

Table 1
Summary of Remedial Technology Screening
Phase III Remedial Action Plan
Former Raytheon Facility, Wayland, MA

DRAFT

<i>Response Action</i>	<i>Remedial Technology</i>	<i>Description</i>	<i>Implementability</i>	<i>Effectiveness</i>	<i>Status</i>
Source Area Saturated Soils	No Action/Institutional Controls	Leave soils in place. Place AUL on Site to manage soils	Could be implemented as a temporary solution. Not likely to permanently abate residual product within the source area	Would not be effective in the achievement of a Permanent Solution unless coupled with groundwater abatement.	Carried forward for consideration in detailed analysis to be coupled with groundwater alternatives.
	Excavation and Thermal Treatment or Off-Site Disposal	Excavate source area; dewater excavated material, and treat off-site using thermal process to vaporize contaminants from media or transport and dispose of off-site in landfill. .	Compatible with site conditions. Moderately difficult to implement.	Effective at removing impacted soils and treating off-site. Ability to achieve a permanent solution.	Carried Forward for Detailed Analysis.
	Pump and Treat	Groundwater extracted via pumping wells, collection trench or other means would be treated using a representative technology such as chemical/UV, liquid phase carbon. Treated groundwater would be discharged to surface water or reinjected.	Compatible with site conditions by installing injection and extraction well network.	Pump and Treat Systems installed in heterogeneous aquifers typically result in channelization of groundwater flow to the pumping well; limiting influence on source area. Ability to achieve a temporary solution.	Eliminated from further consideration.
	Air Sparging/Soil Vapor Extraction	The injection of air or steam into groundwater promotes the degradation/volatilization of dissolved phase contaminants. Extraction wells are installed to recover the volatilized or dissolved contaminants.	Compatible with site conditions by installing extensive well network.	Silt layer identified across site may cause channelization of air stream. Removal of VOCs below silt layer will be limited by diffusion rates. Does not have the ability to achieve a permanent solution	Eliminated from further consideration.
	Bioremediation	Injection of carbon, nutrients and other materials necessary to promote microbial anaerobic degradation of CVOCs. May promote source area dissolution.	Could be implemented by installing wells/infiltration gallery to facilitate the injection of carbon solution into the aquifer.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution. Bench scale study indicates it would be effective.	Carried forward for consideration in detailed analysis.
	In-Situ Chemical Oxidation	The injection of an oxidizing agent to chemically breakdown chlorinated VOCs to water, carbon dioxide, and chloride.	Could be implemented by installing wells/infiltration gallery to facilitate injection of oxidants into the aquifer.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution. Bench scale study indicates it would be effective.	Carried forward for consideration in detailed analysis.
	In Situ Thermal Treatment	Heating of subsurface groundwater to enhance degradation and volatilization. Techniques include Radio Frequency (RF), Six-Phase, Three-Phase, Steam and Conductive Heating.	Difficult to propagate heat through large impacted areas. Appropriate only in source area.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution in source area, too expensive to treat downgradient plume.	Carried Forward for Detailed Analysis in source area only.
	Injectable ZVI	The injection of ZVI to chemically breakdown CVOCs to water and chloride via abiotic degradation pathways.	Compatible with site conditions by installing well network. Bench scale and pilot studies have not been conducted.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution. Bench scale study would be required to determine if effective.	Carried forward for consideration in detailed analysis.

Table 1
Summary of Remedial Technology Screening
Phase III Remedial Action Plan
Former Raytheon Facility, Wayland, MA

DRAFT

<i>Response Action</i>	<i>Remedial Technology</i>	<i>Description</i>	<i>Implementability</i>	<i>Effectiveness</i>	<i>Status</i>
Groundwater	Monitored Natural Attenuation	Natural processes of degradation, dispersion, dilution, volatilization and adsorption. Subsurface chemical reactions would be monitored and modeled to evaluate long-term trends.	Could be implemented through monitoring to establish consistency with existing site conceptual model and overall decrease in concentrations over time.	Reaction rate may be limited by concentrations of total organic carbon in groundwater. Ability to achieve a temporary solution.	Carried forward for consideration in detailed analysis.
	Bioremediation	Injection of carbon, nutrients and other materials necessary to promote microbial anaerobic degradation of CVOCs.	Could be implemented by installing wells/infiltration gallery to facilitate the injection of carbon solution into the aquifer.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution. Bench scale study indicates it would be effective.	Carried forward for consideration in detailed analysis.
	Pump and Treat	Groundwater extracted via pumping wells, collection trench or other means would be treated using a representative technology such as chemical/UV, liquid phase carbon. Treated groundwater would be discharged to surface water or reinjected.	Compatible with site conditions by installing injection and extraction well network.	Pump and Treat Systems installed in heterogeneous aquifers typically result in channelization of groundwater flow to the pumping well; limiting influence on subsurface. Ability to achieve a temporary solution	Carried Forward for Detailed Analysis.
	Permeable Reactive Barrier	The injection media to intercept downgradient extent of plume. Reductant to chemically breakdown CVOCs to water and chloride via abiotic degradation pathways.	Bench scale and pilot studies have not been conducted. Implementability is uncertain and may be difficult over large areas.	Could reduce groundwater concentrations to levels necessary to achieve a Permanent Solution. Alternate reductants and/or combinations could be considered to increase duration and effectiveness of treatment.	Eliminated from further consideration

Table 2

**Detailed Cost Estimate for No Action/Institutional Controls Alternative for Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA**

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Preparation of AUL and Soils Management Plan	1	Lump Sum	\$30,000		\$30,000
				Contingency - 15%	\$4,500
Estimated Construction Cost					\$34,500
B. Annual O&M Cost					
Sample wells	20	well	\$750	(a)	\$15,000
Data compilation and review	1	Lump Sum	\$2,500		\$2,500
				Subtotal	\$17,500
				Contingency 15%	\$2,625
Estimated Annual O&M Cost					\$20,125
C. Present Worth					
Present Worth of Construction Costs					\$34,500
Present Worth of O&M	30	Years			\$267,000
Estimated Present Worth (rounded)					\$300,000

Notes:

- (a) Sampling costs based on sampling 10 wells semi-annually for VOCs by Method 8260. Labor is included.
(b) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary.

Table 3
Detailed Cost Estimate for Excavation of Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$) Notes	Cost (\$)
A. Construction Activities				
Excavation				
Mobilization	1	Lump Sum	\$57,500	\$57,500
Sheeting (~10,000 sf.)	1	Lump Sum	\$345,000	\$345,000
Groundwater Handling and Treatment	100,000	gallon	\$0.58	\$57,500
Excavation, Bracing and Backfill (~4,500 yd ³)	1	Lump Sum	\$345,000 (a)	\$345,000
Transportation and Disposal	2,550	Ton	\$80	\$204,000
Demobilization	1	Lump Sum	\$34,500	\$34,500
			<i>subtotal</i>	\$1,043,500
Oversight				
Labor	13	week	\$7,500	\$97,500
Sampling Analytical for Disposal	10	Each	\$1,500	\$15,000
			<i>subtotal</i>	\$112,500
Design				
Labor	1	Lump Sum	\$30,000	\$30,000
			<i>subtotal</i>	\$30,000
			Estimated Construction Cost	\$1,186,000
Contingency - %15				\$177,900
			Total	\$1,363,900
C. Present Worth				
Present Worth of Construction Costs				\$1,363,900
Present Worth of O&M	0	Years		\$0
			Estimated Present Worth (rounded) (b)	\$1,400,000

Notes:

- (a) T&D costs assume the waste will be disposed of as a U-listed waste. No monitoring activities were included in this option. It is assumed the Site will be monitored as part of downgradient plume activities.
- (b) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 4
Detailed Cost Estimate for Bioremediation in Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Well Network					
Injection Well Installation - 2"	24	Each	\$1,395	(a)	\$33,483
Monitoring Well Installation -2"	6	Each	\$1,845		\$11,071
Equipment					
Pump	4	Each	\$500		\$2,000
Hose, Fittings	1	Lump Sum	\$3,500		\$3,500
Labor					
Field Geologist	1	Each	\$12,960		\$12,960
Project Engineer	1	Each	\$9,600		\$9,600
Design					
ERM Labor	1	Each	\$35,000		\$35,000
Estimated Construction Cost					\$107,614
B. Annual Injection Cost					
Labor					
Technician	2	Injection	\$19,440	(b)	\$38,880
Project Engineer	2	Injection	\$21,600		\$43,200
Oversight	2	Injection	\$9,360		\$18,720
Substrate					
Mixing Tank	3	Injection	\$4,500		\$13,500
Misc Equipment	2	Lump Sum	\$3,000		\$6,000
Substrate	17640	lb	\$1.55		\$27,386
Nutrients	20	50lb bag	\$60		\$1,200
Water	3	Lump Sum	\$600		\$1,800
Estimated Annual Injection Cost Year 1 and 2					\$150,686
Estimated Annual Injection Cost Year 3 thru 10					\$75,343
C. Annual Monitoring Costs					
Sample wells - semi-annually	36	well	\$530		\$19,080
Field Parameter Monitoring - Quarterly	168	well	\$200	(c)	\$33,600
Analytical Cost	36	Lump Sum	\$460		\$16,560
Injection data compilation and review	1	Lump Sum	\$15,000		\$15,000
Estimated Annual Monitoring Cost Year 1 and 2					\$84,240
Estimated Annual Monitoring Cost Year 3 thru 10					\$50,640
Estimated Annual Total Year 1					\$342,540
Estimated Annual Total Year 2					\$234,926
Estimated Annual Total Year 3 thru 10					\$125,983
Contingency - 15%					\$237,800
C. Present Worth					
Present Worth of Construction Costs and Year 1 Injection					\$393,921
Present Worth of O&M					\$1,160,926
Estimated Present Worth (rounded)					\$1,600,000

Notes:

- (a) ERM assumes wells installed to a depth of 30 feet.
- (b) ERM assumes 2 injections per year due to groundwater velocity of 0.5 ft/day.
- (c) ERM assumes field parameter monitoring will be conducted during injection of soybean oil solution.
- (d) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 5
Detailed Cost Estimate for ISCO in Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$) Notes	Cost (\$)
A. Construction Activities				
Well Network - Assume Well Application into 30 points concurrently				
Injection Well Installation - 2"	60	Wells	\$234 (a)	\$14,030
Monitoring Well Installation - 2"	3	Wells	\$1,395	\$4,185
Well Materials	60	Each	\$234	\$14,030
Supervision	8.0	Days	\$1,625	\$13,000
Design				
ERM Labor	1	Each	\$35,000	\$35,000
Estimated Construction Cost				\$80,245
B. Injection Program				
Preparation				
Labor (assume 50% allocated to each area)	10	Days	\$3,438	\$34,375
Injection				
Labor	36	Days	\$5,156	\$185,625
Decommissioning				
Labor (assume 50% allocated to each area)	5	Days	\$3,438	\$17,188
Materials				
Potassium Permanganate	12,500	Pound	\$2 (b)	\$21,563
Delivery (GOD, tanker loads - diluted)	2	Lump Sum	\$1,725	\$3,450
Equipment				
Pumping Skid	41	Day	\$150	\$6,150
Trailer	41	Day	\$75	\$3,075
Generator	41	Day	\$100	\$4,100
Health and Safety	44	Each	\$150	\$6,600
Hose, Fittings, Disposables	2	Lump Sum	\$3,220	\$6,440
Misc Equipment	2	Lump Sum	\$2,300	\$4,600
Tankage (1 10,000-gal)	41	Day	\$86	\$3,536
Secondary Containment	41	Day	\$69	\$2,829
Tank Mobilization	2	Lump Sum	\$863	\$1,725
Water (allowance)	2	Lump Sum	\$1,380	\$2,760
Trash Disposal	2	Lump Sum	\$604	\$1,208
Estimated Injection Cost				\$305,223
C. Annual Monitoring Costs (Each Area)				
Sample wells - semi-annually	36	well	\$531	\$19,125
Quarterly field parameter sampling (Year 1 and 2 only)	100	well	\$200	\$20,000
Analytical Cost	36	well	\$200	\$7,200
Reporting Cost	1	Lump Sum	\$20,000	\$20,000
Injection data compilation and review	1	Lump Sum	\$25,000	\$25,000
Estimated Annual Monitoring Cost				\$91,325
Contingency - 15%				\$194,808
D. Present Worth				
Present Worth of Construction Costs and Year 1 Injection				\$456,030
Present Worth of O&M	9	Years		\$732,000
Estimated Present Worth (rounded) (c)				\$1,200,000

Notes:

- (a) ERM assumes wells installed to a depth of 30 feet.
- (b) NOD value used obtained from sample MW-552 (18 - 20 feet) 2.14 g/kg
- (c) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 6
Detailed Cost Estimate for Thermal Treatment in Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Design Activities					
Structural Survey	1	Lump Sum	\$1,100		\$1,100
Design Permitting and Work Plan (Subcontractor)	1	Lump Sum	\$44,000		\$44,000
Estimated Design Cost					\$45,100
B. Construction Activities					
System Preparation and Operation (Subcontractor)					
				(a)	
Mobilization	1	Lump Sum	\$38,500		\$38,500
Drill and install wells	1	Lump Sum	\$206,800		\$206,800
Vapor cover installation	1	Lump Sum	\$22,000		\$22,000
Electrical construction	1	Lump Sum	\$35,200		\$35,200
Mechanical construction	1	Lump Sum	\$31,900		\$31,900
Vapor and water treatment system	1	Lump Sum	\$250,800		\$250,800
Commissioning	1	Lump Sum	\$38,500		\$38,500
Maintenance hardware etc.	1	Lump Sum	\$67,100		\$67,100
Labor, travel, per diem	1	Lump Sum	\$74,800		\$74,800
Power	1	Lump Sum	\$96,800		\$96,800
Sampling and analysis	1	Lump Sum	\$16,500		\$16,500
Waste and GAC	1	Lump Sum	\$22,000		\$22,000
Rental and fees	1	Lump Sum	\$22,000		\$22,000
Demobilization	1	Lump Sum	\$33,000		\$33,000
Reporting	1	Lump Sum	\$16,500		\$16,500
Office support	1	Lump Sum	\$152,900		\$152,900
Licensing fees	1	Lump Sum	\$48,400		\$48,400
Indirect Costs	1	Lump Sum	\$182,600		\$182,600
Other Costs					
Interim and Final Structural Survey and Reporting	1	Lump Sum	\$3,800		\$3,800
Project Management	5	Month	\$7,500		\$37,500
Thermal system data compilation, review, reporting	5	Month	\$7,500		\$37,500
NAPL Disposal	1	Lump Sum	\$5,000		\$5,000
Effluent Piping to Stormwater Drain	1	Lump Sum	\$2,000		\$2,000
Permitting (Bldg., POTW/NPDES)	1	Lump Sum	\$2,000		\$2,000
Discharge sampling	12	event	\$105		\$1,260
Sample wells - semi-annual	10	Well	\$730		\$7,300
Analytical Cost	10	Well	\$200		\$2,000
Subtotal					\$1,454,660
Contingency (15%)					\$218,199
Estimated Construction Cost					\$1,672,859
C. Annual Groundwater Monitoring Cost					
Sample wells - semi-annual	36	Well	\$730	(b)	\$26,280
Analytical Cost	36	Well	\$200		\$7,200
Groundwater data compilation, review, reporting	1	Lump Sum	\$5,000		\$5,000
Subtotal					\$38,480
Contingency (15%)					\$5,772
Estimated Annual Monitoring Cost					\$82,732
D. Present Worth					
Design Activities					\$45,100
Present Worth of Construction Costs					\$1,672,859
Present Worth of O&M	5	Years		(c)	\$363,000
Estimated Present Worth (Rounded)					\$2,100,000

Notes:

- (a) Treatment Area of 40' x 60'
- (b) Assumed 18 samples per area semi-annually for monitoring with lab analysis for VOCs by 8260.
- (c) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 7
Detailed Cost Estimate for Injectable ZVI in Source Area Saturated Soils
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Construct Infiltration Trench					
Subcontractor	1	Days	\$3,450	(a)	\$3,450
Materials	1	Lump Sum	\$2,875		\$2,875
Supervision	4.0	Days	\$1,625		\$6,500
			subtotal		\$12,825
Contingency - 15%					\$1,924
Estimated Construction Cost					\$14,749
B. Injection Program					
Preparation					
Labor	3.0	Days	\$3,438		\$10,313
Injection (Assume 8 Injections over Six (6) Months Applying Dose for Downgradient Area Only)					
Labor	18.0	Days	\$5,156		\$92,813
Geoprobe	18	Days	\$2,300		\$41,400
Flash Mixer	1	LS	\$7,475		\$7,475
PPT	18.0	Days	\$1,000		\$18,000
Decommissioning					
Labor	3	Days	\$3,438		\$10,313
Materials					
Iron	28100	Pound	\$29		\$807,875
Delivery (GOD, single event)	1.0	Lump Sum	\$40,394		\$40,394
Equipment					
Pumping Skid and Eductor	18	Day	\$300		\$5,400
Trailer	18	Day	\$75		\$1,350
Generator	18	Day	\$100		\$1,800
Health and Safety	60.0	Each	\$150		\$9,000
Hose, Fittings, Disposables	1.0	Lump Sum	\$3,220		\$3,220
Forklift	1	Lump Sum	\$1,725		\$1,725
Misc Equipment	1	Lump Sum	\$2,300		\$2,300
Tankage (1 1,000 gal)	1	Lump Sum	\$1,725		\$1,725
Secondary Containment	1	Lump Sum	\$1,725		\$1,725
Tank Delivery	1	Lump Sum	\$575		\$575
Water (allowance)	9	Lump Sum	\$144		\$1,294
Trash Disposal	1	Lump Sum	\$604		\$604
			subtotal		\$1,059,299
Contingency - 15%					\$158,895
Estimated Injection Cost					\$1,218,194
C. Annual Monitoring Costs (Assume One Area Only)					
Sample wells - semi-annually	36	well	\$531	(a)	\$6,375
Quarterly field parameter sampling (Year 1 and 2 or	48	well	\$200		\$9,600
Analytical Cost	36	well	\$200		\$2,640
Reporting Cost	1	Lump Sum	\$15,000		\$15,000
Injection data compilation and review	1	Lump Sum	\$15,000		\$15,000
			subtotal		\$48,615
Contingency - 15%					\$7,292
Estimated Annual Monitoring Cost					\$55,907
D. Present Worth					
Present Worth of Construction Costs and Year 1 Injection					\$1,232,942
Present Worth of Annual Monitoring	5	Years		(b)	\$200,000
Estimated Present Worth (rounded)					\$1,400,000

Notes:

(a) Assumed 18 samples per area (total of 20) semi-annually for monitoring with lab analysis for VOCs by 8260.

(b) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 8
Detailed Cost Estimate for Natural Attenuation Alternative
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Baseline model	1	Lump Sum	\$50,000		\$50,000
Contingency - 20%					\$10,000
Estimated Construction Cost					\$60,000
B. Annual O&M Cost					
Sample wells	30	well	\$750	(a)	\$22,500
Data compilation and review	2	Lump Sum	\$2,500		\$5,000
Model calibration and review	1	Lump Sum	\$5,000		\$5,000
Subtotal					\$32,500
Contingency (20%)					\$6,500
Estimated Annual O&M Cost					\$39,000
C. Present Worth					
Present Worth of Construction Costs					\$60,000
Present Worth of O&M	30	Years			\$518,000
Estimated Present Worth (rounded)					\$600,000

Notes:

- (a) Sampling costs based on sampling 15 wells semi-annually for VOCs by Method 8260. Labor is included.
- (b) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 9
Detailed Cost Estimate for Pump and Treat Alternative
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Mobilization	1	Lump Sum	\$20,000		\$20,000
Source Area Extraction Wells	2	Per Well	\$4,300		\$8,600
Downgradient Extraction Wells	6	Per Well	\$6,500		\$39,000
Extraction Pumps	8	each	\$5,000		\$40,000
Pump Controls	8	each	\$2,500		\$20,000
Piping	1	Lump Sum	\$25,000		\$25,000
Treatment System Building	1	Lump Sum	\$50,000		\$50,000
Heater	1	Lump Sum	\$5,000		\$5,000
5000 gal. Equalization Tank	1	each	\$6,500		\$6,500
Particle Filter	2	Lump Sum	\$3,000		\$6,000
Air Stripper w/ Blower	1	each	\$85,000		\$85,000
Vapor Phase Carbon w/ Regeneration	1	Lump Sum	\$100,000		\$100,000
Liquid Phase Carbon	1	Lump Sum	\$50,000		\$50,000
Transfer Pumps	7	each	\$1,000		\$7,000
Compressor	1	each	\$5,000		\$5,000
Effluent Piping	1	Lump Sum	\$10,000		\$10,000
Equipment Installation, including oversight	1	Lump Sum	\$200,000		\$200,000
Control Panel	1	Lump Sum	\$35,000		\$35,000
Utilities (elect., telephone, water)	1	Lump Sum	\$5,000		\$5,000
Design					
ERM Labor	1	Each	\$35,000		\$35,000
			Subtotal		\$752,100
Contingency - 15%					\$150,420
Estimated Construction Cost					\$902,520
B. Annual O&M Cost					
Sample wells	30	well	\$750	(a)	\$22,500
Regeneration Liquid Disposal	12	drums	\$350		\$4,200
Utilities	1	year	\$5,000		\$5,000
O&M Labor	52	week	\$2,000		\$104,000
			Subtotal		\$135,700
Contingency (15%)					\$27,140
Estimated Annual O&M Cost					\$162,840
C. Present Worth					
Present Worth of Construction Costs					\$902,520
Present Worth of O&M	30	Years			\$2,162,000
Estimated Present Worth (rounded) (b)					\$3,100,000

Notes:

(a) Sampling costs based on sampling 15 wells semi-annually for VOCs by Method 8260. Labor is included.

(b) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.

Table 10
Detailed Cost Estimate for Bioremediation Alternative
Former Raytheon Property - Northern Area
Wayland, MA

Remedial Cost Item	No. of Units	Units	Unit Cost (\$)	Notes	Cost (\$)
A. Construction Activities					
Well Network					
Injection Well Installation - 2"	8	Each	\$1,395	(a)	\$11,161
Monitoring Well Installation -2"	2	Each	\$1,395		\$2,790
Equipment					
Pump	2	Each	\$500		\$1,000
Hose, Fittings	1	Lump Sum	\$1,500		\$1,500
Labor					
Field Geologist	1	Each	\$8,640		\$8,640
Project Engineer	1	Each	\$4,800		\$4,800
Design					
ERM Labor	1	Each	\$30,000		\$30,000
Estimated Construction Cost					\$59,891
B. Annual Injection Cost					
Labor					
Technician	2	Injection	\$8,640		\$17,280
Project Engineer	2	Injection	\$9,600		\$19,200
Oversight	2	Injection	\$4,160		\$8,320
Substrate					
Mixing Tank	2	Injection	\$450		\$900
Misc Equipment	1	Lump Sum	\$3,000		\$3,000
Substrate	5880	lb	\$1	(b)	\$5,880
Nutrients	8	50lb bag	\$60		\$480
Water	2	Lump Sum	\$900		\$1,800
Estimated Annual Injection Cost Year 1 and 2					\$56,860
Estimated Annual Injection Cost Year 3 thru 10					\$28,430
C. Annual Monitoring Costs					
Sample wells - semi-annually	30	well	\$530		\$15,900
Field Parameter Monitoring - Quarterly	92	well	\$200		\$18,400
Analytical Cost	30	well	\$460		\$13,800
Data compilation and review	1	Lump Sum	\$15,000		\$15,000
Estimated Annual Monitoring Cost Year 1 and 2					\$63,100
Estimated Annual Monitoring Cost Year 3 thru 10					\$44,700
Estimated Annual Total Year 1					\$179,851
Estimated Annual Total Year 2					\$119,960
Estimated Annual Total Year 3 thru 10					\$73,130
Contingency - 15%					\$132,728
C. Present Worth					
Present Worth of Construction Costs and Year 1 Injection					\$206,829
Present Worth of O&M	9	Years			\$705,960
Estimated Present Worth (rounded)					\$900,000

Notes:

- (a) ERM assumes wells installed to a depth of 30 feet.
- (b) ERM assumes 2 injections per year.
- (c) The above cost estimate is intended for comparison of the alternatives, not for budgeting or contracting purposes. Actual costs will vary. Supplemental investigation activities and detailed-design phases would provide the specific information needed to increase the accuracy of the cost estimates.