

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 100-gpm RCF System without Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.W. on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|------|------------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 2,400 | \$ 2,400 | Quotes from Ryan Herco & Core-Rosion; 70/75 gal PE, outdoor, incl. seismic; in 2015 dollars |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quotes from C.P. Crowley & HTP; 0.21 gph; 1 duty/ 1 stdby; in 2015 dollars |
| Static Mixers | 1 | EA | \$ 900 | \$ 900 | Quotes from Komax & EWS; 3-inch; adjusted to 2015 dollars |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 9,600 | \$ 9,600 | Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | LS | \$ 600 | \$ 600 | Quote from Polyprocessing; 55 gal, HDPE, outdoor, incl. seismic, adjusted to 2015 dollars |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 0.06 gph, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Static Mixers | 1 | EA | \$ 900 | \$ 900 | Quotes from Komax & EWS; 3-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 9,600 | \$ 9,600 | Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; in 2015 dollars |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 297,000 | \$ 297,000 | Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia VPF, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,900 | \$ 11,800 | Quotes from DTT and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Pumps | | | | | |
| Filter Feed Pumps (Centrifugal) | 2 | EA | \$ 5,600 | \$ 11,200 | Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars (Centrifugal) |
| Polymer Feed Systems | | | | | |
| Polymer Feed System (Coagulant Aid) | 1 | LS | \$ 29,000 | \$ 29,000 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Filtrate Tank for Backwash | 1 | EA | \$ 28,000 | \$ 28,000 | Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2015 dollars |
| Backwash Pumps | 2 | EA | \$ 9,400 | \$ 18,800 | Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars |
| Backwash Waste Storage Tank | 1 | EA | \$ 36,000 | \$ 36,000 | Based on previous quotes for various tank sizes, estimated for 21,000 gal, adjusted to 2015 dollars |
| Sewer Discharge Pumps | 2 | EA | \$ 5,200 | \$ 10,400 | Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby |
| Subtotal | | | | \$ 486,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 146,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 2 | CY | \$ 1,330 | \$ 3,262 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 22 | CY | \$ 1,330 | \$ 29,260 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 665,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 49,875 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 33,250 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 33,250 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 100,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 100,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 981,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 196,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 1,177,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 235,400 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 235,400 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 1,648,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,154,000 | -30% |
| High Estimate | | | | \$ 2,472,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

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|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 500-gpm RCF System without Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.W. on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|------|------------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 3,400 | \$ 3,400 | Quotes from Core-Rosion & Ryan Herco; 400/500 gal PE, outdoor, incl. seismic; in 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 4,600 | \$ 9,200 | Quotes from C.P. Crowley & HTP; 1.04 gph; 1 duty/ 1 stdby; in 2015 dollars. |
| Static Mixer | 1 | EA | \$ 2,300 | \$ 2,300 | Quotes from Komax & EWS; 8-inch; adjusted to 2015 dollars. |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 15,400 | \$ 15,400 | Quotes from Core-Rosion & Ryan Herco; 2,500 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 1,100 | \$ 1,100 | Quote from Polyprocessing; 115 gal, HDPE, outdoor, incl. seismic; adjusted to 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 0.30 gph, 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Static Mixers | 1 | EA | \$ 2,300 | \$ 2,300 | Quotes from Komax & EWS; 8-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 15,400 | \$ 15,400 | Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic; adjusted to 2015 dollars. |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 494,000 | \$ 494,000 | Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf; Coombs-Hopkins filters, 10' x 24' (4 cells, 3 duty/ 1 stdby); Layne filters, (2) 8" x 22', 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,100 | \$ 10,200 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Pumps | | | | | |
| Filter Feed Pumps (Centrifugal) | 2 | EA | \$ 9,000 | \$ 18,000 | Quotes from Cortech & Flow-Systems; 500 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars. (Centrifugal) |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Filtrate Tank for Backwash | 1 | EA | \$ 42,000 | \$ 42,000 | Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height; adjusted to 2015 dollars. |
| Backwash Pumps | 2 | EA | \$ 15,200 | \$ 30,400 | Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars. |
| Backwash Waste Storage Tank | 1 | EA | \$ 72,800 | \$ 72,800 | Based on previous quotes for various tank sizes, estimated for 85,000 gal, adjusted to 2015 dollars |
| Sewer Discharge Pumps | 2 | EA | \$ 5,200 | \$ 10,400 | Quote based upon 175 gpm Hydromatic Submersible pump, 1 duty/ 1 stdby |
| Subtotal | | | | \$ 748,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 225,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 6 | CY | \$ 1,330 | \$ 8,638 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 56 | CY | \$ 1,330 | \$ 74,480 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,057,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 79,275 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 52,850 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 52,850 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 159,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 159,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 1,560,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 312,000 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 1,872,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 374,400 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 374,400 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 2,621,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,835,000 | -30% |
| High Estimate | | | | \$ 3,932,000 | +50% |

Notes:

1. This opinion of probable cost is based on ACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

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| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 1000-gpm RCF System without Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.W. on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|------|------------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 5,300 | \$ 5,300 | Quotes from Core-Rosion & Ryan Herco; 685/750 gal PE, outdoor, incl. seismic; in 2015 Dollars. |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quotes from C.P. Crowley & HTP; 2 gph; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Static Mixers | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & Koflo; 10-inch; in 2015 dollars. |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 29,000 | \$ 29,000 | Quotes from Core-Rosion & Ryan Herco; 5,000 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 2,800 | \$ 2,800 | Quote from Polyprocessing; 230/210 gal, HDPE, outdoor, incl. seismic; in 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quote from Prominent; 0.52 gph, 1 duty/ 1 stdby; in 2015 dollars. |
| Static Mixers | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & Koflo; 10-inch; in 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 29,000 | \$ 29,000 | Quotes from Core-Rosion & Ryan Herco; 5000 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 599,000 | \$ 599,000 | Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, 12' x 38' (4 cells, 3 duty/ 1 stdby); Layne filters, (1) 10" x 36", (4 cells, 3 duty/1 standby); in 2015 dollars. |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,300 | \$ 10,600 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Pumps | | | | | |
| Filter Feed Pumps (centrifugal) | 2 | EA | \$ 16,000 | \$ 32,000 | Quotes from Cortech & Flow-Systems; 1000 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Filtrate Tank for Backwash | 1 | EA | \$ 60,000 | \$ 60,000 | Quotes from Superior; 43,000 gal; 23' diameter x 16' high; in 2015 dollars. |
| Backwash Pumps | 2 | EA | \$ 22,800 | \$ 45,600 | Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars |
| Backwash Waste Storage Tank | 1 | EA | \$ 155,000 | \$ 155,000 | Based on previous quotes for various tank sizes, estimated for 170,000 gal, in 2015 dollars |
| Sewer Discharge Pumps | 2 | EA | \$ 5,200 | \$ 10,400 | Quote based upon 175 gpm Hydromatic Submersible pump, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Subtotal | | | | \$ 1,020,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 306,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 9 | CY | \$ 1,330 | \$ 11,614 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 98 | CY | \$ 1,330 | \$ 130,340 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,468,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 110,100 | Division I requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 73,400 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 73,400 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 221,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 221,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 2,167,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 433,400 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 2,600,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 520,000 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 520,000 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 3,640,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 2,548,000 | -30% |
| High Estimate | | | | \$ 5,460,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

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| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2000-gpm RCF System without Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|--|------|------------|--------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 8,000 | \$ 8,000 | Quotes from Core-Rosion & Ryan Henco; 1,400/1,500 gal PE, outdoor, incl. seismic; in 2015 dollars |
| Metering Pumps | 2 | EA | \$ 7,000 | \$ 14,000 | Quotes from C.P. Crowley & HTP; 4.17 gph; in 2015 dollars |
| Static Mixers | 1 | EA | \$ 4,500 | \$ 4,500 | Quotes from Komax & EWS; 14-inch; adjusted to 2015 dollars |
| Reduction Tank | | | | | |
| Mixers | 1 | EA | \$ 18,000 | \$ 18,000 | Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2015 dollars |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | LS | \$ 2,400 | \$ 2,400 | Quote from Polyprocessing; 475 gal, HDPE, outdoor, incl. seismic; adjusted to 2015 dollars |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 1.22 gph, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Static Mixers | 1 | EA | \$ 4,500 | \$ 4,500 | Quotes from Komax & EWS; 14-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tanks | | | | | |
| Mixers | 1 | EA | \$ 18,000 | \$ 18,000 | Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2015 dollars |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 1,044,000 | \$ 1,044,000 | Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, (2) 10' x 42', 4 cells per filter, 3 duty / 1 stdby; Layne filters, (4) 10' x 24', 3 duty/ 1 stdby; adjusted to 2015 dollars |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,300 | \$ 10,600 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Pumps | | | | | |
| Filter Feed Pumps (Centrifugal) | 3 | EA | \$ 21,000 | \$ 63,000 | Quotes from Cortech & Flow-Systems; 2,000 gpm @ 70 ft; 2 duty/ 1 stdby; in 2015 dollars |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Filtrate Tank for Backwash | 1 | EA | \$ 53,000 | \$ 53,000 | Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height; adjusted to 2015 dollars |
| Backwash Pumps | 2 | EA | \$ 22,800 | \$ 45,600 | Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars |
| Backwash Waste Storage Tank | 1 | EA | \$ 175,000 | \$ 175,000 | Based on previous quotes for various tank sizes, estimated for 286,000 gal, adjusted to 2015 dollars |
| Sewer Discharge Pumps | 2 | EA | \$ 5,200 | \$ 10,400 | Quote based upon 175 gpm Hydromatic Submersible pump, 1 duty/ 1stdby; adjusted to 2015 dollars |
| Subtotal | | | | \$ 1,493,000 | Rounded up to \$1000 |
| Equipment Installation Cost (30% of Equipment) | 30% | | | \$ 448,000 | Including tax, freight, installation and manufacturer services. |
| Reduction Tanks | | | | | 10,000 gal based on 5 min detention time |
| Slab | 17 | CY | \$ 740 | \$ 12,580 | Based on 2 ft slab or wall; \$735/CY; adjusted to 2015 dollars. |
| Walls | 35 | CY | \$ 850 | \$ 29,750 | Based on 2 ft slab or wall; and 2 ft freeboard; \$840/CY; adjusted to 2015 dollars |
| Elevated Slab | 17 | CY | \$ 1,170 | \$ 19,890 | Based on 2 ft slab or wall; \$1155/CY; adjusted to 2015 dollars. |
| Chlorine Contact Tanks | | | | | 15 ft x 15 ft tank |
| Slab | 17 | CY | \$ - | \$ - | Based on 2 ft slab or wall; \$735/CY; adjusted to 2014 dollars. |
| Walls | 35 | CY | \$ - | \$ - | Based on 2 ft slab or wall; and 2 ft freeboard; \$840/CY; adjusted to 2014 dollars |
| Elevated Slab | 17 | CY | \$ - | \$ - | Based on 2 ft slab or wall; \$1155/CY; adjusted to 2014 dollars. |
| Rapid Mixing Tanks | | | | | 15 ft x 15 ft tank |
| Slab | 17 | CY | \$ 740 | \$ 12,580 | Based on 2 ft slab or wall; \$735/CY; adjusted to 2015 dollars. |
| Walls | 35 | CY | \$ 850 | \$ 29,750 | Based on 2 ft slab or wall; and 2 ft freeboard; \$840/CY; adjusted to 2015 dollars |
| Elevated Slab | 17 | CY | \$ 1,170 | \$ 19,890 | Based on 2 ft slab or wall; \$1155/CY; adjusted to 2015 dollars. |
| Chemical Storage Containment | 15 | CY | \$ 1,330 | \$ 19,968 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 124 | CY | \$ 1,330 | \$ 164,920 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 2,250,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 168,750 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 112,500 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 112,500 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 338,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 338,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 3,320,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 664,000 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 3,984,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 796,800 | Budget item to cover change orders due to unforeseen conditions |

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| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2000-gpm RCF System without Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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| Updated by Y.W. on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| | | | | | |
|---------------------------------------|-----|--|--|---------------------|---|
| Engineering, Legal and Administrative | 20% | | | \$ 796,800 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 5,578,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 3,905,000 | -30% |
| High Estimate | | | | \$ 8,367,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

Estimated Annual O&M Costs for RCF without Recycle

| RCF System Size (gpm) | Residuals Disposal (Sewer) | Chemicals | Labor | Filter Media Replacement | Maintenance and Spare Parts | Electricity | Lab and Field Analysis | Annual O&M (Rounded up to \$1,000) |
|------------------------------|-----------------------------------|------------------|--------------|---------------------------------|------------------------------------|--------------------|-------------------------------|---|
| 100 | \$ 10,400 | \$ 8,800 | \$ 137,000 | \$ 600 | \$ 6,700 | \$ 1,700 | \$ 20,800 | \$ 186,000 |
| 500 | \$ 37,000 | \$ 36,700 | \$ 137,000 | \$ 2,700 | \$ 10,600 | \$ 5,800 | \$ 31,700 | \$ 262,000 |
| 1,000 | \$ 70,200 | \$ 71,700 | \$ 137,000 | \$ 3,700 | \$ 14,700 | \$ 12,200 | \$ 33,773 | \$ 343,000 |
| 2000 | \$ 136,600 | \$ 141,500 | \$ 205,000 | \$ 6,500 | \$ 22,500 | \$ 23,400 | \$ 63,500 | \$ 599,000 |

Costs are in 2015 dollars.

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| Item | 100-gpm RCF System with Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

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|---|------|------------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 2,400 | \$ 2,400 | Quotes from Ryan Herco & Core-Rosion; 70/75 gal PE, outdoor, incl. seismic; in 2015 dollars |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quotes from C.P. Crowley & HTP; 0.21 gph; 1 duty/ 1 stdby; in 2015 dollars |
| Static Mixer | 1 | EA | \$ 900 | \$ 900 | Quotes from Komax & EWS; 3-inch; adjusted to 2015 dollars |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 9,600 | \$ 9,600 | Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; in 2015 dollars |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | LS | \$ 600 | \$ 600 | Quote from Polyprocessing; 55 gal, HDPE, outdoor, incl. seismic, adjusted to 2015 dollars |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 0.06 gph, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Static Mixer | 1 | EA | \$ 900 | \$ 900 | Quotes from Komax & EWS; 3-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 9,600 | \$ 9,600 | Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 297,000 | \$ 297,000 | Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia VPF, 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,900 | \$ 11,800 | Quotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Filter Feed Pumps (Centrifugal) | 2 | EA | \$ 5,600 | \$ 11,200 | Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars (Centrifugal) |
| Polymer Feed Systems | | | | | |
| Polymer Feed System (Coagulant Aid) | 1 | LS | \$ 29,000 | \$ 29,000 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Polymer Feed System (Solids Settling Aid) | 1 | LS | \$ 11,000 | \$ 11,000 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Filtrate Tank for Backwash | | | | | |
| Backwash Pumps | 2 | EA | \$ 9,400 | \$ 18,800 | Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars |
| Residuals Treatment System | | | | | |
| Gravity Thickener | 2 | EA | \$ 34,000 | \$ 68,000 | Quote from Plastic-Mart for 13,000-gallon cone bottom tank with stand; adjusted to 2015 dollars |
| Flo-Trend SludgeMate Container | 2 | EA | \$ 15,100 | \$ 30,200 | Quote from Flo-Trend for 6-CY SludgeMate container; adjusted to 2015 dollars |
| Pumps | 1 | LS | \$ 10,600 | \$ 10,600 | Includes all sludge pumps and recycle pumps, one duty and one standby; adjusted to 2015 dollars |
| Subtotal | | | | \$ 559,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 168,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 2 | CY | \$ 1,330 | \$ 3,262 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 62 | CY | \$ 1,330 | \$ 82,460 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 813,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 60,975 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 40,650 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 40,650 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 122,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 122,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 1,199,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 239,800 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 1,439,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 287,800 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 287,800 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 2,015,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,411,000 | -30% |
| High Estimate | | | | \$ 3,023,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|--|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 500-gpm RCF System with Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|------|------------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 3,400 | \$ 3,400 | Quotes from Core-Rosion & Ryan Herco; 400/500 gal PE, outdoor, incl. seismic; in 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 4,600 | \$ 9,200 | Quotes from C.P. Crowley & HTP; 1.04 gph; 1 duty/ 1 stdby; in 2015 dollars. |
| Static Mixer | 1 | EA | \$ 2,300 | \$ 2,300 | Quotes from Komax & EWS; 8-inch; adjusted to 2015 dollars. |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 15,400 | \$ 15,400 | Quotes from Core-Rosion & Ryan Herco; 2,500 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 1,100 | \$ 1,100 | Quote from Polyprocessing; 115 gal, HDPE, outdoor, incl. seismic; adjusted to 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 0.30 gph, 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Static Mixer | 1 | EA | \$ 2,300 | \$ 2,300 | Quotes from Komax & EWS; 8-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 15,400 | \$ 15,400 | Quotes from Core-Rosion & Ryan Herco; 2500 gal PE, outdoor, incl. seismic; in 2015 dollars. |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 494,000 | \$ 494,000 | Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf; Coombs-Hopkins filters, 10' x 24' (4 cells, 3 duty/ 1 stdby); Layne filters, (2) 8' x 22'; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,100 | \$ 10,200 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Filter Feed Pumps (Centrifugal) | 2 | EA | \$ 9,000 | \$ 18,000 | Quotes from Cortech & Flow-Systems; 500 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars. (Centrifugal) |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Polymer Feed Systems (Solids Settling Aid) | 1 | LS | \$ 12,100 | \$ 12,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Filtrate Tank for Backwash | 1 | EA | \$ 42,000 | \$ 42,000 | Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height; adjusted to 2015 dollars. |
| Backwash Pumps | 2 | EA | \$ 15,200 | \$ 30,400 | Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Residuals Treatment System | | | | | |
| Equalization Tank | 1 | EA | \$ 129,000 | \$ 121,154 | Adjusted installed costs from RS Means for 90,000-gal tank, which was divided by 1.3 to exclude installation cost (assuming an installation cost of 30%); adjusted to 2015 dollars. |
| Plate Settler | 1 | EA | \$ 62,000 | \$ 62,000 | Quote from Meurer Research, Inc. and Parkson for a system handles a 26-gpm sludge flow; adjusted to 2015 dollars. |
| Flo-Trend SludgeMate Container | 3 | EA | \$ 27,400 | \$ 82,200 | Quote from Flo-Trend for 15-CY SludgeMate container; adjusted to 2015 dollars. |
| Pumps | 1 | LS | \$ 15,900 | \$ 15,900 | Includes all sludge pumps and recycle pumps, one duty and one standby; adjusted to 2015 dollars. |
| Subtotal | | | | \$ 959,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 288,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 6 | CY | \$ 1,330 | \$ 8,638 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 157 | CY | \$ 1,330 | \$ 208,810 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,465,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 109,875 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 73,250 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 73,250 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 220,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 220,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 2,161,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 432,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 2,593,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 518,600 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 518,600 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 3,631,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 2,542,000 | -30% |
| High Estimate | | | | \$ 5,447,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 1000-gpm RCF System with Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| Description | Quantity | Unit | Unit Cost | Total Cost | Notes |
|---|----------|------|------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 5,300 | \$ 5,300 | Quotes from Core-Rosion & Ryan Herco; 685/750 gal PE, outdoor, incl. seismic; in 2015 Dollars. |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quotes from C.P. Crowley & HTP; 2 gph; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Static Mixer | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & Koflo; 10-inch; in 2015 dollars. |
| Reduction Tank | | | | | |
| Tank and Mixer | 1 | EA | \$ 29,000 | \$ 29,000 | Quotes from Core-Rosion & Ryan Herco; 5,000 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 2,800 | \$ 2,800 | Quote from Polyprocessing; 230/210 gal, HDPE, outdoor, incl. seismic; in 2015 dollars. |
| Metering Pumps | 2 | EA | \$ 4,500 | \$ 9,000 | Quote from Prominent; 0.52 gph, 1 duty/ 1 stdby; in 2015 dollars. |
| Static Mixer | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & Koflo; 10-inch; in 2015 dollars. |
| Polymer Mixing Tank | | | | | |
| Rapid Mixing Tank and Mixer | 1 | EA | \$ 29,000 | \$ 29,000 | Quotes from Core-Rosion & Ryan Herco; 5,000 gal PE, outdoor, incl. seismic; one mixer is included; in 2015 dollars. |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 599,000 | \$ 599,000 | Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, 12' x 38' (4 cells, 3 duty/ 1 stdby); Layne filters, (1) 10' x 36', (4 cells, 3 duty/1 standby); in 2015 dollars. |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,300 | \$ 10,600 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Filter Feed Pumps (centrifugal) | 2 | EA | \$ 16,000 | \$ 32,000 | Quotes from Cortech & Flow-Systems; 1000 gpm @ 70 ft; 1 duty/ 1 stdby; in 2015 dollars |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Polymer Feed Systems (Solids Settling Aid) | 1 | LS | \$ 11,800 | \$ 11,800 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars. |
| Filtrate Tank for Backwash | 1 | EA | \$ 60,000 | \$ 60,000 | Quotes from Superior; 43,000 gal; 23' diameter x 16' high ; in 2015 dollars. |
| Backwash Pumps | 2 | EA | \$ 22,800 | \$ 45,600 | Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2015 dollars |
| Residuals Treatment System | | | | | |
| Equalization Tank | 1 | EA | \$ 155,000 | \$ 155,000 | Use same size tank as the non-recycle option in 2015 dollars. |
| Plate Settler | 1 | EA | \$ 68,000 | \$ 68,000 | Quote from Meurer Research, Inc. and Parkson for a system handles a 44-gpm sludge flow; in 2015 dollars. |
| Flo-Trend SludgeMate Container | 3 | EA | \$ 32,350 | \$ 97,050 | Quote from Flo-Trend for 25-CY SludgeMate container; adjusted to 2015 dollars. |
| Pumps | 1 | LS | \$ 19,600 | \$ 19,600 | Includes all sludge pumps and recycle pumps, one duty and one standby; adjusted to 2015 dollars. |
| Subtotal | | | | \$ 1,206,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 362,000 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 9 | CY | \$ 1,330 | \$ 11,614 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 183 | CY | \$ 1,330 | \$ 243,390 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,824,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 136,800 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 91,200 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 91,200 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 274,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 274,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 2,691,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 538,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 3,229,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 645,800 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 645,800 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 4,521,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 3,165,000 | -30% |
| High Estimate | | | | \$ 6,782,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|----------------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2000-gpm RCF System with Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|--|------|------------|--------------|---------------------|--|
| Equipment | | | | | |
| FeSO ₄ Feed System | | | | | |
| Storage Tank | 1 | EA | \$ 8,000 | \$ 8,000 | Quotes from Core-Rosion & Ryan Herco; 1,400/1,500 gal PE, outdoor, incl. seismic; in 2015 dollars |
| Metering Pumps | 2 | EA | \$ 7,000 | \$ 14,000 | Quotes from C.P. Crowley & HTP; 5 gph; in 2015 dollars |
| Static Mixer | 1 | EA | \$ 4,500 | \$ 4,500 | Quotes from Komax & EWS; 14-inch; adjusted to 2015 dollars |
| Reduction Tank | | | | | |
| Mixer | 1 | EA | \$ 18,000 | \$ 18,000 | Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2015 dollars |
| NaOCl Feed System | | | | | |
| Storage Tank | 1 | LS | \$ 2,400 | \$ 2,400 | Quote from Polyprocessing; 475 gal, HDPE, outdoor, incl. seismic; adjusted to 2015 dollars |
| Metering Pumps | 2 | EA | \$ 5,000 | \$ 10,000 | Quote from Prominent; 1.22 gph, 1 duty/ 1 stbby; adjusted to 2015 dollars |
| Static Mixer | 1 | EA | \$ 4,500 | \$ 4,500 | Quotes from Komax & EWS; 14-inch; adjusted to 2015 dollars. |
| Polymer Mixing Tanks | | | | | |
| Mixer | 1 | EA | \$ 18,000 | \$ 18,000 | Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2015 dollars |
| Filters | | | | | |
| Filter Equipment (Pressure Filters) | 1 | LS | \$ 1,044,000 | \$ 1,044,000 | Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, (2) 10' x 42', 4 cells per filter, 3 duty / 1 stbby; Layne filters, (4) 10' x 24', 3 duty/ 1 stbby; adjusted to 2015 dollars |
| Filter Drawdown Transfer Pump | 2 | EA | \$ 5,300 | \$ 10,600 | Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stbby; adjusted to 2015 dollars |
| Filter Feed Pumps (Centrifugal) | 3 | EA | \$ 21,000 | \$ 63,000 | Quotes from Cortech & Flow-Systems; 2,000 gpm @ 70 ft; 2 duty/ 1 stbby; in 2015 dollars |
| Polymer Feed Systems | | | | | |
| Polymer Feed Systems (Coagulant Aid) | 1 | LS | \$ 11,100 | \$ 11,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Polymer Feed Systems (Solids Settling Aid) | 1 | LS | \$ 12,100 | \$ 12,100 | Quotes from Siemens & C.P. Crowley; adjusted to 2015 dollars |
| Filtrate Tank for Backwash | 1 | EA | \$ 53,000 | \$ 53,000 | Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height; adjusted to 2015 dollars |
| Backwash Pumps | 2 | EA | \$ 22,800 | \$ 45,600 | Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stbby; adjusted to 2015 dollars |
| Residuals Treatment System | | | | | |
| Equalization Tank | 1 | EA | \$ 146,000 | \$ 137,385 | Adjusted installed costs from RS Means for 280,000-gal tank, which was divided by 1.3 to exclude installation cost (assuming a installation cost of 30%); adjusted to 2015 dollars |
| Plate Settler | 1 | EA | \$ 82,000 | \$ 82,000 | Quote from Meurer Research, Inc. and Parkson for a system handles a 88-gpm sludge flow; adjusted to 2015 dollars |
| Flo-Trend SludgeMate Container | 3 | EA | \$ 40,800 | \$ 122,400 | Quote from Flo-Trend for 40-CY SludgeMate container; adjusted to 2015 dollars |
| Pumps | 1 | LS | \$ 23,000 | \$ 23,000 | Includes sludge pumps and recycle pumps for equalization tank and plate settlers, one duty and one standby; adjusted to 2015 dollars. |
| Subtotal | | | | \$ 1,684,000 | Rounded up to \$1000 |
| Equipment Installation Cost (30% of Equipment) | 30% | | | \$ 506,000 | Including tax, freight, installation and manufacturer services. |
| Reduction Tank | | | | | 15 ft x 15 ft tank |
| Slab | 17 | CY | \$ 740 | \$ 12,580 | Based on 2 ft slab or wall; adjusted to 2015 dollars. |
| Walls | 35 | CY | \$ 850 | \$ 29,750 | Based on 2 ft slab or wall; and 2 ft freeboard; adjusted to 2015 dollars |
| Elevated Slab | 17 | CY | \$ 1,170 | \$ 19,890 | Based on 2 ft slab or wall; adjusted to 2015 dollars. |
| Rapid Mixing Tank | | | | | 15 ft x 15 ft tank |
| Slab | 17 | CY | \$ 740 | \$ 12,580 | Based on 2 ft slab or wall; adjusted to 2015 dollars. |
| Walls | 35 | CY | \$ 850 | \$ 29,750 | Based on 2 ft slab or wall; and 2 ft freeboard; adjusted to 2015 dollars |
| Elevated Slab | 17 | CY | \$ 1,170 | \$ 19,890 | Based on 2 ft slab or wall; adjusted to 2015 dollars. |
| Chemical Storage Containment | 15 | CY | \$ 1,330 | \$ 19,368 | Adjusted to 2015 dollars |
| Equipment Concrete Pads | 281 | CY | \$ 1,330 | \$ 373,730 | Adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 2,708,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 203,100 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 135,400 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 135,400 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 407,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 407,000 | PLC and SCADA equipment to control |

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2000-gpm RCF System with Recycle (5-min reduction, with chlorination without aeration, granular media filter) |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| | | | | | |
|---------------------------------------|-----|--|--|---------------------|--|
| Total Direct Costs | | | | \$ 3,996,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 799,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 4,795,200 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 959,040 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 959,040 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 6,714,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 4,700,000 | -30% |
| High Estimate | | | | \$ 10,071,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

Estimated Annual O&M Costs for RCF with Recycle

| System Size (gpm) | Residuals Disposal | Chemicals | Labor | Filter Media Replacement | Maintenance and Spare Parts | Electricity | Lab and Field Analysis | Annual O&M (Rounded up to \$1,000) |
|--------------------------|---------------------------|------------------|--------------|---------------------------------|------------------------------------|--------------------|-------------------------------|---|
| 100 | \$ 28,500 | \$ 8,900 | \$ 210,000 | \$ 600 | \$ 8,100 | \$ 1,700 | \$ 38,200 | \$ 296,000 |
| 500 | \$ 142,700 | \$ 37,400 | \$ 210,000 | \$ 2,600 | \$ 14,700 | \$ 6,100 | \$ 53,500 | \$ 467,000 |
| 1000 | \$ 285,400 | \$ 73,000 | \$ 210,000 | \$ 3,700 | \$ 18,200 | \$ 12,800 | \$ 59,864 | \$ 663,000 |
| 2000 | \$ 570,800 | \$ 144,300 | \$ 273,000 | \$ 6,400 | \$ 27,100 | \$ 24,500 | \$ 80,400 | \$ 1,127,000 |

Costs are in 2015 dollars.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 100-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|------|------------|------------|-------------------|--|
| Equipment | | | | | |
| <i>Pretreatment</i> | | | | | |
| Bag Filters | 1 | LS | \$ 4,400 | \$ 4,400 | Includes one standby; one quote from 2011 and one from 2015; scaled to 2015\$ |
| <i>Treatment</i> | | | | | |
| Ion Exchange Equipment | 1 | LS | \$ 156,700 | \$ 156,700 | Quote from Evoqua for two service vessels and one standby/regen vessel; quote from Envirogen for three service vessels and one standby/regen vessel. |
| <i>Storage Tanks</i> | | | | | |
| Brine Storage Tank (Fresh 26% Brine) | 1 | EA | \$ 3,100 | \$ 3,100 | 600 gal, PE, single-wall, incl. seismic; quote from Brine Make-up and Storage Systems |
| Treated Water Tank (Brine Dilution) | 1 | EA | \$ 4,100 | \$ 4,100 | 1200 gal, PE, single-wall, incl. seismic; quote from Brine Make-up and Storage Systems |
| Diluted Brine Tank (12% Brine) | 1 | EA | \$ 4,100 | \$ 4,100 | 1200 gal, PE, single-wall, incl. seismic; quote from Brine Make-up and Storage Systems |
| Slow-Rinse/Clarified Brine Waste Storage Tank | 1 | EA | \$ 5,100 | \$ 5,100 | 2025 gal, PE, single-wall, incl. seismic; quote from Brine Make-up and Storage Systems |
| Backwash/Fast-Rinse Waste Storage Tank | 1 | EA | \$ 5,400 | \$ 5,400 | 2363 gal, PE, single-wall, incl. seismic, quote from Brine Make-up and Storage Systems |
| Ferrous Sulfate Storage Tank | 1 | EA | \$ 1,900 | \$ 1,900 | 53 gal, PE, single-wall, incl. seismic, quote from Brine Make-up and Storage Systems |
| <i>Pumps</i> | | | | | |
| Backwash Pump (Backwash, Fast/Slow Rinse) | 2 | EA | \$ 15,100 | \$ 30,200 | 29 gpm Backwash Pump, 1 duty/1 standby |
| Brine Pump (From Brine Storage Tank to either Backwash/Fast-Rinse or Slow-Rinse/Waste Brine Tank) | 2 | EA | \$ 14,400 | \$ 28,800 | 5 gpm Brine Pump, 1 duty/1 standby |
| Return Pump (From Fast-Rinse Tank to Wellhead) | 2 | EA | \$ 15,100 | \$ 30,200 | 20 gpm Return Pump, 1 duty/1 standby |
| Waste Pump (from Slow-Rinse/Waste Brine Tank to Clarification Tank) | 2 | EA | \$ 15,100 | \$ 30,200 | 21 gpm Waste Pump |
| Ferrous Sulfate Pump | 2 | EA | \$ 4,600 | \$ 9,200 | 12 gph Ferrous Sulfate Pump |
| Sludge Pump | 4 | EA | \$ 3,100 | \$ 12,400 | 6 gpm, Sludge and Recycle pumps, 1 duty/1 standby each |
| Recovered Dewatered Pump | 2 | EA | \$ 15,100 | \$ 30,200 | Allow 20 gpm, 1 duty/1 standby |
| <i>Solids Handling</i> | | | | | |
| Gravity Thickener (Ferrous Iron precipitation) | 2 | EA | \$ 3,300 | \$ 6,600 | 338 gal cone bottom tank, including stand |
| Gravity Thickener Blower | 2 | EA | \$ 793 | \$ 1,586 | 1181 CFM; 0.25 HP; B135 Ultrafan Pak 2000 |
| Dewatering Equipment | 2 | EA | \$ 39,800 | \$ 79,600 | 5 cy Sludgemate |
| Polymer Dosing System | 1 | EA | \$ 12,000 | \$ 12,000 | 0.02 gal/hour |
| Subtotal | | | | \$ 456,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 136,800 | Including tax, freight, installation and manufacturer services. |
| Equipment Concrete Pads/Containment Wall | 39 | CY | \$ 1,000 | \$ 38,700 | Assume pad for all pumps, IX System, Bag Filters, Tanks and Polymer System |
| Subtotal (Installed Equipment Costs) | | | | \$ 632,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 47,400 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 31,600 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 31,600 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 94,800 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 94,800 | PLC and SCADA equipment to control |

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 100-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| | | | | | |
|---------------------------------------|-----|--|--|---------------------|--|
| | | | | | |
| Total Direct Costs | | | | \$ 932,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 186,400 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Engineering, Legal and Administrative | 20% | | | \$ 186,400 | Includes permits, legal fees and engineering fees for design and construction |
| Contingency | 20% | | | \$ 186,400 | |
| Project Total | | | | \$ 1,492,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,044,000 | -30% |
| High Estimate | | | | \$ 2,238,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 500-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|-----|------------|------------|-------------------|---|
| Equipment | | | | | |
| <i>Pretreatment</i> | | | | | |
| Bag Filters | 1 | LS | \$ 16,500 | \$ 16,500 | includes one standby; one quote from 2011 and one from 2015; scaled to 2015\$ |
| <i>Treatment</i> | | | | | |
| Ion Exchange Equipment | 1 | LS | \$ 378,900 | \$ 378,900 | Quote from Evoqua for two service vessels and one standby/regen vessel; quote from Envirogen for 13 service vessels and 3 standby/regen vessel. |
| <i>Storage Tanks</i> | | | | | |
| Brine Storage Tank (fresh 26%) | 1 | EA | \$ 6,100 | \$ 6,100 | 3000 gallon Brine Tank |
| Treated Water Tank (for brine dilution) | 1 | EA | \$ 10,500 | \$ 10,500 | 6000 gallon Treated Water Tank |
| Diluted Brine Tank (12%) | 1 | EA | \$ 10,500 | \$ 10,500 | 6000 gallon Diluted Water Tank |
| Slow-Rinse/Clarified Brine Tank (Waste Storage) | 1 | EA | \$ 19,400 | \$ 19,400 | 10125 gal Clarifier Brine/Slow Rinse Tank |
| Backwash/Fast-Rinse Tank (Waste Storage) | 1 | EA | \$ 22,500 | \$ 22,500 | 11813 gal Backwash/Fast Rinse Tank |
| Ferrous Sulfate Tank | 1 | EA | \$ 2,000 | \$ 2,000 | 263 gal Ferrous Sulfate Tank |
| <i>Pumps</i> | | | | | |
| Backwash Pump (Backwash, Fast/Slow Rinse) | 2 | EA | \$ 17,000 | \$ 34,000 | 85 gpm Backwash Pump, 1 duty/1 standby |
| Brine Pump (From Brine Storage Tank to either Backwash/Fast-Rinse or Slow-Rinse/Waste Brine Tank) | 2 | EA | \$ 15,100 | \$ 30,200 | 25 gpm Brine Pump, 1 duty/1 standby |
| Return Pump (From Fast-Rinse Tank to Wellhead) | 2 | EA | \$ 15,100 | \$ 30,200 | 20 gpm Return Pump, 1 duty/1 standby |
| Waste Pump (from Slow-Rinse/Waste Brine Tank to Clarification Tank) | 2 | EA | \$ 18,500 | \$ 37,000 | 101 gpm Waste Pump |
| Ferrous Sulfate Pump | 2 | EA | \$ 5,000 | \$ 10,000 | 57 gph Ferrous Sulfate Pump |
| Sludge Pump | 4 | EA | \$ 3,600 | \$ 14,400 | 29 gpm, Sludge and Recycle pumps, 1 duty/1 standby each |
| Recovered Dewatered Pump | 2 | EA | \$ 15,100 | \$ 30,200 | Allow 20 gpm, 1 duty/1 standby |
| <i>Solids Handling</i> | | | \$ - | \$ - | |
| Gravity Thickener (Ferrous Iron precipitation) | 2 | EA | \$ 5,200 | \$ 10,400 | 1688 gal cone bottom tank, including stand |
| Gravity Thickener Blower | 2 | EA | \$ 1,541 | \$ 3,082 | 5905 CFM; 1.5 HP; B222 Ultrafan Pak 2000 |
| Dewatering Equipment | 2 | EA | \$ 102,300 | \$ 204,600 | 25 cy Sludgemate |
| Polymer Dosing System | 1 | EA | \$ - | \$ 12,000 | 0.11 gal/hour |
| Subtotal | | | | \$ 883,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 264,900 | Including tax, freight, installation and manufacturer services. |
| Equipment Concrete Pads/Containment Wall | 115 | CY | \$ 1,000 | \$ 114,800 | Assume pad for all pumps, IX System, Bag Filters, Tanks and Polymer System |

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 500-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| | | | | | |
|---|------|--|--|---------------------|--|
| Subtotal (Installed Equipment Costs) | | | | \$ 1,263,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 94,800 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 63,200 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 63,200 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 189,500 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 189,500 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 1,863,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 372,600 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Engineering, Legal and Administrative | 20% | | | \$ 372,600 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 2,609,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,826,000 | -30% |
| High Estimate | | | | \$ 3,914,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 1,000-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|-----|------------|------------|---------------------|--|
| Equipment | | | | | |
| <i>Pretreatment</i> | | | | | |
| Bag Filters | 1 | LS | \$ 27,100 | \$ 27,100 | Includes one standby; one quote from 2011 and one from 2015; scaled to 2015\$ |
| <i>Treatment</i> | | | | | |
| Ion Exchange Equipment | 1 | LS | \$ 575,100 | \$ 575,100 | Quote from Evoqua for two PTISSA120x96 systems; quote from Envirogen for 13 service vessels and 3 standby/regen vessels. |
| <i>Storage Tanks</i> | | | | | |
| Brine Storage Tank (fresh 26%) | 1 | EA | \$ 10,500 | \$ 10,500 | 6000 gallon Brine Tank |
| Treated Water Tank (for brine dilution) | 1 | EA | \$ 22,500 | \$ 22,500 | 12000 gallon Treated Water Tank |
| Diluted Brine Tank (12%) | 1 | EA | \$ 22,500 | \$ 22,500 | 12000 gallon Diluted Water Tank |
| Slow-Rinse/Clarified Brine Tank (Waste Storage) | 1 | EA | \$ 44,500 | \$ 44,500 | 20250 gal Clarifier Brine/Slow Rinse Tank, RFP |
| Backwash/Fast-Rinse Tank (Waste Storage) | 1 | EA | \$ 46,000 | \$ 46,000 | 23625 gal Backwash/Fast Rinse Tank, RFP |
| Ferrous Sulfate Tank | 1 | EA | \$ 2,700 | \$ 2,700 | 525 gal Ferrous Sulfate Tank |
| <i>Pumps</i> | | | | | |
| Backwash Pump (Backwash, Fast/Slow Rinse) | 2 | EA | \$ 20,500 | \$ 41,000 | 151 gpm Backwash Pump, 1 duty/1 standby |
| Brine Pump (From Brine Storage Tank to either Backwash/Fast-Rinse or Slow-Rinse/Waste Brine Tank) | 2 | EA | \$ 17,000 | \$ 34,000 | 50 gpm Brine Pump, 1 duty/1 standby |
| Return Pump (From Fast-Rinse Tank to Wellhead) | 2 | EA | \$ 15,100 | \$ 30,200 | 20 gpm Return Pump, 1 duty/1 standby |
| Waste Pump (from Slow-Rinse/Waste Brine Tank to Clarification Tank) | 2 | EA | \$ 20,200 | \$ 40,400 | 201 gpm Waste Pump |
| Ferrous Sulfate Pump | 2 | EA | \$ 6,400 | \$ 12,800 | 1.88 gpm Ferrous Sulfate Pump |
| Sludge Pump | 4 | EA | \$ 5,100 | \$ 20,400 | 57 gpm, Sludge and Recycle pumps, 1 duty/1 standby each |
| Recovered Dewatered Pump | 2 | EA | \$ 15,100 | \$ 30,200 | Allow 20 gpm, 1 duty/1 standby |
| <i>Solids Handling</i> | | | \$ - | \$ - | |
| Gravity Thickener (Ferrous Iron precipitation) | 2 | EA | \$ 9,700 | \$ 19,400 | 3375 gal cone bottom tank, including stand |
| Gravity Thickener Blower | 2 | EA | \$ 1,541 | \$ 3,082 | 5905 CFM; 1.5 HP; B222 Ultrafan Pak 2000 |
| Dewatering Equipment | 2 | EA | \$ 172,200 | \$ 344,400 | 50 cy Sludgemate. Factored. |
| Polymer Dosing System | 1 | EA | \$ - | \$ 12,000 | 0.22 gal/hour |
| Subtotal | | | | \$ 1,339,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 401,700 | Including tax, freight, installation and manufacturer services. |
| Equipment Concrete Pads/Containment Wall | 184 | CY | \$ 1,000 | \$ 184,400 | Assume pad for all pumps, IX System, Bag Filters, Tanks and Polymer System |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,926,000 | Rounded up to \$1000 |

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 1,000-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| | | | | | |
|--|------|--|--|---------------------|--|
| General Requirements | 7.5% | | | \$ 144,500 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 96,300 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 96,300 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 288,900 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 288,900 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 2,841,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 568,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Engineering, Legal and Administrative | 20% | | | \$ 568,200 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 3,978,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 2,785,000 | -30% |
| High Estimate | | | | \$ 5,967,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2,000-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| DESCRIPTION | QTY | UNIT MEAS. | UNIT COST | TOTAL COST | COMMENTS |
|---|-----|------------|--------------|---------------------|--|
| Equipment | | | | | |
| <i>Pretreatment</i> | | | | | |
| Bag Filters | 1 | LS | \$ 46,900 | \$ 46,900 | includes one standby; one quote from 2011 and one from 2015; scaled to 2015\$ |
| Ion Exchange Equipment | 1 | LS | \$ 1,126,000 | \$ 1,126,000 | Quote from Evoqua for 3 service vessels and one standby/regen vessel; quote from Envirogen for 26 service vessels and 6 standby/regen vessels. |
| <i>Storage Tanks</i> | | | | | |
| Brine Storage Tank (fresh 26%) | 1 | EA | \$ 14,300 | \$ 14,300 | 8000 gallon Brine Tank |
| Treated Water Tank (for brine dilution) | 1 | EA | \$ 39,300 | \$ 39,300 | 16000 gallon Treated Water Tank |
| Diluted Brine Tank (12%) | 1 | EA | \$ 39,300 | \$ 39,300 | 16000 gallon Diluted Water Tank |
| Slow-Rinse/Clarified Brine Tank (Waste Storage) | 1 | EA | \$ 92,800 | \$ 92,800 | 40500 gal Clarifier Brine/Slow Rinse Tank, FRP |
| Backwash/Fast-Rinse Tank (Waste Storage) | 1 | EA | \$ 97,900 | \$ 97,900 | 42000 gal Backwash/Fast Rinse Tank, FRP |
| Ferrous Sulfate Tank | 1 | EA | \$ 3,600 | \$ 3,600 | 1049 gal Ferrous Sulfate Tank |
| <i>Pumps</i> | | | | | |
| Backwash Pump (Backwash, Fast/Slow Rinse) | 2 | EA | \$ 25,500 | \$ 51,000 | 236 gpm Backwash Pump, 1 duty/1 standby |
| Brine Pump (From Brine Storage Tank to either Backwash/Fast-Rinse or Slow-Rinse/Waste Brine Tank) | 2 | EA | \$ 16,900 | \$ 33,800 | 67 gpm Brine Pump, 1 duty/1 standby |
| Return Pump (From Fast-Rinse Tank to Wellhead) | 2 | EA | \$ 15,000 | \$ 30,000 | 20 gpm Return Pump, 1 duty/1 standby |
| Waste Pump (from Slow-Rinse/Waste Brine Tank to Clarification Tank) | 2 | EA | \$ 20,100 | \$ 40,200 | 268 gpm Waste Pump |
| Ferrous Sulfate Pump | 2 | EA | \$ 7,700 | \$ 15,400 | 2.5 gpm Ferrous Sulfate Pump |
| Sludge Pump | 4 | EA | \$ 5,100 | \$ 20,400 | 75 gpm, Sludge and Recycle pumps, 1 duty/1 standby each |
| Recovered Dewatered Pump | 2 | EA | \$ 15,000 | \$ 30,000 | Allow 20 gpm, 1 duty/1 standby |
| <i>Solids Handling</i> | | | \$ - | \$ - | |
| Gravity Thickener (Ferrous Iron precipitation) | 2 | EA | \$ 11,000 | \$ 22,000 | 4500 gal cone bottom tank, including stand |
| Gravity Thickener Blower | 2 | EA | \$ 1,841 | \$ 3,682 | 11809 CFM; 2.68 HP; B3330 Ultrafan Pak 2000 |
| Dewatering Equipment | 4 | EA | \$ 171,700 | \$ 686,800 | 100 cy Sludgemate. Assume 50 cy containers |
| Polymer Dosing System | 1 | EA | \$ 12,000 | \$ 12,000 | 0.3 gal/hour |
| Subtotal | | | | \$ 2,406,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 721,800 | Including tax, freight, installation and manufacturer services. |
| Equipment Concrete Pads/Containment Wall | 274 | CY | \$ 1,000 | \$ 274,100 | Assume pad for all pumps, IX System, Bag Filters, Tanks and Polymer System |
| Subtotal (Installed Equipment Costs) | | | | \$ 3,402,000 | Rounded up to \$1000 |

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2,000-gpm SBA System |

| | |
|--|-----------------|
| Hazen and Sawyer Project No. 20002-004 | |
| By Y.W. & C.P. | Updated by M.P. |
| Date: Dec. 2014 | Date: May 2015 |

| | | | | | |
|--|------|--|--|---------------------|--|
| General Requirements | 7.5% | | | \$ 255,200 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 170,100 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 170,100 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 510,300 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 510,300 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 5,018,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 1,003,600 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Engineering, Legal and Administrative | 20% | | | \$ 1,003,600 | Includes permits, legal fees and engineering fees for design and construction |
| Project Total | | | | \$ 7,026,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 4,918,000 | -30% |
| High Estimate | | | | \$ 10,539,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

Estimated Annual O&M Costs for SBA

Sulfate = 50 mg/L

| System Flow Rate (gpm) | Electricity | Chemicals | Resin Replacement (Fresh Resin and Spent Resin Disposal) | Residuals Disposal (Brine and Wastewater) | Labor | Other Consumables (Bag Filters) | Maintenance and Spare Parts | Lab and Field Analysis | Annual O&M (Rounded up to \$1000) |
|------------------------|-------------|-----------|--|---|------------|---------------------------------|-----------------------------|------------------------|-----------------------------------|
| 100 | \$ 2,318 | \$ 1,354 | \$ 2,290 | \$ 9,394 | \$ 136,500 | \$ 1,632 | \$ 5,630 | \$ 29,616 | \$ 189,000 |
| 500 | \$ 6,043 | \$ 6,768 | \$ 11,452 | \$ 31,850 | \$ 136,500 | \$ 1,632 | \$ 9,364 | \$ 29,616 | \$ 233,000 |
| 1000 | \$ 10,700 | \$ 13,537 | \$ 22,904 | \$ 59,919 | \$ 136,500 | \$ 1,632 | \$ 13,851 | \$ 29,616 | \$ 289,000 |
| 2000 | \$ 20,013 | \$ 27,074 | \$ 45,808 | \$ 116,059 | \$ 136,500 | \$ 1,632 | \$ 22,226 | \$ 39,153 | \$ 408,000 |

Sulfate = 110 mg/L

| System Flow Rate (gpm) | Electricity | Chemicals | Resin Replacement (Fresh Resin and Spent Resin Disposal) | Residuals Disposal (Brine and Wastewater) | Labor | Other Consumables (Bag Filters) | Maintenance and Spare Parts | Lab and Field Analysis | Annual O&M (Rounded up to \$1000) |
|------------------------|-------------|-----------|--|---|------------|---------------------------------|-----------------------------|------------------------|-----------------------------------|
| 100 | \$ 2,348 | \$ 1,679 | \$ 2,290 | \$ 10,908 | \$ 136,500 | \$ 1,632 | \$ 5,630 | \$ 36,406 | \$ 197,000 |
| 500 | \$ 6,193 | \$ 8,397 | \$ 11,452 | \$ 39,422 | \$ 136,500 | \$ 1,632 | \$ 9,364 | \$ 36,406 | \$ 249,000 |
| 1000 | \$ 10,999 | \$ 16,795 | \$ 22,904 | \$ 75,064 | \$ 136,500 | \$ 1,632 | \$ 13,851 | \$ 36,406 | \$ 314,000 |
| 2000 | \$ 20,611 | \$ 33,589 | \$ 45,808 | \$ 146,348 | \$ 136,500 | \$ 1,632 | \$ 22,226 | \$ 49,339 | \$ 456,000 |

Costs are in 2015 dollars.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 100-gpm WBA System |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| Description | Quantity | Unit | Unit Cost | Total Cost | Notes |
|---|----------|------|------------|---------------------|--|
| Equipment | | | | | |
| CO ₂ Feed System | 1 | LS | \$ 164,000 | \$ 164,000 | Quote from TOMCO; 15 lb/hr PSF and 6 ton storage; adjusted to 2015 dollars. |
| CO ₂ Feed Water Pump | 2 | EA | \$ 7,600 | \$ 15,200 | Quote from ITT; centrifugal; 15 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2015 dollars. |
| Static Mixer | 1 | EA | \$ 900 | \$ 900 | Quotes from Komax & EWS; 3-inch; adjusted to 2015 dollars. |
| Bag Filters | 2 | EA | \$ 2,200 | \$ 4,400 | Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Ion Exchange Equipment | 1 | LS | \$ 65,000 | \$ 65,000 | Quotes from Evoqua, not including first fill of resin; adjusted to 2015 dollars. |
| Booster Pump | 2 | EA | \$ 8,200 | \$ 16,400 | Quote from ITT, 100 gpm @ 15 ft; 1 duty/1 stdby; adjusted to 2015 dollars. |
| Antiscalant Feed System for Aeration | 1 | LS | \$ 7,000 | \$ 7,000 | Including one 60-gal storage tank and two chemical pumps. Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Aeration Equipment | 1 | EA | \$ 105,000 | \$ 105,000 | Quote from CECO and JAWS; 18-24/30" tower; in 2015 dollars. |
| Subtotal | | | | \$ 378,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 113,400 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 2 | CY | \$ 1,330 | \$ 2,660 | \$1330/CY, adjusted to 2015 dollars |
| Equipment Concrete Pad | 52 | CY | \$ 1,330 | \$ 69,500 | \$1330/CY, adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 564,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 42,300 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 28,200 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 28,200 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 85,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 85,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 833,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 166,600 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 999,600 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 199,920 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 199,920 | Includes permits, legal fees and engineering fees for design and construction |
| Initial Fill of Resin | 1 | LS | \$ 33,000 | \$ 33,000 | Including tax, freight, installation and manufacturer services. |
| Project Total | | | | \$ 1,433,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 1,003,000 | -30% |
| High Estimate | | | | \$ 2,150,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 500-gpm WBA System |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| Description | Quantity | Unit | Unit Cost | Total Cost | Notes |
|---|----------|------|------------|---------------------|--|
| Equipment | | | | | |
| CO ₂ Feed System | 1 | LS | \$ 202,000 | \$ 202,000 | Quote from TOMCO; 75 lb/hr PSF and 14 ton storage; adjusted to 2015 dollars. |
| CO ₂ Feed Water Pump | 2 | EA | \$ 8,000 | \$ 16,000 | Quote from ITT; centrifugal; 75 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2015 dollars. |
| Static Mixer | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & EWS; 8-inch; adjusted to 2015 dollars. |
| Bag Filters | 2 | EA | \$ 10,000 | \$ 20,000 | Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Ion Exchange Equipment | 1 | LS | \$ 253,000 | \$ 253,000 | Quotes from Evoqua, not including first fill of resin; adjusted to 2015 dollars. |
| Booster Pump | 2 | EA | \$ 12,000 | \$ 24,000 | Quote from ITT, 500 gpm @ 15 ft; 1 duty/1 stdby; adjusted to 2015 dollars. |
| Antiscalant Feed System for Aeration | 1 | LS | \$ 8,000 | \$ 8,000 | Including one 120-gal storage tank and two chemical pumps. Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/1 stdby; adjusted to 2015 dollars |
| Aeration Equipment | 1 | EA | \$ 153,000 | \$ 153,000 | Quote from CECO and JAWS; 54-60/72" tower; in 2015 dollars. |
| Subtotal | | | | \$ 682,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 204,600 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 2 | CY | \$ 1,330 | \$ 2,660 | \$1330/CY, adjusted to 2015 dollars |
| Equipment Concrete Pad | 157 | CY | \$ 1,330 | \$ 209,000 | \$1330/CY, adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,099,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 82,425 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 54,950 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 54,950 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 165,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 165,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 1,621,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 324,200 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 1,945,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 389,000 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 389,000 | Includes permits, legal fees and engineering fees for design and construction |
| Initial Fill of Resin | 1 | LS | \$ 164,000 | \$ 164,000 | Including tax, freight, installation and manufacturer services. |
| Project Total | | | | \$ 2,887,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 2,021,000 | -30% |
| High Estimate | | | | \$ 4,331,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 1000-gpm WBA System |

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|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| Description | Quantity | Unit | Unit Cost | Total Cost | Notes |
|---|----------|------|------------|---------------------|--|
| Equipment | | | | | |
| CO ₂ Feed System | 1 | LS | \$ 250,000 | \$ 250,000 | Quote from TOMCO; 150 lb/hr PSF and 25 ton storage; in 2015 dollars. |
| CO ₂ Feed Water Pump | 2 | EA | \$ 7,200 | \$ 14,400 | Quote from Cortech; centrifugal; 153 gpm @ 80 psi; 1 duty/1 stdby |
| Static Mixer | 1 | EA | \$ 5,900 | \$ 5,900 | Quotes from Komax & KOFLO; 10-inch. |
| Bag Filters | 2 | EA | \$ 19,600 | \$ 39,200 | Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; in 2015 dollars. |
| Ion Exchange Equipment | 1 | LS | \$ 301,500 | \$ 301,500 | Quotes from Evoqua and Calgon, not including first fill of resin; in 2015 dollars. |
| Booster Pump | 2 | EA | \$ 14,500 | \$ 29,000 | Quote from ITT, 1000 gpm @ 15 ft; 1 duty/1 stdby |
| Antiscalant Feed System for Aeration | 1 | LS | \$ 7,000 | \$ 7,000 | Including one 60-gal storage tank and two chemical pumps. Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby; adjusted to 2014 dollars |
| Aeration Equipment | 1 | LS | \$ 200,000 | \$ 200,000 | Quote from CECO and JAWS; 72/96" tower; in 2015 dollars. |
| Subtotal | | | | \$ 847,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 254,100 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 1 | CY | \$ 1,330 | \$ 1,330 | \$1330/CY, adjusted to 2015 dollars |
| Equipment Concrete Pad | 177 | CY | \$ 1,330 | \$ 234,778 | \$1250/CY, adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 1,338,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 100,350 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 66,900 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 66,900 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 201,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 201,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 1,974,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 394,800 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 2,369,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 473,800 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 473,800 | Includes permits, legal fees and engineering fees for design and construction |
| Initial Fill of Resin | 1 | LS | \$ 328,000 | \$ 328,000 | Including tax, freight, installation and manufacturer services. |
| Project Total | | | | \$ 3,645,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 2,552,000 | -30% |
| High Estimate | | | | \$ 5,468,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

| | |
|---------|---|
| Client | City of Glendale |
| Project | Enhanced RCF Testing for Removing Hexavalent Chromium |
| Item | 2000-gpm WBA System |

| |
|---|
| Hazen and Sawyer Project No. 20002-004 |
| Based on the costs in Blute et al. 2013b. |
| Updated by Y.Wu on 3/13/2014. |
| Updated by M. Santos on 3/25/2015. |

| Description | Quantity | Unit | Unit Cost | Total Cost | Notes |
|---|----------|------|------------|---------------------|--|
| Equipment | | | | | |
| CO ₂ Feed System | 1 | LS | \$ 292,000 | \$ 292,000 | Quote from TOMCO; 300 lb/hr and 50 ton storage; adjusted to 2015 dollars. |
| CO ₂ Feed Water Pump | 2 | EA | \$ 9,200 | \$ 18,400 | Quote from ITT; centrifugal; 305 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2015 dollars. |
| Static Mixer | 1 | EA | \$ 9,500 | \$ 9,500 | Quotes from Komax & EWS; 14-inch; adjusted to 2015 dollars. |
| Bag Filters | 2 | EA | \$ 30,100 | \$ 60,200 | Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2015 dollars. |
| Ion Exchange Equipment | 1 | LS | \$ 692,000 | \$ 692,000 | Quotes from Evoqua, not including first fill of resin; adjusted to 2015 dollars. |
| Antiscalant Feed System for Aeration | 1 | LS | \$ 8,000 | \$ 8,000 | Including one 120-gal storage tank and two chemical pumps. Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby; adjusted to 2015 dollars |
| Aeration Equipment | 1 | EA | \$ 302,000 | \$ 302,000 | Quote from CECO and JAWS; 108/144" tower; in 2015 dollars. |
| Subtotal | | | | \$ 1,433,000 | Rounded up to \$1000 |
| Equipment Installation Cost | 30% | | | \$ 429,900 | Including tax, freight, installation and manufacturer services. |
| Chemical Storage Containment | 2 | CY | \$ 1,330 | \$ 2,660 | \$1330/CY, adjusted to 2015 dollars |
| Equipment Concrete Pad | 270 | CY | \$ 1,330 | \$ 359,400 | \$1330/CY, adjusted to 2015 dollars |
| Subtotal (Installed Equipment Costs) | | | | \$ 2,225,000 | Rounded up to \$1000 |
| General Requirements | 7.5% | | | \$ 166,875 | Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents |
| Earthwork | 5% | | | \$ 111,250 | Excavation, backfill, and fill required to construct project |
| Site Improvements | 5% | | | \$ 111,250 | Roadways, curb and gutter, sidewalk and landscaping |
| Valves, Piping, and Appurtenances | 15% | | | \$ 334,000 | Major system piping and valves |
| Electrical, Instrumentation and Controls | 15% | | | \$ 334,000 | PLC and SCADA equipment to control |
| Total Direct Costs | | | | \$ 3,282,000 | Rounded up to \$1000 |
| Contractor's Overhead and Profit | 20% | | | \$ 656,400 | Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves |
| Construction Total | | | | \$ 3,938,000 | Rounded up to \$1000 |
| Project Level Allowance (contingency) | 20% | | | \$ 787,600 | Budget item to cover change orders due to unforeseen conditions |
| Engineering, Legal and Administrative | 20% | | | \$ 787,600 | Includes permits, legal fees and engineering fees for design and construction |
| Initial Fill of Resin | 1 | LS | \$ 658,000 | \$ 658,000 | Including tax, freight, installation and manufacturer services. |
| Project Total | | | | \$ 6,172,000 | Rounded up to \$1000 |
| Low Estimate | | | | \$ 4,320,000 | -30% |
| High Estimate | | | | \$ 9,258,000 | +50% |

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2015 dollars.
3. Costs for land or easements are not included.

Estimated Annual O&M Costs for WBA with Purolite S106 Resin

| System Size (gpm) | Electricity* | Chemicals | Resin Replacement (Fresh Resin) | Spent Resin & Wastewater Disposal | Labor | Other Consumables (Bag Filters) | Maintenance and Spare Parts | Lab and Field Analysis & | Annual O&M (Rounded up to \$1000) |
|-------------------|--------------|------------|---------------------------------|-----------------------------------|-----------|---------------------------------|-----------------------------|--------------------------|-----------------------------------|
| 100 | \$ 2,300 | \$ 11,200 | \$ 12,300 | \$ 11,600 | \$ 42,000 | \$ 130 | \$ 5,600 | \$ 27,871 | \$ 113,000 |
| 500 | \$ 11,700 | \$ 56,126 | \$ 34,700 | \$ 37,000 | \$ 42,432 | \$ 540 | \$ 11,000 | \$ 27,871 | \$ 221,000 |
| 1000 | \$ 28,000 | \$ 112,100 | \$ 62,629 | \$ 68,758 | \$ 42,432 | \$ 1,100 | \$ 13,400 | \$ 27,871 | \$ 356,000 |
| 2000 | \$ 43,000 | \$ 224,503 | \$ 115,000 | \$ 132,240 | \$ 68,951 | \$ 1,600 | \$ 22,300 | \$ 47,651 | \$ 655,000 |

* Electricity does not include power for aeration off-gas treatment. Estimated costs were \$700, \$11,000 and \$22,000 for 100, 500 and 2000 gpm, respectively.

& Lab and field analysis does not include cost for aeration off-gas analysis.

Costs are in 2015 dollars.