5,000	20,000	
Flow meter	4	ea	1,500	6,000	
Misc. wellhead piping and valves	4	ea	400	1,600	
Electrical disconnect switch at well vault	4	ea	500	2,000	
Installation (pump, wellhead piping/valves)	4	LS	2,000	8,000	
One-time initial extraction well sampling	4	ea	650	2,600	
Power service drop	2	ea	5,000	10,000	
Buried electrical power (480v, 3-phase)	2,800	lin ft	15	39,000	
Buried instrumentation and control wiring	6,300	lin ft	7	44,100	
Electrical pull boxes every 400'	23	ea	500	11,500	
Motor starters for wells (for MCC, main disconnect, see trmit)	4	ea	1,500	6,000	
Controls for well pumps (in new MCC - see below)	4	ea	500	2,000	
Service road to extraction wells	2,350	lin ft	10	23,500	
Subtotal - Extraction Walls				571,000	
<b>Piping</b>					
Secure easements	1	LS	5,000	5,000	
Surveying	3	day	1,000	3,000	
Single-walled piping system (open field)					
6"	5,150	lin ft	64	329,600	
8"	2,400	lin ft	64	153,600	
10"	1,700	lin ft	80	136,000	
Single-walled piping system (in street)					
8"	1,200	lin ft	120	144,000	
Connect 10" pipeline from GET D wells to existing ARGET 10" PE piping	2	LS	2,000	4,000	
Subtotal - Untreated Groundwater Piping				775,000	
<b>Treatment at Modified ARGET Treatment Facility; approximately 3,900 gpm total flow</b>					
Approximately 1,460 gpm from extraction wells 4325, 4330, 4335 and GET D extraction and mass removal wells conveyed via 10" secondary contained pipeline. Also, approx 500 gpm from wells Z1-C2 and -D2. This combined flow would be "pretreated" for perchlorate removal and UV/ox or HIPOx for VOCs reduction and 1,4-dioxane removal.					
Approximately 1,940 gpm from extraction wells North and Southwest of the American River conveyed via 20" pipe to ARGET. This flow would be combined with the "pretreated" flow and treated via air stripping for VOCs removal.					
Slab on grade for ion exchange system (48'x30'x1.5')	1,440	sq ft	20	28,800	
Transfer pumping w/ variable frequency drive	1	ea	25,000	25,000	
Bag pre-filters	2	ea	13,000	26,000	
Ion exchange contactors and valving (12' dia system) up to 2,500 gpm capacity	1	ea	175,000	175,000	
In-plant piping, valving	1	LS	10,000	10,000	
Instrumentation and control/telemetry	1	LS	20,000	20,000	
Electrical	1	LS	10,000	10,000	
General contractor installation (interconnecting piping, valving only)	1	LS	20,000	20,000	
Startup/troubleshooting	1	LS	5,000	5,000	
Subtotal - Treatment				320,000	
<b>Estimated Construction Costs - Subtotal</b>				<b>1,716,000</b>	
Contractor Markup, Mob/demob, Insurance	% of equipment		10	56,000	
Engineering, Permitting and Construction Management	%		15	257,000	
Regulatory Oversight	%		2.5	43,000	
<b>Estimated Project Capital Costs - Subtotal</b>				<b>2,074,000</b>	
Contingency	%		15	311,000	
<b>Estimated Project Capital Costs - Total</b>				<b>2,390,000</b>	

**Estimated Annual Operation, Maintenance, and Monitoring Costs**  
**Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater**

**PGOU FS**

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost (\$/yr)
<b>Estimated O&amp;M Costs</b>					
New perchlorate treatment via ion exchange at approximately 1,960 gpm					
Existing UV/oxidation treatment for 1,4-dioxane removal and VOCs pretreatment at approximately 1,460 gpm					
Removal/polishing of VOCs via existing air stripping process at approximately 3,900 gpm					
Extraction well maintenance		17	ea	200	3,400
Electric utilities:					
Existing containment and mass removal extraction wells 4580 estimate	10	1,500,215	kwh	0.075	112,500
New C1 extraction well:	1	98,002	kwh	0.075	7,400
New C2 extraction well:	1	73,501	kwh	0.075	5,500
New D1 extraction well:	1	147,002	kwh	0.075	11,000
New D2 extraction well:	1	214,378	kwh	0.075	16,100
New 5020:	1	153,127	kwh	0.075	11,500
New 5105:	1	64,681	kwh	0.075	4,900
Transfer pump from influent tank (assume 44 running hp)	1	54,391	kwh	0.075	4,100
UV/oxidation pretreatment (1,460 gpm)	72 kw	285,969	kwh	0.075	21,400
Air stripper blower, effluent transfer pump, misc. power	52 kw	630,720	kwh	0.075	47,300
Ion exchange resin replacement (1,960 gpm)		455,520	kwh	0.075	34,200
UV lamp replacement		3,162	acre-ft	167	528,000
Hydrogen peroxide use (assume 12 mg/L, 35% solution)		205	ea	125	25,600
Materials and expendables (assume same as 2003 ARGET actuals)		7,759	gal	3	23,300
Equip Maintenance (@ % of new equipment capital)		1	LS	45,000	45,000
Equipment Replacement (@ % of new equipment capital)		139,000	%	3	4,200
Labor (incl. fringe benefits):		139,000	%	3	4,200
Operator labor (assume same as 2003 ARGET actuals)		1	year	17,000	17,000
<b>Subtotal - Operation and Maintenance</b>					<b>927,000</b>
Contingency (scope)					
			%	10	92,700
<b>Estimated O&amp;M Costs - Total</b>					<b>1,020,000</b>
 <b>Estimated Monitoring Costs</b>					
Monitoring:					
Monitoring and extraction wells		1	LS	147,000	147,000
ARGET treatment		1	LS	54,000	54,000
<b>Estimated Monitoring Costs - Total</b>					<b>201,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>1,221,000</b>

**Non-Discounted Constant Dollar Cost Estimate**  
**Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater**

Time until RAOs achieved = 151 years (reduce TCE to less than 5 ug/L)

Year	n	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2070	65		1,221,000	1,221,000	84,755,000
2071	66		1,221,000	1,221,000	85,976,000
2072	67		1,221,000	1,221,000	87,197,000
2073	68		1,221,000	1,221,000	88,418,000
2074	69		1,221,000	1,221,000	89,639,000
2075	70	220,000	1,221,000	1,441,000	91,080,000
2076	71		1,221,000	1,221,000	92,301,000
2077	72		1,221,000	1,221,000	93,522,000
2078	73		1,221,000	1,221,000	94,743,000
2079	74		1,221,000	1,221,000	95,964,000
2080	75		1,221,000	1,221,000	97,185,000
2081	76		1,221,000	1,221,000	98,406,000
2082	77		1,221,000	1,221,000	99,627,000
2083	78		1,221,000	1,221,000	100,848,000
2084	79		1,221,000	1,221,000	102,069,000
2085	80	610,000	1,221,000	1,831,000	103,900,000
2086	81		1,221,000	1,221,000	105,121,000
2087	82		1,221,000	1,221,000	106,342,000
2088	83		1,221,000	1,221,000	107,563,000
2089	84		1,221,000	1,221,000	108,784,000
2090	85		1,221,000	1,221,000	110,005,000
2091	86		1,221,000	1,221,000	111,226,000
2092	87		1,221,000	1,221,000	112,447,000
2093	88		1,221,000	1,221,000	113,668,000
2094	89		1,221,000	1,221,000	114,889,000
2095	90	220,000	1,221,000	1,441,000	116,330,000
2096	91		1,221,000	1,221,000	117,551,000
2097	92		1,221,000	1,221,000	118,772,000
2098	93		1,221,000	1,221,000	119,993,000
2099	94		1,221,000	1,221,000	121,214,000
2100	95		1,221,000	1,221,000	122,435,000
2101	96		1,221,000	1,221,000	123,656,000
2102	97		1,221,000	1,221,000	124,877,000
2103	98		1,221,000	1,221,000	126,098,000
2104	99		1,221,000	1,221,000	127,319,000
2105	100	1,810,000	1,221,000	3,031,000	130,350,000
2106	101		1,221,000	1,221,000	131,571,000
2107	102		1,221,000	1,221,000	132,792,000
2108	103		1,221,000	1,221,000	134,013,000
2109	104		1,221,000	1,221,000	135,234,000
2110	105		1,221,000	1,221,000	136,455,000
2111	106		1,221,000	1,221,000	137,676,000
2112	107		1,221,000	1,221,000	138,897,000
2113	108		1,221,000	1,221,000	140,118,000
2114	109		1,221,000	1,221,000	141,339,000
2115	110	220,000	1,221,000	1,441,000	142,780,000
2116	111		1,221,000	1,221,000	144,001,000
2117	112		1,221,000	1,221,000	145,222,000
2118	113		1,221,000	1,221,000	146,443,000
2119	114		1,221,000	1,221,000	147,664,000
2120	115		1,221,000	1,221,000	148,885,000
2121	116		1,221,000	1,221,000	150,106,000
2122	117		1,221,000	1,221,000	151,327,000
2123	118		1,221,000	1,221,000	152,548,000
2124	119		1,221,000	1,221,000	153,769,000
2125	120	610,000	1,221,000	1,831,000	155,600,000
2126	121		1,221,000	1,221,000	156,821,000
2127	122		1,221,000	1,221,000	158,042,000
2128	123		1,221,000	1,221,000	159,263,000
2129	124		1,221,000	1,221,000	160,484,000

# **Detailed Cost Estimates**

## **Alternative Z2-2**

**Capital Cost Estimate**  
**Alternative Z2-2: Contain Zone 2 Groundwater**  
**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost
<b>Estimated Capital Costs:</b>				
<b>Extraction Wells</b>	<b>[3 locations]</b>			
Surveying	3.0	day	1,000	3,000
Secure well permit	3	ea	1,000	3,000
Secure permanent easement	3	LS	1,000	3,000
Extraction wells - drilling and development	<u>No. Wells</u>			
Layer C	3		250	150,000
Layer D	0		250	0
Aquifer pumping test and data reduction	3	LS	6,000	18,000
Well pump discharge piping, 3" SS threaded	600	lin ft	40	24,000
Pumps, incl. elec. cable	3	ea	25,000	75,000
Wellhead vault: H-20 traffic rated	3	ea	5,000	15,000
Flow meter	3	ea	1,500	4,500
Misc. wellhead piping and valves	3	ea	400	1,200
Electrical disconnect switch at well vault	3	ea	500	1,500
Installation (pump, wellhead piping/valves)	3	LS	2,000	6,000
One-time initial extraction well sampling	3	ea	650	2,000
Power service drop	1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)	4,600	lin ft	15	69,000
Buried instrumentation and control wiring	9,000	lin ft	7	63,000
Electrical pull boxes every 400'	34	ea	500	17,000
Motor starters for wells	3	ea	1,500	4,500
Controls for well pumps	3	ea	500	1,500
Service road to extraction wells	4,600	lin ft	10	46,000
<b>Subtotal - Extraction Wells</b>				<b>512,000</b>
<b>Piping</b>				
Secure easements	1	LS	5,000	5,000
Surveying	2	day	1,000	2,000
Single-walled piping system (open field)				
6"	1,700	lin ft	48	81,600
8"	1,400	lin ft	64	89,600
10"	2,200	lin ft	80	176,000
Single-walled untreated groundwater piping system (in street)				
10"	3,800	lin ft	140	532,000
<b>Subtotal - Untreated Groundwater Piping</b>	9,100			<b>886,000</b>
<b>Treatment at GET E/F (additional 1,400 gpm)</b>				
Sitework	1	LS	2,000	2,000
Additional equalization tank capacity	20,000	gal	1	20,000
Booster pump	1	ea	20,000	20,000
Expand fluidized bed reactor (FBR) system	1	ea	1,571,962	1,572,000
Rehab spare 480 kv UV/oxidation equip. for add'l 1,400 gpm, incl. controls, piping, a	1	ea	150,000	150,000
Additional air stripper for add'l 1,400 gpm; including transfer pumps	1	LS	125,000	125,000
In-plant piping, valving	1	LS	20,000	20,000
Instrumentation and control/telemetry	1	LS	5,000	20,000
Electrical	1	LS	10,000	20,000
General contractor installation (tanks, pumps, piping, valving only)	1	LS	10,000	10,000
Startup/troubleshooting	1	LS	5,000	5,000
<b>Subtotal - Treatment</b>				<b>1,964,000</b>
<b>Estimated Construction Costs - Subtotal</b>				<b>3,362,000</b>
Contractor Markup, Mob/demob, Insurance	% of equip/mat'ls		10	76,000
Engineering, Permitting and Construction Management	%		15	504,000
Regulatory Oversight	%		2.5	84,000
<b>Estimated Project Capital Costs - Subtotal</b>				<b>4,026,000</b>
Contingency	%		15	604,000
<b>Estimated Project Capital Costs - Total</b>				<b>4,630,000</b>

**Estimated Annual Operation, Maintenance, and Monitoring Costs**  
**Alternative Z2-2: Contain Zone 2 Groundwater**  
**PGOU FS**

<b>Description</b>	<b>Number</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Rate</b>	<b>Estimated O&amp;M Cost (\$/yr)</b>
Extraction well maintenance		3	ea	200	600
Electric utilities:					
New extraction wells:					
Z2-C1 and -C3	2	220,504	kwh	0.075	16,500
Z2-C2	1	122,502	kwh	0.075	9,200
Proposed booster pumping (assume 100' TDH, 52 running hp)	1	343,005	kwh	0.075	25,700
Air stripper blower, effluent transfer pump	50 kw	438,000	kwh	0.075	32,900
UV/oxidation (additional 1,400 gpm)	144 kw	1,261,440	kwh	0.075	94,600
UV lamp replacement (additional 1,400 gpm)		392	ea	125	49,100
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		9,300	gal	3	27,900
Proposed new FBR O&M costs at 1,400 gpm		2,258	acre-ft	80	180,700
Equip Maintenance (@ % of new equipment capital)		105,500	%	3	3,200
Equipment Replacement (@ % of new equipment capital)		105,500	%	3	3,200
Labor (incl. fringe benefits):					
Existing GET E/F operator labor (incl. w/ GET E/F O&M costs)	1		year	0	0
Subtotal Operation and Maintenance					<b>444,000</b>
Contingency (scope)			%	10	44,400
<b>Estimated O&amp;M Costs - Total</b>					<b>488,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells		1	LS	36,000	36,000
GET E/F treatment		1	LS	4,000	4,000
Subtotal Monitoring					<b>40,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>528,000</b>

**Non-Discounted Constant Dollar Cost Estimate  
Alternative Z2-2: Contain Zone 2 Groundwater**

Time until RAOs achieved = 232 years (reduce TCE to less than 5 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2188	183		528,000	528,000	132,456,000
2189	184		528,000	528,000	132,984,000
2190	185		528,000	528,000	133,512,000
2191	186		528,000	528,000	134,040,000
2192	187		528,000	528,000	134,568,000
2193	188		528,000	528,000	135,096,000
2194	189		528,000	528,000	135,624,000
2195	190	156,000	528,000	684,000	136,308,000
2196	191		528,000	528,000	136,836,000
2197	192		528,000	528,000	137,364,000
2198	193		528,000	528,000	137,892,000
2199	194		528,000	528,000	138,420,000
2200	195		528,000	528,000	138,948,000
2201	196		528,000	528,000	139,476,000
2202	197		528,000	528,000	140,004,000
2203	198		528,000	528,000	140,532,000
2204	199		528,000	528,000	141,060,000
2205	200	4,910,000	528,000	5,438,000	146,498,000
2206	201		528,000	528,000	147,026,000
2207	202		528,000	528,000	147,554,000
2208	203		528,000	528,000	148,082,000
2209	204		528,000	528,000	148,610,000
2210	205		528,000	528,000	149,138,000
2211	206		528,000	528,000	149,666,000
2212	207		528,000	528,000	150,194,000
2213	208		528,000	528,000	150,722,000
2214	209		528,000	528,000	151,250,000
2215	210	156,000	528,000	684,000	151,934,000
2216	211		528,000	528,000	152,462,000
2217	212		528,000	528,000	152,990,000
2218	213		528,000	528,000	153,518,000
2219	214		528,000	528,000	154,046,000
2220	215		528,000	528,000	154,574,000
2221	216		528,000	528,000	155,102,000
2222	217		528,000	528,000	155,630,000
2223	218		528,000	528,000	156,158,000
2224	219		528,000	528,000	156,686,000
2225	220	3,014,000	528,000	3,542,000	160,228,000
2226	221		528,000	528,000	160,756,000
2227	222		528,000	528,000	161,284,000
2228	223		528,000	528,000	161,812,000
2229	224		528,000	528,000	162,340,000
2230	225		528,000	528,000	162,868,000
2231	226		528,000	528,000	163,396,000
2232	227		528,000	528,000	163,924,000
2233	228		528,000	528,000	164,452,000
2234	229		528,000	528,000	164,980,000
2235	230	156,000	528,000	684,000	165,664,000
2236	231		528,000	528,000	166,192,000
2237	232		528,000	528,000	166,720,000

# **Detailed Cost Estimates**

## **Alternative Z2-3**

**Capital Cost Estimate**  
**Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater**  
**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost	
<b>Estimated Capital Costs:</b>					
<b>Extraction Wells [3 locations]</b>					
Surveying	3.0	day	1,000	3,000	
Secure well permit	3	ea	1,000	3,000	
Secure permanent easement	4	LS	1,000	4,000	
Extraction wells - drilling and development	<u>No. Wells</u>				
Layer C	3	200	ft	250	150,000
Layer D	0	250	ft	250	0
Aquifer pumping test and data reduction	4	LS	6,000	24,000	
Well pump discharge piping, 3" SS threaded	600	lin ft	40	24,000	
Pumps, incl. elec. cable	4	ea	25,000	100,000	
Wellhead vault: H-20 traffic rated	4	ea	5,000	20,000	
Flow meter	4	ea	1,500	6,000	
Misc. wellhead piping and valves	4	ea	400	1,600	
Electrical disconnect switch at well vault	4	ea	500	2,000	
Installation (pump, wellhead piping/valves)	4	LS	2,000	8,000	
One-time initial extraction well sampling	4	ea	650	2,600	
Power service drop	2	ea	5,000	10,000	
Buried electrical power (480v, 3-phase)	4,600	lin ft	15	69,000	
Buried instrumentation and control wiring	13,600	lin ft	7	95,200	
Electrical pull boxes every 400'	46	ea	500	23,000	
Motor starters for wells	4	ea	1,500	6,000	
Controls for well pumps	4	ea	500	2,000	
Service road to extraction wells	4,600	lin ft	10	46,000	
Subtotal - Extraction Wells				599,000	
<b>Piping</b>					
Secure easements	1	LS	5,000	5,000	
Surveying	2	day	1,000	2,000	
Single-walled piping system (open field) - 3 new wells					
6"	1,700	lin ft	48	81,600	
8"	1,400	lin ft	64	89,600	
10"	2,200	lin ft	80	176,000	
Single-walled untreated groundwater piping system (in street) - 3 new wells					
10"	3,800	lin ft	140	532,000	
Single-walled untreated groundwater piping system (open field) - Well 4420 to GET B					
6"	4,600	lin ft	48	220,800	
Subtotal - Untreated Groundwater Piping	13,700			1,107,000	
<b>Treatment at GET E/F (additional 1,400 gpm)</b>					
Sitework	1	LS	2,000	2,000	
Additional equalization tank capacity	20,000	gal	1	20,000	
Booster pump	1	ea	20,000	20,000	
Expand fluidized bed reactor (FBR) system	1	ea	1,571,962	1,572,000	
Rehab spare 480 kv UV/oxidation equip. for add'l 1,400 gpm, incl. controls, piping, appurten., ins	1	ea	150,000	150,000	
Additional air stripper for add'l 1,400 gpm; including transfer pumps	1	LS	125,000	125,000	
In-plant piping, valving	1	LS	20,000	20,000	
Instrumentation and control/telemetry	1	LS	5,000	20,000	
Electrical	1	LS	10,000	20,000	
General contractor installation (tanks, pumps, piping, valving only)	1	LS	10,000	10,000	
Startup/troubleshooting	1	LS	5,000	5,000	
Subtotal - Treatment at GET E/F				1,964,000	
<b>Treatment at GET B (expand 150 gpm for Well 4420)</b>					
Existing ion exchange contactors at GET B can accommodate add'l 150 gpm	0	ea	150,000	0	
Add'l UV/oxidation equip. at 150 gpm, incl. controls, piping, appurten., install'n	1	ea	130,000	130,000	
In-plant piping, valving	1	LS	5,000	5,000	
Instrumentation and control/telemetry	1	LS	5,000	5,000	
Electrical	1	LS	5,000	5,000	
General contractor installation (tanks, pumps, piping, valving only)	1	LS	5,000	5,000	
Startup/troubleshooting	1	LS	1,000	1,000	
Subtotal - Treatment				151,000	
<b>Estimated Construction Costs - Subtotal</b>				<b>3,821,000</b>	
Contractor Markup, Mob/demob, Insurance	% of equip/mat'ls		10	92,000	
Engineering, Permitting and Construction Management	%		15	573,000	
Regulatory Oversight	%		2.5	96,000	
<b>Estimated Project Capital Costs - Subtotal</b>				<b>4,582,000</b>	
Contingency	%		15	687,000	
<b>Estimated Project Capital Costs - Total</b>				<b>5,270,000</b>	

**Estimated Annual Operation, Maintenance, and Monitoring Costs**  
**Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater**  
**PGOU FS**

<b>Description</b>	<b>Number</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Rate</b>	<b>Estimated O&amp;M Cost (\$/yr)</b>
Extraction well maintenance		5	ea	200	1,000
Electric utilities:					
Extraction wells:					
Z2-C1 and -C3	2	220,504	kwh	0.075	16,500
Z2-C2	1	122,502	kwh	0.075	9,200
4420	1	36,751	kwh	0.075	2,800
GET E/F					
Electric utilities:					
Proposed booster pumping (assume 100' TDH, 52 run hp)	1	343,005	kwh	0.075	25,700
UV/oxidation (additional 1,400 gpm)	144 kw	1,261,440	kwh	0.075	94,600
Air stripper blower, effluent transfer pump	50 kw	438,000	kwh	0.075	32,900
UV lamp replacement (additional 1,400 gpm)		392	ea	125	49,100
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		9,300	gal	3	27,900
Proposed new FBR O&M costs at 1,400 gpm		2,258	acre-ft	80	180,700
GET B					
Electric utilities:					
UV/oxidation (additional 150 gpm)	15 kw	131,400	kwh	0.075	9,900
UV lamp replacement (additional 150 gpm)		42	ea	125	5,300
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		996	gal	3	3,000
Ion exchange resin replacement (150 gpm)		242	acre-ft	167	40,400
Equip Maintenance (@ % of new equipment capital)		134,000	%	3	4,000
Equipment Replacement (@ % of new equipment capital)		134,000	%	3	4,000
Labor (incl. fringe benefits):					
Existing GET E/F and GET B operator labor (incl. w/ exist O&M costs)	1	year		0	0
Subtotal Operation and Maintenance					507,000
Contingency (scope)			%	10	50,700
<b>Estimated O&amp;M Costs - Total</b>					<b>558,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells	1	LS		36,000	36,000
GET B treatment	1	LS		4,000	4,000
GET E/F treatment	1	LS		4,000	4,000
Subtotal Monitoring					<b>44,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>602,000</b>

**Non-Discounted Constant Dollar Cost Estimate**

**Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater**

Time until RAOs achieved = 131 years (reduce TCE to less than 5 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2133	128		602,000	602,000	103,276,000
2134	129		602,000	602,000	103,878,000
2135	130	90,000	602,000	692,000	104,570,000
2136	131		602,000	602,000	105,172,000

# **Detailed Cost Estimates**

## **Alternative Z3-2**

**Capital Cost Estimate**  
**Alternative Z3-2 Contain and Remediate Zone 3 Groundwater**  
**(Ion Exchange for perchlorate removal)**  
**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost
<b>Estimated Capital Costs:</b>				
<b>Extraction Wells [12 new wells, 6 locations]</b>				
Surveying	4.0	day	1,000	4,000
Secure well permit	12	ea	1,000	12,000
Secure permanent easement	12	LS	1,000	12,000
Extraction wells - drilling and development				
	<u>No. Wells</u>			
Layer C	3	200	ft	250
Layer D	3	250	ft	250
Layers E/F	6	300	ft	250
Aquifer pumping test and data reduction	12	LS	6,000	72,000
Well pump discharge piping, 3" SS threaded	3,150	lin ft	40	126,000
Pumps, incl. elec. Cable: 15 hp or less	3	ea	15,000	45,000
Pumps, incl. elec. Cable: greater than 15 hp	9	ea	35,000	315,000
Wellhead vault: H-20 traffic rated	12	ea	5,000	60,000
Flow meter	12	ea	1,500	18,000
Misc. wellhead piping and valves	12	ea	400	4,800
Electrical disconnect switch at well vault	12	ea	500	6,000
Installation (pump, wellhead piping/valves)	12	LS	2,000	24,000
One-time initial extraction well sampling	12	ea	650	7,800
Power service drop (at Grant Line Rd)	1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)	9,200	lin ft	15	138,000
Buried instrumentation and control wiring	0	lin ft	7	0
Electrical pull boxes every 400'	26	ea	500	13,000
Motor starters for wells (for MCC, main disconnect, see trmt)	12	ea	1,500	18,000
Controls for well pumps (in new MCC - see below)	12	ea	500	6,000
Radio repeaters for new wells (control from GET B GWTF)	1	ea	20,000	20,000
Service road to extraction wells	9,200	lin ft	10	92,000
Subtotal - Extraction Wells				1,786,000
<b>Piping</b>				
Secure easements	1	LS	5,000	5,000
Surveying	2	day	1,000	2,000
Single-walled piping system (open field)				
6"	5,100	lin ft	48	244,800
8"	4,100	lin ft	64	262,400
Subtotal - Untreated Groundwater Piping	9,200			514,000
<b>Treatment at GET B ( approximately 1,900 gpm)</b>				
Sitework	1	LS	5,000	5,000
Expand existing pre-engineered metal building: 20'x40'	800	sq ft	50	40,000
Add'l UV/oxidation equip. at 400 gpm, incl. controls, piping, appurten., install'n	1	ea	346,000	346,000
In-plant piping, valving	1	LS	20,000	20,000
Instrumentation and control/telemetry	1	LS	30,000	30,000
Electrical MCC, main disconnect (exists)	0	LS	10,000	0
Electrical	1	LS	40,000	40,000
General contractor installation (tanks, pumps, piping, valving only)	1	LS	50,000	50,000
Startup/troubleshooting	1	LS	10,000	10,000
Subtotal - Treatment				541,000
<b>Estimated Construction Costs - Subtotal</b>				<b>2,841,000</b>
Contractor Markup, Mob/demob, Insurance		% of equipment	10	60,000
Engineering, Permitting and Construction Management		%	15	426,000
Regulatory Oversight		%	2.5	71,000
<b>Estimated Project Capital Costs - Subtotal</b>				<b>3,398,000</b>
Contingency		%	15	510,000
<b>Estimated Project Capital Costs - Total</b>				<b>3,910,000</b>

**Estimated Annual Operation, Maintenance, and Monitoring Costs  
Alternative Z3-2 Contain and Remediate Zone 3 Groundwater  
(Ion Exchange for perchlorate removal)**

**PGOU FS**

<b>Description</b>	<b>Number</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Rate</b>	<b>Estimated O&amp;M Cost (\$/yr)</b>
<b>Operation and Maintenance:</b>					
Extraction well maintenance		18	ea	200	3,600
Electric utilities:					
Existing extraction wells:					
4570 (flow increased from 60 to 400 gpm)	1	196,003	kwh	0.075	14,700
4505, -10, -15, -20-, -25 (52 gpm)	1	112,398	kwh	0.075	8,400
New extraction wells:					
Z3-C1 and -2 (100 gpm, est. 7.5 running hp)	2	98,002	kwh	0.075	7,400
Z3-C3 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-D1 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z3-D2 and -3 (250 gpm, est. 18.7 running hp)	2	245,004	kwh	0.075	18,400
Z3-E1 (150 gpm, est. 11.2 running hp)	1	73,501	kwh	0.075	5,500
Z3-E2 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z3-E3 (80 gpm, est. 6 running hp)	1	39,201	kwh	0.075	2,900
Z3-F1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
Z3-F2 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-F3 (120 gpm, est. 9 running hp)	1	58,801	kwh	0.075	4,400
UV/oxidation (2 systems: 1 existing, 1 new) 1,900 gpm	190 kw	1,664,400	kwh	0.075	124,800
Air stripper blowers (20 hp)	2	261,749	kwh	0.075	39,000
Ion exchange resin replacement (1,900 gpm)		3,065	acre-ft	167	511,800
UV lamp replacement		533	ea	125	66,600
Hydrogen peroxide use (assume 5 mg/L, 35% solution)		12,622	gal	3	37,900
Equip Maintenance (@ % of new equipment capital)		402,000	%	3	12,100
Equipment Replacement (@ % of new equipment capital)		402,000	%	3	12,100
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET B)		1	year	17,000	17,000
Subtotal Operation and Maintenance					<b>901,300</b>
				Contingency (scope)	
				%	10
					90,100
<b>Estimated O&amp;M Costs - Total</b>					<b>991,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells		1	LS	157,000	157,000
GET B treatment		1	LS	15,000	15,000
Subtotal Monitoring					<b>172,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>1,163,000</b>

**Non-Discounted Constant Dollar Cost Estimate  
Alternative Z3-2 Contain and Remediate Zone 3 Groundwater  
(Ion Exchange for perchlorate removal)**

**PGOU FS**

Time until RAOs achieved = 327 years (reduce NDMA to less than 0.0017 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2305	300	4,120,000	1,163,000	5,283,000	396,520,000
2306	301		1,163,000	1,163,000	397,683,000
2307	302		1,163,000	1,163,000	398,846,000
2308	303		1,163,000	1,163,000	400,009,000
2309	304		1,163,000	1,163,000	401,172,000
2310	305		1,163,000	1,163,000	402,335,000
2311	306		1,163,000	1,163,000	403,498,000
2312	307		1,163,000	1,163,000	404,661,000
2313	308		1,163,000	1,163,000	405,824,000
2314	309		1,163,000	1,163,000	406,987,000
2315	310	590,000	1,163,000	1,753,000	408,740,000
2316	311		1,163,000	1,163,000	409,903,000
2317	312		1,163,000	1,163,000	411,066,000
2318	313		1,163,000	1,163,000	412,229,000
2319	314		1,163,000	1,163,000	413,392,000
2320	315		1,163,000	1,163,000	414,555,000
2321	316		1,163,000	1,163,000	415,718,000
2322	317		1,163,000	1,163,000	416,881,000
2323	318		1,163,000	1,163,000	418,044,000
2324	319		1,163,000	1,163,000	419,207,000
2325	320	1,450,000	1,163,000	2,613,000	421,820,000
2326	321		1,163,000	1,163,000	422,983,000
2327	322		1,163,000	1,163,000	424,146,000
2328	323		1,163,000	1,163,000	425,309,000
2329	324		1,163,000	1,163,000	426,472,000
2330	325		1,163,000	1,163,000	427,635,000
2331	326		1,163,000	1,163,000	428,798,000
2332	327		1,163,000	1,163,000	429,961,000

**Detailed Cost Estimates**

**Alternative Z3-3**

**Capital Cost Estimate**

**Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater  
(Ion Exchange for perchlorate removal)**

**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost
<b>Estimated Capital Costs:</b>				
<b>Extraction Wells [12 new wells, 6 locations]</b>				
Surveying	4.0	day	1,000	4,000
Secure well permit	12	ea	1,000	12,000
Secure permanent easement	12	LS	1,000	12,000
Extraction wells - drilling and development				
	<u>No. Wells</u>			
Layer C	3	200	ft	250
Layer D	3	250	ft	250
Layers E/F	6	300	ft	250
Aquifer pumping test and data reduction	12	LS	6,000	72,000
Well pump discharge piping, 3" SS threaded	3,150	lin ft	40	126,000
Pumps, incl. elec. Cable: 15 hp or less	3	ea	15,000	45,000
Pumps, incl. elec. Cable: greater than 15 hp	9	ea	35,000	315,000
Wellhead vault: H-20 traffic rated	12	ea	5,000	60,000
Flow meter	12	ea	1,500	18,000
Misc. wellhead piping and valves	12	ea	400	4,800
Electrical disconnect switch at well vault	12	ea	500	6,000
Installation (pump, wellhead piping/valves)	12	LS	2,000	24,000
One-time initial extraction well sampling	12	ea	650	7,800
Power service drop (at Grant Line Rd)	1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)	9,200	lin ft	15	138,000
Buried instrumentation and control wiring	0	lin ft	7	0
Electrical pull boxes every 400'	26	ea	500	13,000
Motor starters for wells (for MCC, main disconnect, see trmt)	12	ea	1,500	18,000
Controls for well pumps (in new MCC - see below)	12	ea	500	6,000
Radio repeater for new wells (control from GET B GWTF)	1	ea	20,000	20,000
Service road to extraction wells	9,200	lin ft	10	92,000
Subtotal - Extraction Wells				1,786,000
<b>Piping</b>				
Secure easements	1	LS	5,000	5,000
Surveying	2	day	1,000	2,000
Single-walled piping system (open field)				
6"	5,100	lin ft	48	244,800
8"	4,100	lin ft	64	262,400
Subtotal - Untreated Groundwater Piping	9,200			514,000
<b>Treatment at GET B ( approximately 2,550 gpm)</b>				
Sitework	1	LS	5,000	5,000
Expand existing pre-engineered metal building: 20'x40'	800	sq ft	50	40,000
Add'l ion exchange capacity (12' dia system, 1,000 gpm) includes install'n	1	ea	150,000	150,000
Add'l UV/oxidation equip. at 1,050 gpm, incl. controls, piping, appurten., install'n	1	ea	908,000	908,000
In-plant piping, valving	1	LS	20,000	20,000
Instrumentation and control/telemetry	1	LS	30,000	30,000
Electrical MCC, main disconnect (exists)	0	LS	10,000	0
Electrical	1	LS	40,000	40,000
General contractor installation (tanks, pumps, piping, valving only)	1	LS	50,000	50,000
Startup/troubleshooting	1	LS	10,000	10,000
Subtotal - Treatment				1,253,000
<b>Estimated Construction Costs - Subtotal</b>				<b>3,553,000</b>
Contractor Markup, Mob/demob, Insurance		% of equipment	10	60,000
Engineering, Permitting and Construction Management		%	15	533,000
Regulatory Oversight		%	2.5	89,000
<b>Estimated Project Capital Costs - Subtotal</b>				<b>4,235,000</b>
Contingency		%	15	635,000
<b>Estimated Project Capital Costs - Total</b>				<b>4,870,000</b>

**Estimated Annual Operation, Maintenance, and Monitoring Costs**  
**Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater**  
**(Ion Exchange for perchlorate removal)**

**PGOU FS**

<b>Description</b>	<b>Number</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Rate</b>	<b>Estimated O&amp;M Cost (\$/yr)</b>
<b>Operation and Maintenance:</b>					
Extraction well maintenance		24	ea	200	4,800
Electric utilities:					
Existing extraction wells:					
4570 (flow increased from 60 to 400 gpm)	1	196,003	kwh	0.075	14,700
4303, 4405, 4450	1	495,326	kwh	0.075	37,100
4011	1	12,250	kwh	0.075	900
4475	1	49,001	kwh	0.075	3,700
4480	1	122,502	kwh	0.075	9,200
4505, -10, -15, -20-, -25 (52 gpm)	1	112,398	kwh	0.075	8,400
New extraction wells:					
Z3-C1 and -2 (100 gpm, est. 7.5 running hp)	2	98,002	kwh	0.075	7,400
Z3-C3 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-D1 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z3-D2 and -3 (250 gpm, est. 18.7 running hp)	2	245,004	kwh	0.075	18,400
Z3-E1 (150 gpm, est. 11.2 running hp)	1	73,501	kwh	0.075	5,500
Z3-E2 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z3-E3 (80 gpm, est. 6 running hp)	1	39,201	kwh	0.075	2,900
Z3-F1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
Z3-F2 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-F3 (120 gpm, est. 9 running hp)	1	58,801	kwh	0.075	4,400
Transfer pumps (assume 40' TDH, 29 run hp)	2	500,788	kwh	0.075	37,600
UV/oxidation (2 systems: 1 existing, 1 new) 2,550 gpm	250 kw	2,190,000	kwh	0.075	164,300
Air stripper blowers (20 hp)	2	261,749	kwh	0.075	39,000
Ion exchange resin replacement (2,550 gpm)		4,113	acre-ft	167	686,900
UV lamp replacement		716	ea	125	89,500
Hydrogen peroxide use (assume 5 mg/L, 35% solution)		16,940	gal	3	50,800
Equip Maintenance (@ % of new equipment capital)		402,000	%	3	12,100
Equipment Replacement (@ % of new equipment capital)		402,000	%	3	12,100
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET B)		1	year	17,000	17,000
<b>Subtotal Operation and Maintenance</b>					<b>1,241,400</b>
Contingency (scope)			%	10	124,100
<b>Estimated O&amp;M Costs - Total</b>					<b>1,366,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells		1	LS	157,000	157,000
GET B treatment		1	LS	15,000	15,000
<b>Subtotal Monitoring</b>					<b>172,000</b>
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>1,538,000</b>

**Non-Discounted Constant Dollar Cost Estimate**  
**Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater**  
**(Ion Exchange for perchlorate removal)**

**PGOU FS**

Time until RAOs achieved = 263 years (reduce NDMA to less than 0.0017 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2215	210	590,000	1,538,000	2,128,000	367,620,000
2216	211		1,538,000	1,538,000	369,158,000
2217	212		1,538,000	1,538,000	370,696,000
2218	213		1,538,000	1,538,000	372,234,000
2219	214		1,538,000	1,538,000	373,772,000
2220	215		1,538,000	1,538,000	375,310,000
2221	216		1,538,000	1,538,000	376,848,000
2222	217		1,538,000	1,538,000	378,386,000
2223	218		1,538,000	1,538,000	379,924,000
2224	219		1,538,000	1,538,000	381,462,000
2225	220	2,430,000	1,538,000	3,968,000	385,430,000
2226	221		1,538,000	1,538,000	386,968,000
2227	222		1,538,000	1,538,000	388,506,000
2228	223		1,538,000	1,538,000	390,044,000
2229	224		1,538,000	1,538,000	391,582,000
2230	225		1,538,000	1,538,000	393,120,000
2231	226		1,538,000	1,538,000	394,658,000
2232	227		1,538,000	1,538,000	396,196,000
2233	228		1,538,000	1,538,000	397,734,000
2234	229		1,538,000	1,538,000	399,272,000
2235	230	590,000	1,538,000	2,128,000	401,400,000
2236	231		1,538,000	1,538,000	402,938,000
2237	232		1,538,000	1,538,000	404,476,000
2238	233		1,538,000	1,538,000	406,014,000
2239	234		1,538,000	1,538,000	407,552,000
2240	235		1,538,000	1,538,000	409,090,000
2241	236		1,538,000	1,538,000	410,628,000
2242	237		1,538,000	1,538,000	412,166,000
2243	238		1,538,000	1,538,000	413,704,000
2244	239		1,538,000	1,538,000	415,242,000
2245	240	2,430,000	1,538,000	3,968,000	419,210,000
2246	241		1,538,000	1,538,000	420,748,000
2247	242		1,538,000	1,538,000	422,286,000
2248	243		1,538,000	1,538,000	423,824,000
2249	244		1,538,000	1,538,000	425,362,000
2250	245		1,538,000	1,538,000	426,900,000
2251	246		1,538,000	1,538,000	428,438,000
2252	247		1,538,000	1,538,000	429,976,000
2253	248		1,538,000	1,538,000	431,514,000
2254	249		1,538,000	1,538,000	433,052,000
2255	250	2,350,000	1,538,000	3,888,000	436,940,000
2256	251		1,538,000	1,538,000	438,478,000
2257	252		1,538,000	1,538,000	440,016,000
2258	253		1,538,000	1,538,000	441,554,000
2259	254		1,538,000	1,538,000	443,092,000
2260	255		1,538,000	1,538,000	444,630,000
2261	256		1,538,000	1,538,000	446,168,000
2262	257		1,538,000	1,538,000	447,706,000
2263	258		1,538,000	1,538,000	449,244,000
2264	259		1,538,000	1,538,000	450,782,000
2265	260	2,430,000	1,538,000	3,968,000	454,750,000
2266	261		1,538,000	1,538,000	456,288,000
2267	262		1,538,000	1,538,000	457,826,000
2268	263		1,538,000	1,538,000	459,364,000

# **Detailed Cost Estimates**

## **Alternative Z4-2**

**Capital Cost Estimate**  
**Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)**  
**PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost
<b>Estimated Capital Costs:</b>				
<b>Extraction Wells</b>	<b>[7 locations]</b>			
Surveying	4	day	1,000	4,000
Secure well permit	7	ea	1,000	7,000
Secure permanent easement (owned by Aerojet)	0	LS	1,000	0
Extraction wells - drilling and development	<u>No. Wells</u>			
Layer A	6	ft	200	120,000
Layer B	1	ft	200	30,000
Aquifer pumping test and data reduction	7	LS	6,000	42,000
Well pump discharge piping, 3" SS threaded	750	lin ft	40	30,000
Pumps, incl. elec. cable	7	ea	10,000	70,000
Wellhead vault: H-20 traffic rated	7	ea	5,000	35,000
Flow meter	7	ea	1,500	10,500
Misc. wellhead piping and valves	7	ea	400	2,800
Electrical disconnect switch at well vault	7	ea	500	3,500
Installation (pump, wellhead piping/valves)	7	LS	2,000	14,000
One-time initial extraction well sampling	7	ea	650	4,600
Power service drop	1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)	8,200	lin ft	15	123,000
Buried instrumentation and control wiring	11,600	lin ft	7	81,200
Electrical pull boxes every 400'	50	ea	500	25,000
Motor starters for wells (for MCC, main disconnect, see trmt)	7	ea	1,500	10,500
Controls for well pumps (in new MCC - see below)	7	ea	500	3,500
Service road to extraction wells	1,800	lin ft	10	18,000
Subtotal - Extraction Wells				640,000
<b>Piping</b>				
Secure easements (owned by Aerojet)	0	LS	5,000	0
Surveying	3	day	1,000	3,000
Single-walled piping system (open field)				
6"	5,200	lin ft	48	249,600
8"	6,400	lin ft	64	409,600
Subtotal - Untreated Groundwater Piping	11,600			662,000
<b>Expand Existing GET A Groundwater Treatment Facility</b>				
<b>New wells 430 gpm (ion exchange for perchlorate removal)</b>				
<b>Total flow 640 gpm (NDMA and VOCs removal)</b>				
Slab-on-grade for air stripper and transfer pump (assume 40'x40'x1.5')	1,600	sq ft	20	32,000
Bag filter housing	1	ea	13,000	13,000
Ion exchange equipment (430 gpm from proposed Sector C wells)	1	ea	150,000	150,000
Low watt UV/oxidation equipment (add'l 240 gpm above exist. 400 gpm)	1	ea	381,000	381,000
Air stripper and blower (replace existing)	1	ea	100,000	100,000
Effluent transfer pumping	1	ea	6,000	6,000
Misc process piping, supports, appurtenances	1	LS	10,000	10,000
Instrumentation and control/telemetry	1	LS	10,000	10,000
MCC and main disconnect exists, combo motor starter for blower, pump	2	LS	1,500	3,000
Electrical	1	LS	10,000	10,000
General contractor installation	1	LS	15,000	15,000
Startup/troubleshooting	1	LS	5,000	5,000
Subtotal - Treatment				735,000
<b>Estimated Construction Costs - Subtotal</b>				<b>2,037,000</b>
Contractor Markup, Mob/demob, Insurance	% of materials		10	57,000
Engineering, Permitting and Construction Management			%	15
Regulatory Oversight			%	2.5
<b>Estimated Project Capital Costs - Subtotal</b>				<b>2,451,000</b>
Contingency			%	15
<b>Estimated Project Capital Costs - Total</b>				<b>2,820,000</b>

**Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)  
PGOU FS**

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost (\$/yr)
Extraction well maintenance		14	ea	200	2,800
Electric utilities:					
Existing 7 containment extraction wells		270,500	kwh	0.075	20,300
New extraction wells:					
Z4-A1 (15 gpm, est. 1.1 running hp)	1	7,350	kwh	0.075	600
Z4-A2 (25 gpm, est. 1.9 running hp)	1	12,250	kwh	0.075	900
Z4-A3 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z4-A4 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z4-A5 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z4-A6 (40 gpm, est. 3.0 running hp)	1	19,600	kwh	0.075	1,500
Z4-B1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
UV/oxidation (640 gpm)	95 kw	832,200	kwh	0.075	62,400
Air stripper blower	10 hp	65,437	kwh	0.075	4,900
Site area lighting	2 kw	17,520	kwh	0.075	1,300
UV lamp replacement		269	ea	125	33,600
Hydrogen peroxide use (assume 7 mg/L, 35% solution)		5,952	gal	3	17,900
Ion exchange resin replacement (430 gpm)		694	acre-ft	167	115,800
Equip Maintenance (@ % of new equipment capital)		100,500	%	3	3,000
Equipment Replacement (@ % of new equipment capital)		100,500	%	3	3,000
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET A)		1	year	6,000	6,000
Subtotal Operation and Maintenance					287,000
Contingency (scope)					28,700
<b>Estimated O&amp;M Costs - Total</b>					<b>316,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells		1	LS	51,000	51,000
GET A treatment		1	LS	10,000	10,000
Subtotal Monitoring					61,000
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>377,000</b>

**Non-Discounted Constant Dollar Cost Estimate**  
**Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)**

Time until RAOs achieved = 347 years (reduce NDMA to less than 0.0017 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2305	300	2,970,000	377,000	3,347,000	142,440,000
2306	301		377,000	377,000	142,817,000
2307	302		377,000	377,000	143,194,000
2308	303		377,000	377,000	143,571,000
2309	304		377,000	377,000	143,948,000
2310	305		377,000	377,000	144,325,000
2311	306		377,000	377,000	144,702,000
2312	307		377,000	377,000	145,079,000
2313	308		377,000	377,000	145,456,000
2314	309		377,000	377,000	145,833,000
2315	310	120,000	377,000	497,000	146,330,000
2316	311		377,000	377,000	146,707,000
2317	312		377,000	377,000	147,084,000
2318	313		377,000	377,000	147,461,000
2319	314		377,000	377,000	147,838,000
2320	315		377,000	377,000	148,215,000
2321	316		377,000	377,000	148,592,000
2322	317		377,000	377,000	148,969,000
2323	318		377,000	377,000	149,346,000
2324	319		377,000	377,000	149,723,000
2325	320	1,200,000	377,000	1,577,000	151,300,000
2326	321		377,000	377,000	151,677,000
2327	322		377,000	377,000	152,054,000
2328	323		377,000	377,000	152,431,000
2329	324		377,000	377,000	152,808,000
2330	325		377,000	377,000	153,185,000
2331	326		377,000	377,000	153,562,000
2332	327		377,000	377,000	153,939,000
2333	328		377,000	377,000	154,316,000
2334	329		377,000	377,000	154,693,000
2335	330	120,000	377,000	497,000	155,190,000
2336	331		377,000	377,000	155,567,000
2337	332		377,000	377,000	155,944,000
2338	333		377,000	377,000	156,321,000
2339	334		377,000	377,000	156,698,000
2340	335		377,000	377,000	157,075,000
2341	336		377,000	377,000	157,452,000
2342	337		377,000	377,000	157,829,000
2343	338		377,000	377,000	158,206,000
2344	339		377,000	377,000	158,583,000
2345	340	1,200,000	377,000	1,577,000	160,160,000
2346	341		377,000	377,000	160,537,000
2347	342		377,000	377,000	160,914,000
2348	343		377,000	377,000	161,291,000
2349	344		377,000	377,000	161,668,000
2350	345		377,000	377,000	162,045,000
2351	346		377,000	377,000	162,422,000
2352	347		377,000	377,000	162,799,000

**Detailed Cost Estimates**

**Alternative Z4-3**

**Capital Cost Estimate**

**Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)  
PGOU FS**

Description	Quantity	Units	Unit Rate	Estimated Cost
<b>Estimated Capital Costs:</b>				
<b>Extraction Wells</b>	<b>[7 locations]</b>			
Surveying	4	day	1,000	4,000
Secure well permit	7	ea	1,000	7,000
Secure permanent easement (owned by Aerojet)	0	LS	1,000	0
Extraction wells - drilling and development	<u>No. Wells</u>			
Layer A	6	ft	200	120,000
Layer B	1	ft	200	30,000
Aquifer pumping test and data reduction	7	LS	6,000	42,000
Well pump discharge piping, 3" SS threaded	750	lin ft	40	30,000
Pumps, incl. elec. cable	7	ea	10,000	70,000
Wellhead vault: H-20 traffic rated	7	ea	5,000	35,000
Flow meter	7	ea	1,500	10,500
Misc. wellhead piping and valves	7	ea	400	2,800
Electrical disconnect switch at well vault	7	ea	500	3,500
Installation (pump, wellhead piping/valves)	7	LS	2,000	14,000
One-time initial extraction well sampling	7	ea	650	4,600
Power service drop	1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)	8,200	lin ft	15	123,000
Buried instrumentation and control wiring	11,600	lin ft	7	81,200
Electrical pull boxes every 400'	50	ea	500	25,000
Motor starters for wells (for MCC, main disconnect, see trmt)	7	ea	1,500	10,500
Controls for well pumps (in new MCC - see below)	7	ea	500	3,500
Service road to extraction wells	1,800	lin ft	10	18,000
<b>Subtotal - Extraction Wells</b>				<b>640,000</b>
<b>Piping</b>				
Secure easements (owned by Aerojet)	0	LS	5,000	0
Surveying	3	day	1,000	3,000
Single-walled piping system (open field)				
6"	5,200	lin ft	48	249,600
8"	6,400	lin ft	64	409,600
<b>Subtotal - Untreated Groundwater Piping</b>				<b>662,000</b>
<b>Expand Existing GET A Groundwater Treatment Facility</b>				
<b>New wells + mass removal wells 450 gpm (ion exchange for perchlorate removal)</b>				
<b>Total flow 670 gpm (NDMA and VOCs removal)</b>				
Slab-on-grade for air stripper and transfer pump (assume 40'x40'x1.5')	1,600	sq ft	20	32,000
Bag filter housing	1	ea	13,000	13,000
Ion exchange equipment (450 gpm from Sector C + mass removal wells)	1	ea	150,000	150,000
Low watt UV/oxidation equipment (add'l 270 gpm above exist. 400 gpm)	1	ea	428,000	428,000
Air stripper and blower (replace existing)	1	ea	100,000	100,000
Effluent transfer pumping	1	ea	6,000	6,000
Misc process piping, supports, appurtenances	1	LS	15,000	15,000
Instrumentation and control/telemetry	1	LS	10,000	10,000
MCC and main disconnect exists, combo motor starter for blower, pump	2	LS	1,500	3,000
Electrical	1	LS	10,000	10,000
General contractor installation	1	LS	15,000	15,000
Startup/troubleshooting	1	LS	5,000	5,000
<b>Subtotal - Treatment</b>				<b>787,000</b>
<b>Estimated Construction Costs - Subtotal</b>				<b>2,089,000</b>
Contractor Markup, Mob/demob, Insurance	% of materials		10	58,000
Engineering, Permitting and Construction Management	%		15	313,000
Regulatory Oversight	%		2.5	52,000
<b>Estimated Project Capital Costs - Subtotal</b>				<b>2,512,000</b>
Contingency	%		15	377,000
<b>Estimated Project Capital Costs - Total</b>				<b>2,890,000</b>

**Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)  
PGOU FS**

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost (\$/yr)
Extraction well maintenance		17	ea	200	3,400
Electric utilities:					
Existing 7 containment extraction wells		270,500	kwh	0.075	20,300
Existing 3 mass removal extraction wells		65,944	kwh	0.075	4,900
New extraction wells:					
Z4-A1 (15 gpm, est. 1.1 running hp)	1	7,350	kwh	0.075	600
Z4-A2 (25 gpm, est. 1.9 running hp)	1	12,250	kwh	0.075	900
Z4-A3 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z4-A4 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z4-A5 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z4-A6 (40 gpm, est. 3.0 running hp)	1	19,600	kwh	0.075	1,500
Z4-B1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
UV/oxidation (670 gpm)	100 kw	876,000	kwh	0.075	65,700
Air stripper blower	10 hp	65,437	kwh	0.075	4,900
Site area lighting	2 kw	17,520	kwh	0.075	1,300
UV lamp replacement		282	ea	125	35,200
Hydrogen peroxide use (assume 7 mg/L, 35% solution)		6,231	gal	3	18,700
Ion exchange resin replacement (450 gpm)		726	acre-ft	167	121,200
Equip Maintenance (@ % of new equipment capital)		100,500	%	3	3,000
Equipment Replacement (@ % of new equipment capital)		100,500	%	3	3,000
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET A)		1	year	6,000	6,000
Subtotal Operation and Maintenance					304,000
Contingency (scope)					30,400
<b>Estimated O&amp;M Costs - Total</b>					<b>334,000</b>
<b>Monitoring:</b>					
Monitoring and extraction wells		1	LS	51,000	51,000
GET A treatment		1	LS	10,000	10,000
Subtotal Monitoring					61,000
<b>Estimated Operation, Maintenance and Monitoring Costs - Total</b>					<b>395,000</b>

**Non-Discounted Constant Dollar Cost Estimate**

**Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)**

Time until RAOs achieved = 208 years (reduce NDMA to less than 0.0017 ug/L)

Year	n	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2143	138		395,000	395,000	67,500,000
2144	139		395,000	395,000	67,895,000
2145	140	1,150,000	395,000	1,545,000	69,440,000
2146	141		395,000	395,000	69,835,000
2147	142		395,000	395,000	70,230,000
2148	143		395,000	395,000	70,625,000
2149	144		395,000	395,000	71,020,000
2150	145		395,000	395,000	71,415,000
2151	146		395,000	395,000	71,810,000
2152	147		395,000	395,000	72,205,000
2153	148		395,000	395,000	72,600,000
2154	149		395,000	395,000	72,995,000
2155	150	590,000	395,000	985,000	73,980,000
2156	151		395,000	395,000	74,375,000
2157	152		395,000	395,000	74,770,000
2158	153		395,000	395,000	75,165,000
2159	154		395,000	395,000	75,560,000
2160	155		395,000	395,000	75,955,000
2161	156		395,000	395,000	76,350,000
2162	157		395,000	395,000	76,745,000
2163	158		395,000	395,000	77,140,000
2164	159		395,000	395,000	77,535,000
2165	160	1,150,000	395,000	1,545,000	79,080,000
2166	161		395,000	395,000	79,475,000
2167	162		395,000	395,000	79,870,000
2168	163		395,000	395,000	80,265,000
2169	164		395,000	395,000	80,660,000
2170	165		395,000	395,000	81,055,000
2171	166		395,000	395,000	81,450,000
2172	167		395,000	395,000	81,845,000
2173	168		395,000	395,000	82,240,000
2174	169		395,000	395,000	82,635,000
2175	170	120,000	395,000	515,000	83,150,000
2176	171		395,000	395,000	83,545,000
2177	172		395,000	395,000	83,940,000
2178	173		395,000	395,000	84,335,000
2179	174		395,000	395,000	84,730,000
2180	175		395,000	395,000	85,125,000
2181	176		395,000	395,000	85,520,000
2182	177		395,000	395,000	85,915,000
2183	178		395,000	395,000	86,310,000
2184	179		395,000	395,000	86,705,000
2185	180	1,150,000	395,000	1,545,000	88,250,000
2186	181		395,000	395,000	88,645,000
2187	182		395,000	395,000	89,040,000
2188	183		395,000	395,000	89,435,000
2189	184		395,000	395,000	89,830,000
2190	185		395,000	395,000	90,225,000
2191	186		395,000	395,000	90,620,000
2192	187		395,000	395,000	91,015,000
2193	188		395,000	395,000	91,410,000
2194	189		395,000	395,000	91,805,000
2195	190	120,000	395,000	515,000	92,320,000
2196	191		395,000	395,000	92,715,000
2197	192		395,000	395,000	93,110,000
2198	193		395,000	395,000	93,505,000
2199	194		395,000	395,000	93,900,000
2200	195		395,000	395,000	94,295,000
2201	196		395,000	395,000	94,690,000
2202	197		395,000	395,000	95,085,000
2203	198		395,000	395,000	95,480,000
2204	199		395,000	395,000	95,875,000
2205	200	3,040,000	395,000	3,435,000	99,310,000
2206	201		395,000	395,000	99,705,000
2207	202		395,000	395,000	100,100,000
2208	203		395,000	395,000	100,495,000
2209	204		395,000	395,000	100,890,000
2210	205		395,000	395,000	101,285,000
2211	206		395,000	395,000	101,680,000

**Non-Discounted Constant Dollar Cost Estimate**

**Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)**

Time until RAOs achieved = 208 years (reduce NDMA to less than 0.0017 ug/L)

Year	<i>n</i>	Capital Costs (\$)	O&M and Monitoring Costs (\$/yr)	Subtotal Non-Discounted Costs (\$)	Cumulative Non-Discounted Costs (\$)
2212	207		395,000	395,000	102,075,000
2213	208		395,000	395,000	102,470,000