

COST ESTIMATE ASSUMPTIONS - Direct Injection into Permanent Wells

SITE: SITE X
 ALTERNATIVE: Source Remediation
 DESCRIPTION: Activated Persulfate Injection - Injection Wells

PREPARED BY: P. Eng
 PROJECT NUMBER: 012345.67.89

Site Background Data

Treatment Zone

Length of Target Groundwater Contamination Zone =	40	ft
Width of Target Groundwater Contamination Zone =	70	ft
Area of Contaminated Groundwater Target Zone =	2,800	sf
Top of Injection Interval =	20	ft bgs
Bottom of Injection Interval =	30	ft bgs
Saturated Thickness =	10	ft
Porosity =	0.3	
Volume of Contaminated Groundwater =	62,836	gal

Oxidant Delivery

Preferred oxidant:	Persulfate
Desired Injected Pore Volumes for Treatment =	0.5

Target Injection Volume (calculated) =	31,418	gal
Target Injection Volume (from ISCO Design Tool) =	-	gal
User-Selected Injection Volume	30,000	gal

Injection or Rate per Well =	7	gpm
Number of Wells Injected Simultaneously	5	
Hours per Day Injected =	8	hours
Amount of active injection time =	2	days
Oxidant Mass (total) =	22,050	lbs
Total Mass of Activator Required =	User Entered	----->
Total Mass of Acid Conditioner =	N/A	----->
		28,456 lbs

Injection System Design

Injection Well Design

Number of Wells =	15
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Injection Well Depth =

40

Total Linear Feet of Injection Wells =

600

Well Screen Length, Diameter, and Materials of Construction =

5

 feet

2

 inch

Stainless Steel

Well Casing Length, Diameter, and Materials of Construction =

35

 feet

2

 inch

Sch 40 PVC

Wellhead Completion Method =

Flush Mount

Number of Well Head Completions =

9

Waste Generation Quantities

Drilling Method =

Hollow-Stem Auger

Diameter of Boreholes =

8

 in

Waste Soil Volume =

7.75

 cy

Waste Containerization Requirements =

28

 55-gal drums

Field Piping Design (if applicable for manifold or recirculation design)

Length of Trenching =

0

 lf

Size of Piping =

--

 in

Length of Piping =

--

 lf

Quantity of Pipe Bedding =

--

 cy

Quantity of Backfill =

--

 cy

Quantity of Excavation Waste =

--

 cy

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Monitoring System Design

Number of Monitoring Wells =

6

Monitoring Well Depth (feet) =

40

Total Linear Feet of monitoring Wells

240

Wellhead Completion Method =

Flush Mount

Number of wellhead completions

4

Waste Generation Quantities

Drilling Method =

Hollow-Stem Auger

Diameter of Boreholes =

8

in

Waste Soil Volume =

3.10

cy

Waste Containerization Requirements =

11

55-gal drums

Total Number of Monitoring Wells to be Sampled =

4

Sampling Rounds per Year =

4

Total Wells Sampled per Year =

16

Estimated Total Samples per Well per Round =

1

Estimated Total Samples per Year =

24

Construction Timeframe

Total Linear Feet of Drilling =

600

Drill Rig Production Rate (including well completion) =

100

ft/day

Number of On-site Days for Drill Rig =

6

days

Number of Days for On-site Equipment Fabrication =

0

days

Total Linear Feet of Trenching =

0

Trenching Production Rate (including pipe and backfill) =

200

ft/day

Number of Days for Trenching =

0

days

Number of Days for Equipment Mobilization =

3

days

Total Number of Days for Construction =

9

days

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Injection Time

Total Number of Days for Mobilization & Site Setup =	2	days
Amount of Active Injection Time =	2	days
Amount of Time for Equipment Setup and Breakdown =	30	hours (assumed: 1 hr setup, 1 hr breakdown per well)
Total Number of Days for Injection =	3	days

Post Remediation Closure

Wells to be Abandoned =	21	wells
Total Number of Days for Well Abandonment =	7	days
Total Number of Days for Equipment Demobilization =	5	days
Total Number of Days for Site Restoration =	12	days

COST ESTIMATE SUMMARY

SITE: SITE X

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PROJECT NUMBER: 012345.67.89

Capital Cost	
Construction	\$ 101,238
Project Management	\$ 8,099
Design	\$ 15,186
Construction Management	\$ 15,186
Subcontractor General Requirements	\$ 5,062
Contingency	\$ 28,954
Total Capital Cost	\$ 173,725
Annual Operations and Monitoring	
Groundwater Sampling	\$ 23,280
Injection	\$ 130,971
Reporting	\$ 16,300
Professional Services ¹	\$ 44,343
Subcontractor General Requirements	\$ 8,528
Contingency	\$ 44,684
Total Year 1 Operations and Monitoring	\$ 268,106
Remaining Annual Operations and Monitoring	
Year 2	\$ 141,064
Year 3	\$ 34,198
Total Remaining Annual Operations and Monitoring	\$ 175,262
Post Closure Cost	
Closure Reporting	\$ 8,840
Well Abandonment and Equipment Demobilization	\$ 11,556
Professional Services ¹	\$ 7,750
Subcontractor General Requirements	\$ 1,020
Contingency	\$ 5,833
Total Post Closure Cost	\$ 35,000
TOTAL PRESENT WORTH	\$ 745,945

NOTE: These cost estimates provided are to an accuracy of +50 percent to -30 percent and are prepared for the sole purpose of alternative comparison. The alternative cost estimates are based on conceptual design information available at the time of this study. The actual cost of the project would depend on the final scope and design of the selected remedial action, the schedule of implementation, competitive market conditions, and other variables.

COST ESTIMATE DETAILS

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CAPITAL COST

Item/Activity	Qty	Unit	Unit Cost	Cost	Comments and References
<u>Construction</u>					
<i>Pilot Test</i>					
Source Area Pilot Test	0	LS	\$ 50,000.00	\$	- Field test at source to determine optimum oxidant/dose
<i>Well Installation and Trenching Subcontractors</i>					
Well Installation Mobilization	1	LS	\$ 2,500.00	\$	2,500 Hollow-Stem Auger
Injection Well Installation	600	lf	\$ 50.00	\$	30,000 Sch 40 PVC
Injection Wellhead Completions	15	ea	\$ 400.00	\$	6,000 Flush Mount
Monitoring Well Installation	240	lf	\$ 40.00	\$	9,600 Hollow-Stem Auger
Well Development Equipment Rental	1	LS	\$ 2,000.00	\$	2,000 Includes water quality meter, pumps, generator, tubing
Monitoring Wellhead Completions	6	ea	\$ 400.00	\$	2,400 Flush Mount
Well Permits	21	ea	\$ 30.00	\$	630 Assume 1 permit for each well
IDW Soil Disposal	40	drum	\$ 350.00	\$	13,952 Assume characterization, management, storage, transportation
Per Diem for Drilling Subcontractors	9	days	\$ 600.00	\$	5,400 Assume all travel expenditures (food, hotel, etc.)
<i>Oversight</i>					
Well Installation Oversight	108	hr	\$ 70.00	\$	7,560
Well Development Labor - Technician	42	hr	\$ 70.00	\$	2,940
System Startup Oversight	0	hr	\$ 90.00	\$	-
Subtotal Capital Cost				\$	82,982
Site Work Allowance	0%	of	\$ 82,982.11	\$	-
Mechanical Allowance	5%	of	\$ 82,982.11	\$	4,149
Instrumentation and Controls Allowance	2%	of	\$ 82,982.11	\$	1,660
Electrical Allowance	10%	of	\$ 82,982.11	\$	8,298
Miscellaneous Equipment Allowance	5%	of	\$ 82,982.11	\$	4,149
Subtotal Capital Cost				\$	101,238

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Project Management	8%	of	\$ 101,238.17	\$ 8,099
Design	15%	of	\$ 101,238.17	\$ 15,186
Construction Management	15%	of	\$ 101,238.17	\$ 15,186
Subcontractor General Requirements	5%	of	\$ 101,238.17	\$ 5,062
Subtotal Capital Cost				\$ 144,771
G&A	5%	of	\$ 144,770.58	\$ 7,239
Field Overhead	5%	of	\$ 144,770.58	\$ 7,239
Tax	7%	of	\$ 144,770.58	\$ 10,134
Contingency	20%	of	\$ 144,770.58	\$ 28,954
Subtotal Capital Cost				\$ 198,336
Bonding & Insurance	2%	of	\$ 198,335.70	\$ 3,967
Fee	8%	of	\$ 198,335.70	\$ 15,867
TOTAL CAPITAL COST				\$ 218,169

FIRST YEAR IMPLEMENTATION AND MONITORING

<u>Item/Activity</u>	<u>Qty</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Cost</u>	<u>Comments</u>
<u>Groundwater Sampling</u>					
Labor - Technician	96	hr	\$ 55.00	\$ 5,280	3 hrs/well, 2 people
Groundwater Sample Analysis	24	sample	\$ 450.00	\$ 10,800	VOC/MNA/metals analysis, incl. QA/QC samples and data validation
Sampling Supplies	4	round	\$ 500.00	\$ 2,000	Includes consumables, shipping
GW Sampling Equipment Rental	4	round	\$ 1,300.00	\$ 5,200	Includes wl meter, down hole water quality meter, pumps, generator
Total Groundwater Sampling				\$ 23,280	
<u>Injection</u>					
Subcontractor Mobilization and Per Diem	2	day	\$ 900.00	\$ 1,800	Includes all support equipment, oxidator transport, and implementation
Oxidant Supply	22,050	lb	\$ 1.75	\$ 38,588	Included shipping and handling
Activator Supply	28,456	lb	\$ 0.39	\$ 11,098	25% NaOH solution

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Acid Conditioner Supply	0	lb	\$ 1.30	\$ -
Injection & Mixing Equipment Rental	2	day	\$ 100.00	\$ 200
Injection Subcontractor - Labor	2	day	\$ 6,000.00	\$ 12,000
Labor - Engineer/Hydrogeologist	20	hr	\$ 90.00	\$ 1,800
Total System Startup (one injection event)				\$ 65,485
Number of Injection Events (first year)	2	events		
				\$ 130,971

Reporting

Labor - Engineer/Hydrogeologist	160	hr	\$ 90.00	\$ 14,400
Labor - Editor	20	hr	\$ 65.00	\$ 1,300
Labor - CAD Technician	8	hr	\$ 75.00	\$ 600
Total Reporting				\$ 16,300
Subtotal Injection Implementation and Monitoring				\$ 170,551

Project Management	8%	of	\$ 170,550.80	\$ 13,644
Technical Support	10%	of	\$ 170,550.80	\$ 17,055
Construction Management	8%	of	\$ 170,550.80	\$ 13,644
Subcontractor General Requirements	5%	of	\$ 170,550.80	\$ 8,528
Subtotal Year 1 Operations and Monitoring				\$ 223,422

G&A	5%	of	\$ 223,421.55	\$ 11,171
Field Overhead	5%	of	\$ 223,421.55	\$ 11,171
Tax	7%	of	\$ 223,421.55	\$ 15,640
Contingency	20%	of	\$ 223,421.55	\$ 44,684
Subtotal Year 1 Operations and Monitoring				\$ 306,088

Bonding & Insurance	0%	of	\$ 306,087.52	\$ -	Bonding only applies to Capital Costs
Fee	8%	of	\$ 306,087.52	\$ 24,487	
TOTAL FIRST YEAR IMPLEMENTATION AND MONITORING COST				\$ 330,575	

SECOND YEAR IMPLEMENTATION AND MONITORING

Groundwater Sampling (percent of first year cost)	50%	of	\$ 23,280.00	\$ 11,640
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COST ESTIMATE DETAILS

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DESCRIPTION: Activated Persulfate Injection - Injection Wells

Number of Injection Events	0.75	events	\$ 65,485.40	\$ 49,114
Reporting (percent of first year cost)	50%	of	\$ 16,300.00	\$ 8,150
Professional Services and Subcontractor General Requirements (percent of first year cost)	50%	of	\$ 52,870.75	\$ 26,435
Subtotal Year 2 Operations and Monitoring				\$ 95,339
G&A	5%	of	\$ 95,339.42	\$ 4,767
Field Overhead	5%	of	\$ 95,339.42	\$ 4,767
Tax	7%	of	\$ 95,339.42	\$ 6,674
Contingency	20%	of	\$ 95,339.42	\$ 19,068
Subtotal Year 2 Operations and Monitoring				\$ 130,615
Bonding & Insurance	0%	of	\$ 130,615.01	\$ - Bonding only applies to Capital Costs
Fee	8%	of	\$ 130,615.01	\$ 10,449
TOTAL SECOND YEAR IMPLEMENTATION AND MONITORING COST				\$ 141,064

THIRD YEAR IMPLEMENTATION AND MONITORING

Groundwater Sampling (percent of first year cost)	25%	of	\$ 23,280.00	\$ 5,820
Number of Injection Events	0	events	\$ 65,485.40	\$ -
Reporting (percent of first year cost)	25%	of	\$ 16,300.00	\$ 4,075
Professional Services and Subcontractor General Requirements (percent of first year cost)	25%	of	\$ 52,870.75	\$ 13,218
Subtotal Year 3 Operations and Monitoring				\$ 23,113
G&A	5%	of	\$ 23,112.69	\$ 1,156
Field Overhead	5%	of	\$ 23,112.69	\$ 1,156
Tax	7%	of	\$ 23,112.69	\$ 1,618
Contingency	20%	of	\$ 23,112.69	\$ 4,623
Subtotal Year 3 Operations and Monitoring				\$ 31,664
Bonding & Insurance	0%	of	\$ 31,664.38	\$ - Bonding only applies to Capital Costs
Fee	8%	of	\$ 31,664.38	\$ 2,533
TOTAL THIRD YEAR IMPLEMENTATION AND MONITORING COST				\$ 34,198

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FOURTH YEAR IMPLEMENTATION AND MAINTENANCE

Groundwater Sampling (percent of first year cost)	0%	of	\$ 23,280.00	\$ -
Number of Injection Events	0	events	\$ 65,485.40	\$ -
Reporting (percent of first year cost)	0%	of	\$ 16,300.00	\$ -
Professional Services and Subcontractor General Requirements (percent of first year cost)	0%	of	\$ 52,870.75	\$ -
Subtotal Year 4 Operations and Maintenance				\$ -

G&A	5%	of	\$ -	\$ -
Field Overhead	5%	of	\$ -	\$ -
Tax	7%	of	\$ -	\$ -
Contingency	25%	of	\$ -	\$ -
Subtotal Year 4 Operations and Maintenance				\$ -

Bonding & Insurance	0%	of	\$ -	\$ -	- Bonding only applies to Capital Costs
Fee	8%	of	\$ -	\$ -	-

TOTAL FOURTH YEAR IMPLEMENTATION AND MAINTENANCE COST

\$ -

FIFTH YEAR IMPLEMENTATION AND MAINTENANCE

Groundwater Sampling (percent of first year cost)	0%	of	\$ 23,280.00	\$ -
Number of Injection Events	0	event	\$ 65,485.40	\$ -
Reporting (percent of first year cost)	0%	of	\$ 16,300.00	\$ -
Professional Services and Subcontractor General Requirements (percent of first year cost)	0%	of	\$ 52,870.75	\$ -
Subtotal Year 5 Operations and Maintenance				\$ -

G&A	5%	of	\$ -	\$ -
Field Overhead	5%	of	\$ -	\$ -
Tax	7%	of	\$ -	\$ -
Contingency	25%	of	\$ -	\$ -
Subtotal Year 4 Operations and Maintenance				\$ -

Bonding & Insurance	0%	of	\$ -	\$ -	- Bonding only applies to Capital Costs
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Fee	8%	of	\$	-	\$	-
TOTAL FIFTH YEAR IMPLEMENTATION AND MAINTENANCE COST					\$	-

TOTAL IMPLEMENTATION AND MONITORING COST (2ND AND 3RD YEAR)	\$	175,262
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POST CLOSURE COST

Item/Activity	Qty	Unit	Unit Cost	Cost	Comments
<i>Closure Reporting</i>					
Labor - Engineer/Hydrogeologist	80	hr	\$ 90.00	\$ 7,200	
Labor - Editor	16	hr	\$ 65.00	\$ 1,040	
Labor - CAD Technician	8	hr	\$ 75.00	\$ 600	
Total <i>Closure Reporting</i>				\$ 8,840	

Well Abandonment and Equipment Demobilization

Well Abandonment	21	well	\$ 300.00	\$ 6,300	Assume abandon 10 wells/day (grout to surface, no overdrilling)
Well Abandonment Permits	21	well	\$ 30.00	\$ 630	
Equipment Demobilization	5	days	\$ 500.00	\$ 2,500	Assume equipment reclamation and shipping returns
Equipment Rental	1	wk	\$ 200.00	\$ 200	PID
Subtotal Well Abandonment and Equipment Demobilization				\$ 9,630	

Site Work Allowance	10%	of	\$ 9,630.00	\$ 963	
Mechanical Allowance	10%	of	\$ 9,630.00	\$ 963	
Instrumentation and Controls Allowance	0%	of	\$ 9,630.00	\$ -	
Electrical Allowance	0%	of	\$ 9,630.00	\$ -	
Miscellaneous Equipment Allowance	0%	of	\$ 9,630.00	\$ -	
Total <i>Well Abandonment and Equipment Demobilization</i>				\$ 11,556	
Subtotal Post-Closure Cost				\$ 20,396	

Project Management	8%	of	\$ 20,396.00	\$ 1,632
Technical Support	15%	of	\$ 20,396.00	\$ 3,059
Construction Management	15%	of	\$ 20,396.00	\$ 3,059

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Subcontractor General Requirements	5%	of	\$ 20,396.00	\$ 1,020
Subtotal Post-Closure Cost				\$ 29,166
G&A	5%	of	\$ 29,166.28	\$ 1,458
Field Overhead	5%	of	\$ 29,166.28	\$ 1,458
Tax	7%	of	\$ 29,166.28	\$ 2,042
Contingency	20%	of	\$ 29,166.28	\$ 5,833
Subtotal Post-Closure Cost				\$ 39,958
Bonding & Insurance	2%	of	\$ 39,957.80	\$ 799
Fee	8%	of	\$ 39,957.80	\$ 3,197
TOTAL POST CLOSURE COST				\$ 43,954

PRESENT WORTH ANALYSIS

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Assumptions

Discount Rate (i) 2.7%

Assumes Total PV earns interest for an entire year (12 months), compound annually.

Current discount rates can be obtained from the U.S. Office of Management and Budget website: http://www.whitehouse.gov/omb/circulars/a094/a94_apr

Present Worth Analysis

A		B	C	D	E=C+D	B*C	B*D	B*E
		*Discount Factor			Total PV			
Elapsed Time	Year	at 2.7%	Capital Cost	O&M Cost	Total Cost	Capital Costs at 2.7%	Total PV O&M Costs at 2.7%	Total PV Costs at 2.7%
0	2009	1.000	\$ 218,169		\$ 218,169	\$ 218,169	\$ -	\$ 218,169
1	2010	0.974		\$ 330,575	\$ 330,575	\$ -	\$ 321,884	\$ 321,884
2	2011	0.948		\$ 141,064	\$ 141,064	\$ -	\$ 133,745	\$ 133,745
3	2012	0.923	\$ 43,954	\$ 34,198	\$ 78,151	\$ 40,577	\$ 31,571	\$ 72,148
4	2013	0.899		\$ -	\$ -	\$ -	\$ -	\$ -
5	2014	0.875		\$ -	\$ -	\$ -	\$ -	\$ -
6	2015	0.852		\$ -	\$ -	\$ -	\$ -	\$ -
Total Alternative			\$ 262,123	\$ 505,836	\$ 767,959	\$ 258,747	\$ 487,199	\$ 745,945

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*Discount Factor = $1/(1 + i)^A$