N60478.AR.001386
NWS EARLE
5090.3a

TRANSMITTAL LETTER FOR THE AMENDED REMEDIAL ALTERNATIVES FOR FREE PRODUCT REMOVAL AT BUILDING 566 NWS EARLE NJ

3/21/1997

BROWN AND ROOT ENVIRONMENTAL

Brown & Root Environmental

993 Old Eagle School Road, Suite 415
Wayne, PA 19087-1710

(610) 971-0900
FAX: (610) 971-9715

BRPH/51-3-7-66

March 21, 1997

Mr. Brian Helland, Code 1812
Senior Environmental Engineer
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway Mail Stop 82
Lester, Pennsylvania

Reference: Contract No. N62472-90-D-1298 (CLEAN)
Contract Task Order No. 226

Subject: Amended Remedial Alternatives Analysis
Free Product Removal at Building 566
NWS Earle - Colts Neck, New Jersey

Dear Mr. Helland:

Attached are the results of the amended remedial alternatives analysis for free-product removal at Building 566, at the Naval Weapons Station Earle. The amended analysis includes the excavation and off-site disposal option.

In summary, we considered five remedial options: an active recovery trench, bioslurping, in-situ bioremediation, passive free product recovery, and excavation and off-site treatment. The first four options are less intrusive than excavation and were chosen to minimize impacts on the adjacent underground storage tanks and wetlands. Our evaluation was based on site-specific information from the remedial investigation that we performed.

In-situ bioremediation is the lowest-cost alternative. However, this option carries with it potentially significant technical and administrative disadvantages. Conversely, bioslurping, while estimated to be the highest, less-intrusive cost alternative, eliminates most of the disadvantages associated with In-situ bioremediation. (See Table B in the attachment to this letter). Bioslurping also offers several important advantages. In particular, it provides better control of the plume of contamination, may likely require fewer years of operation in comparison with the other less-intrusive remedial options evaluated, and may be combined with bioventing as a long-term remedial action, after free-product recovery is complete. (The long-term bioventing option may be appropriate if natural attenuation cannot be demonstrated.)

Excavation and off-site treatment may be the most advantageous option in the long-term, provided that waste volumes and waste characteristics remain consistent with the assumptions developed for this evaluation.

The following table summarizes the estimated costs for implementing each option. Costs are based on specific assumptions listed in Tables A-1 through A-6 in the attached Remedial Alternative Analysis. Costs are subject to change based on design parameters and site conditions at the time of construction.

ALTERNATIVE	TOTAL COST (PRESENT WORTH)
Active Recovery Trench	$ 309,000
Bioslurping	$ 321,000
Excavation and Off-site Treatment (Non-hazardous Waste)	$ 320,500
Excavation and Off-site Treatment (Hazardous Waste)	$ 649,000
In-situ Bioremediation	$ 225,000
Passive Free Product Removal	$ 280,000

Refer to the attached Remedial Options Analysis for a presentation of the engineering analysis, including detailed descriptions of remedial alternatives and cost estimates.

Sincerely,

Richard J. Gorrell
Project Manager

RJG/dhn

Attachment

c: Lawrence Burg - NWS Earle
John Trepanowski, P.E. - B&R Environmental
Michael Turco, P.E., DEE - B&R Environmental
Russell Turner - B&R Environmental

REMEDIAL OPTIONS ANALYSIS
FOR FREE-PRODUCT RECOVERY
BUILDING 566 SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

JANUARY 1997

1.0 OBJECTIVE

The main objective of this analysis is to assist the Navy in choosing a reliable, cost-effective remedial option to recover free-product from the subsurface, retard free-product migration to the on-site wetlands, and if possible, reduce the hydrocarbon concentrations in the soil and groundwater at the Building 566 Site. The remedial option must not impact the underground storage tank (UST) system located beside the site, and must prevent continued free-product releases to the surface water swales surrounding the site.

Findings and data contained in the Phase I Remedial Investigation (RI) Report prepared by Brown & Root Environmental (1996) and approved by the New Jersey Department of Environmental Protection (NJDEP) were used to prepare this analysis. Please refer to the Phase I RI for background and site information.

2.0 REMEDIAL ALTERNATIVE OPTIONS

After screening viable remedial technologies, B&R Environmental and the Navy selected five options for final analysis and costing.

- Active Recovery Trench
- Bioslurping
- Excavation and Off-site Treatment
- In-Situ Bioremediation
- Passive Free-Product Recovery

All the alternatives are focused on free-product recovery with the added benefit of hydrocarbon reduction in the groundwater and soil. It is assumed that natural attenuation or bioventing will be relied upon for long-term remediation to reduce groundwater and soil concentrations to NJDEP action levels.

Utilization of the existing septic system drainage field as a horizontal venting system, and excavation and off-site disposal of contaminated soil from trenches and other areas of equipment installation, have been integrated into the conceptual design and cost of each remedial option except excavation and off-site treatment.

2.1 ACTIVE RECOVERY TRENCH

A trench would be used to recover free-product within the aquifer by intercepting the movement of the product with the groundwater. Under the influence of gravity, the groundwater and the floating free-product will accumulate in the trench where it can be discharged into a collection sump. Once there, the bulk of the free-product is separated from the groundwater and removed, and the mixture of groundwater and remaining free-product is pumped to the surface where the mixture is treated. Pumping groundwater from the collection sump will depress the water table and increase the hydraulic gradient ensuring capture of the free-product. Once the mixture is pumped from the subsurface it will be processed using oil/water separation and air stripping for primary treatment, and activated carbon adsorption for final polishing before discharge.

The planned recovery trench will be installed between the septic tank drain field (the source area) and the delineated wetland (the nearest receptor). The proposed trench would be approximately 240 ft in length, 5 ft in depth, and 2 ft in width. The downgradient wall and the bottom of the trench will be plastic lined to form an impermeable barrier. The upgradient wall will be lined with permeable geotextile to prevent silting of the trench. Three 4-inch-diameter perforated PVC pipes and gravel will be placed in the trench at different depths corresponding to seasonal water table fluctuation. The pipes will be sloped to allow gravity drainage of accumulated free-product and groundwater to a central collection sump. The estimated flow rate of groundwater extracted from the trench is 5 to 10 gallons per minute. It is estimated that it will take three years before free-product recovery becomes minimal.

The estimated cost of active recovery trench implementation with system O&M is presented in Attachment A-1.

2.2 BIOSLURPING

Bioslurping applies vacuum-enhanced dewatering technology to the remediation of petroleum-contaminated sites. Bioslurping combines two remedial approaches: (1) bioventing to stimulate bioremediation of petroleum-contaminated soil in situ; and (2) vacuum-enhanced free-product recovery to extract free-product from the capillary fringe and the water table. The bioslurping system withdraws groundwater, free-product, and soil gas in the same process stream with a single surface pump (liquid ring). A treatment system will separate the groundwater from free-product and treat the water before discharging via an NPDES permit or to a permitted POTW. The recovered stream will be treated using process components similar to those described in the active recovery trench section. Offgases from the bioventing will be treated before discharge to the atmosphere.

Approximately twenty (20) extraction wells are proposed for recovering free-product. The extraction well locations are concentrated around the septic tank drain field and the seep areas. Extraction wells are 2-inch-diameter Schedule 40 PVC, 8 feet below grade, with a screened interval ranging from 5 - 7 feet. The extraction wells will be used to convey soil gas, free-product, and groundwater from the soil/groundwater interface zone through 2-inch Schedule 40 PVC piping to a vacuum (liquid-ring) pump. The liquid-ring pump will be connected to the extraction wells by a common pipe header.

A pilot test will be required prior to implementation of the bioslurping system to determine design parameters such as radius of influence, and groundwater and vapor extraction rates. It is estimated that it will take two years before free-product recovery becomes minimal.

The estimated cost of bioslurping implementation with system O&M is presented in Attachment A-2.

2.3 IN-SITU BIOREMEDIATION

In-situ bioremediation is the controlled use of microbial biodegradation to reduce petroleum hydrocarbon concentrations in soil and groundwater. Bioremediation requires the presence of oxygen, nutrients, and a carbon source (petroleum hydrocarbons) for the microbial population to thrive. Nutrients and oxygen, the limiting factors, can be added to the subsurface to enhance environmental conditions necessary for optimal microbe growth.

Groundwater and free-product at the subject site would be collected via a recovery trench identical to that described in Alternative 1. The collection sump associated with the recovery trench will be designed to function as an oil/water separator in which accumulated free-product is separated from the groundwater and removed. The groundwater is then transferred via a sump pump into the on-site septic tank. To promote mixing, the recovered groundwater will be pumped to the bottom of the septic tank. Recovered groundwater will be introduced to an oxygen releasing compound (ORC) and nutrients. This set up will make the septic tank perform as a biological reactor/mixing tank. The mixture, which can still contain dissolved petroleum compounds, is reintroduced to the aquifer in an attempt to flush residual product from the unsaturated zone and promote biological activity. The mixture is reintroduced to the contaminated zone via a centrifugal pump and an upgradient seepage trench (infiltration gallery). The proposed seepage trench would be located northeast of the drain field and be approximately 150 ft long, 2 ft wide, and 3 ft deep. A 2-foot layer of gravel in the trench will serve as bedding for the perforated infiltration pipe and infiltrating media for water dispensing.

It is estimated that groundwater will be extracted from the trench at a rate of 5 to 10 gallons per minute and the system will operate three years before targeted free-product recovery has been achieved.

The estimated cost of in-situ bioremediation implementation with system O&M is presented in Attachment A-3.

2.4 PASSIVE FREE-PRODUCT RECOVERY

Free-product (only) can be recovered passively through the use of several recovery wells and passive skimmers. Passive skimmers are designed to recover free-floating hydrocarbon from any thickness down to a sheen. Skimmers consists of four main items: a floating intake head, guide rod and flexible tube, a well centering disk, and a clear product canister. Recovery wells are usually installed downgradient and within the source area. Passive skimmers are lowered into the recovery/monitoring well until the midpoint of the skimmer's travel is located at the fluid level in the well. The support rope is tied off holding the skimmer at a specific depth and the skimmer is left in the well to collect floating hydrocarbons. Under the influence of gravity, the groundwater and the free-product will accumulate in the recovery well where the floating free-product enters the skimmer through the floating intake's outer debris screen and then an inner oilophilic hydrocarbon screen, down through a flexible tube and into the see-through canister.

To empty the skimmer, it is manually pulled to the surface and the canister is drained using the valve at its base. The skimmer is returned to the well until next checked at its predetermined maintenance interval.

Approximately twenty (20) recovery wells equipped with skimmers are proposed for installation at the site. The well locations are concentrated around the drain field, the seep areas, and downgradient of the drain field. Recovery wells are 4-inch-diameter, Schedule 40 PVC, 8 feet deep below grade with a screened interval ranging from 2 - 7 feet. It is estimated that it will take five years before free-product recovery becomes minimal.

The estimated cost of passive free-product recovery implementation with system O&M is presented in Attachment A-4.

2.5 VENTING -IN COMBINATION WITH ALL PROPOSED ALTERNATIVES

All four alternatives include using the existing septic tank drain lines as a horizontal venting well. The drain field line will be attached to a low pressure/low flow soil venting blower to enhance bioremediation and volatilization of hydrocarbons. Air will be forced into or extracted from the drain lines based on the site conditions and the results of the pilot study.

The estimated cost of venting and system O&M are included as part of each remedial option presented in Attachments A-1 through A-4.

2.6 EXCAVATION AND OFF-SITE TREATMENT

Excavation is an active alternative for soil remediation and free product removal that involves rapid soil and groundwater removal, off-site disposal/treatment, and site restoration. The total area containing free product and grossly contaminated soil is expected to be within the drainage field, stained seeps, and subsurface soil between the septic tank and drainage field. Soil within the drainage field and soil east of the septic tank will be excavated to an average depth of one foot below the shallow groundwater table. Stained soils within the seep areas will be excavated to an average depth of 1.5 feet below the ground surface. It is also assumed that some seep areas will be excavated from the surface, back to the drainage field or source area. The estimated volume of material within this area is approximately 1,500 cubic yards. The soil is assumed to be non-hazardous based on the results of the RI soil and groundwater samples.

Prior to excavation, shoring/sheetpiling will be placed along the northwest corner of the drainage field adjacent to the new underground storage tanks, and erosion and sedimentation controls will be installed to protect adjacent wetlands. Due to the presence of shallow groundwater and the possible reoccurrence of the leaking water supply line, dewatering of the excavation area with temporary well points is included in the estimate. It is assumed that the groundwater will carry free product. Based on an assumed average hydraulic conductivity of 2 gallons per day/square foot for sandy soils, an estimated range of 50,000 to 60,000 gallons of oily groundwater could be generated during the dewatering activities. The contaminated groundwater will be transported and disposed of off-site.

Excavated soils will be treated (disposed of) off-site by thermal destruction. The thermal destruction involves volatilizing the contaminants by heating the soil which could then be used as an admixture in asphalt or other encapsulating materials. Sampling and analysis is required to confirm the presence or absence of hazardous waste characteristics, prior to disposal approvals.

The advantages of excavation and treatment include the short remedial time period and the associated one-time cost expenditure to complete the work. Long-term operation and maintenance costs are not required. Impacted soils and floating free-product are physically removed from the site in a matter of days as opposed to months or years that may be required with the four groundwater remediation alternatives.

Disadvantages to this alternative include potential negative impacts to adjacent wetlands, inefficient groundwater remediation, and potentially significant additional costs for dewatering and off-site treatment if the wastes are characterized as hazardous. The negative impacts to the wetlands could be minimized with adequate surface drainage and erosion controls. Off-site treatment costs could be better defined by performing in-situ waste characterization of the subsurface soils within the drainage field. Dewatering costs could be minimized if the Navy continues to control the previously identified leaking water line and if excavation work is performed during dry periods.

An evaluation summary of the soil excavation alternative is presented in Table B. The estimated costs for dewatering and off-site disposal of 50,000 gallons of groundwater, installation of shoring, excavation, transportation, and off-site disposal (thermal destruction) of 1,500 cubic yards of non-hazardous soil, and site restoration, is presented in Attachment A-5. For comparison, a worse-case scenario that assumes dewatering and off-site disposal of 60,000 gallons of groundwater, installation of shoring, excavation, transportation, and off-site disposal (stabilization) of 1,700 cubic yards of hazardous soil, and site restoration, is presented in Attachment A-6.

3.0 RECOMMENDATIONS

To aid in the selection of a remedial option, two tables were generated: Table A which provides a cost summary of remedial alternatives and Table B which provides advantages and disadvantages for each.

All five remedial alternatives are applicable to the Building 566 Site. In-situ Bioremediation appears to be the least costly option. However, there are potential technical and regulatory disadvantages for this option. In particular, site conditions may change, reducing the short-term effectiveness and prolonging the operational time required to remove the free product. In addition, rigorous maintenance and continuous monitoring may be required, and NJDEP approval to implement the system may be difficult or impractical to obtain.

Bioslurping appears to be the most advantageous non-intrusive corrective action. This alternative offers better control of the plume of contamination, may likely require fewer years of operation, and may be combined with bioventing as a long-term remedial action after the free product is removed. The long-term bioventing option may be appropriate if natural attenuation cannot be demonstrated. In the event that bioventing becomes the selected long-term remedial action, the bioslurping extraction wells may be retrofitted and used for bioventing.

Excavation and off-site treatment is expected to be less costly than bioslurping, given the assumed waste quantities and non-hazardous waste characteristics. This option also carries a significant advantage over the other four less-intrusive options in that the free product could be removed in a relatively short period of time with no future operation and maintenance costs. This advantage alone could off-set disadvantages associated with increased short-term costs, if waste volumes and/or waste characteristics change.

REFERENCES

References are available upon request.

TABLE A

COST SUMMARY OF REMEDIAL ALTERNATIVES (1)
Building 566 Site
Naval Weapons Station Earle
Colts Neck, New Jersey

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	ESTIMATED YEARS OF OPERATION (2)	O&M PRESENT WORTH	TOTAL PRESENT WORTH
Active Recovery Trench	$155,000	$64,000	5	$154,000	$309,000
Bioslurping	$184,000	$77,000	4	$137,000	$321,000
Excavation and Off-Site Treatment (Non-hazardous)	$320,500	$0	1 month	$0	$320,500
Excavation and Off-Site Treatment (Hazardous)	$649,800	$0	1 month	$0	$649,800
In-situ Bioremediation	$120,000	$44,000	5	$105,000	$225,000
Passive Free Product Recovery	$68,000	$53,000	5	$212,000	$280,000

Notes:
(1) See Attachments A-1 through A-6 for detailed cost estimates for the remedial alternatives.
(2) The estimated years of operation includes the time of operation during the active free-product recovery plus the time of operation of the venting system after the free-product recovery is complete.

TABLE B
EVALUATION OF FREE-PRODUCT REMOVAL ALTERNATIVES
BUILDING 566 SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
Active Recovery Trench	• Readily available equipment, easy installation • Easily combined with other technologies • May not require costly offgas treatment • No pilot testing is required	• Average recovery is approximately 25% of the initial spill volume • Generates large volume of water requiring treatment • High concentrations of petroleum compounds will necessitate costly, intrinsically safe equipment • Longer duration for remediation • Does not address dissolved groundwater contamination and residual soil contamination • Requires discharge permit
Bioslurping	• Proven performance. Requires no downhole pumps • Reduces remediation duration over other alternatives • Substantially increases groundwater extraction rates • Good plume control and high percentage of contaminants removal • After free-product removal, extraction wells can be used for long-term bioventing to address dissolved-phase groundwater contamination and residual soil contamination	• Difficult to apply to sites where the water table fluctuates • Requires specialized equipment with sophisticated control capability • Could be labor intensive to maintain optimal performance • May generate large volumes of groundwater that require treatment • Requires pilot testing • Requires Permits
In-situ Bioremediation	• Remediates free-product, dissolved-phase groundwater contaminants and residual soil contamination • Readily available equipment, easy installation • Relative Cost • Utilizes existing on-site septic tank	• Average recovery is approximately 25% of the initial spill volume • Infiltration galleries may become plugged by microbial growth • Difficult to implement in low-permeability aquifers • Re-injection/infiltration gallery requires permits and may be prohibited by NJDEP • Could be labor intensive to maintain optimum performance
Passive Free-product Recovery	• Readily available equipment, easy installation. • Minimal disturbance to site operations. • Relative Cost • Requires no removal, treatment, storage, or discharge considerations for groundwater • No discharge permits are required	• Labor intensive • Potentially long duration for remediation • Less control of plume migration • Does not remediate dissolved-phase groundwater contamination and residual soil contamination

TABLE B
EVALUATION OF FREE-PRODUCT REMOVAL ALTERNATIVES
BUILDING 566 SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
Excavation and Off-Site Treatment	• Short remediation time. • Efficient, long-term solution for removing free product from soil matrix and addressing residual soil contamination. • Discharge permits not required.	• Minor risk to workers and on-site personnel. • Potential impact to wetlands and adjacent USTs if protective measures are not included with design and execution. • Potential high disposal costs if waste volumes increase and soil exhibits hazardous waste characteristics. • Inefficient for free-product recovery from groundwater.

NOTES:

[1]Though significant water table fluctuations have been observed at the site, the Navy has implemented measures to help stabilize hydrologic conditions. If bioventing is used, the Navy should continue corrective actions relative to the observed leaking water supply system at Building 566.

ATTACHMENT A-1

Estimated Installation/Operation Cost for Recovery Trench
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Permitting (b)	1	1	job	$6,000	$6,000
2) Design & Bid Preparation	1	1	job	$10,000	$10,000
3) System Installation					
Recovery Trench (c)	2	1	item	$25,000	$25,000
Collection Sump (d)	2	1	item	$10,000	$10,000
Transfer pump	3	1	item	$2,000	$2,000
Oil/Water Separator (e)	4	1	item	$4,000	$4,000
Low Profile Stacked Tray Air Stripper (f)	5	1	item	$15,000	$15,000
Filtration System	6	1	system	$2,500	$3,000
Discharge Pump	3	1	item	$1,500	$2,000
Liquid Phase Carbon (g)	4	2	vessel	$1,000	$2,000
Vacuum Blower and Appurtenances (h)	7	1	item	$6,000	$6,000
Vapor Phase Carbon (i)	4	2	drum	$1,250	$3,000
Soil Disposal	2	120	cu. yd	$100	$12,000
Piping and Trenching	2	300	ft	$30	$9,000
System Controls	4	1	item	$4,000	$4,000
Electrical Service, Wiring	2	1	job	$6,000	$6,000
Equipment Area	8	200	ft2	$35	$7,000
Construction Management	1	1	job	$15,000	$15,000
				Subtotal:	$141,000
				Contingencies (10%):	$14,000
				Total Construction Cost:	$155,000

Annual Operating Costs

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
Periodic Maintenance (j)	1	24	visit	$500	$12,000
Sampling and Analysis (k)	9	12	job	$1,000	$12,000
Free Product Disposal (l)	2	12	job	$450	$5,000
Electrical (m)	8	8.5	hp	$0.08	$3,000
Carbon Usage/Replacement (n)	4	6	drum	$1,000	$6,000
Project Management	1	1	job	$12,000	$12,000
				1 year O&M Cost:	$50,000
				Present Worth Factor (o):	2.577
				O&M Present Worth :	$129,000

Annual Operating Costs After Free Product Recovery Phase Completion

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
Periodic Maintenance	1	12	visit	$300	$4,000
Sampling and Analysis (p)	9	4	job	$600	$2,000
Electrical (q)	8	1.5	Hp	$0.08	$1,000
Condensate Disposal	2	200	gal	$2.00	$0
Carbon Usage/Replacement (r)	4	1	drum	$1,000	$1,000
Project Management	1	1	job	$6,000	$6,000
				1 year O&M Cost:	$14,000
				Present Worth Factor (s):	1.783
				O&M Present Worth :	$25,000

Total Estimated Project Costs: $309,000

ATTACHMENT A-1

Estimated Installation/Operation Cost for Recovery Trench
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Notes:

(a) All costs rounded to the nearest $1000.
(b) Includes construction, electrical, and NPDES permits, and professional fees.
(c) Based on a trench dimension of 240 ft long, 2 ft wide, and 4 ft deep. Includes materials and installation.
(d) Based on a 500-gallon capacity tank equipped with free product skimmer, chamber and floats.
(e) Based on an oil/water separator rated for 15 gpm and equipped with free product holding tank and float switch.
(f) Equipment included are control panels, 2-hp blower and low profile tray air stripper.
(g) Based on two-200 lbs high pressure activated carbon vessels.
(h) Equipment included are 1-hp blower, 0.5-hp transfer pump, and 40-gallon Knockout tank.
(i) Based on two- 200 lbs vapor phase activated carbon drums.
(j) Based on bimonthly visits.
(k) Includes manpower to collect groundwater, air, and treated effluent samples and laboratory analyses per scheduled sampling period.
(l) Based on transportation and disposal of 100 gallons of free product per month.
(m) based on one 1-hp transfer sump pump, one 1-hp stripper feed pump, one 1-hp vacuum blower, one 0.5-hp sump pump, one 2-hp discharge pump, and one 2-hp air stripper blower running @ $0.08/kw hr (0.746 kw/Hp).
(n) Based on replacement of two-200 lbs. liquid phase carbon vessels and four-200 bls vapor phase carbon drums per year.
(o) Assume an 8% interest rate and 3 years of operation.
(p) Includes manpower to collect air samples and laboratory analyses per quarter.
(q) Based on one 1-hp Vacuum blower and one 0.5 Hp sump pump running @ $0.08/kw hr (0.746 kw/Hp).
(r) Based on replacement of two-200 lbs vapor phase carbon drums per year.
(s) Assume an 8% interest rate and 2 years of operation.

References:

(1) Brown and Root Environmental, 1997.
(2) North Carolina Remediation, 1997.
(3) Goulds Pumps, Inc., 1996.
(4) Carbtrol, 1996.
(5) North East Environmental Products, Inc., 1996.
(6) Filtration Systems, 1996.
(7) Aim Power & Fluids, 1996
(8) Means Building Construction Cost Data, 1996.
(9) Specialized Assays, Inc., 1997.

ATTACHMENT A-2

Estimated Installation/Operation Cost for Bioslurping
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Permitting (b)	1	1	job	$6,000	$6,000
2) Pilot Test (c)	1	1	job	$8,000	$8,000
3) Design & Bid Preparation	1	1	job	$10,000	$10,000
4) System Installation					
Bioslurping Wells (d)	2	20	well	$500	$10,000
Bioslurping Wells Appurtenances (e)	2	20	well	$300	$6,000
Pre-Separation Skid (f)	3	1	item	$6,500	$7,000
Liquid Ring Pump and Knockout Tank Skid (g)	3	1	item	$15,000	$15,000
Oil/Water Separator (h)	3	1	item	$5,500	$6,000
Low Profile Stacked Tray Air Stripper (i)	4	1	item	$16,000	$16,000
Filtration System	5	1	system	$2,500	$3,000
Discharge Pump	6	1	item	$1,500	$2,000
Liquid Phase Carbon (j)	3	2	vessel	$1,000	$2,000
Vapor Phase Carbon (k)	3	2	drum	$1,250	$3,000
Soil Disposal	2	120	cu. yd	$100	$12,000
Piping and Trenching	2	700	ft	$33	$23,000
System Controls	3	1	item	$5,000	$5,000
Electrical Service, Wiring	2	1	job	$7,000	$7,000
Equipment Area	7	225	ft2	$35	$8,000
Construction Management	1	1	job	$18,000	$18,000
				Subtotal:	$167,000
				Contingencies (10%):	$17,000
				Total Construction Cost:	$184,000

Annual Operating Costs

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
Periodic Maintenance (l)	1	24	visit	$500	$12,000
Sampling and Analysis (m)	8	12	job	$1,000	$12,000
Free Product Disposal (n)	2	12	job	$800	$10,000
Electrical (o)	7	17	hp	$0.08	$6,000
Carbon Usage/Replacement (p)	3	6	drum	$1,000	$6,000
Project Management	1	1	job	$12,000	$12,000
				1 year O&M Cost:	$58,000
				Present Worth Factor (q):	1.783
				O&M Present Worth :	$103,000

Annual Operating Costs After Free Product Recovery Phase completion

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
Periodic Maintenance	1	12	visit	$300	$4,000
Sampling and Analysis (r)	8	4	job	$600	$2,000
Electrical (s)	7	10	Hp	$0.08	$4,000
Condensate Disposal	2	100	gal	$2.00	$0
Carbon Usage/Replacement (t)	3	2	drums	$1,250	$3,000
Project Management	1	1	job	$6,000	$6,000
				1 year O&M Cost:	$19,000
				Present Worth Factor (u):	1.783
				O&M Present Worth :	$34,000

Total Estimated Project Costs: **$321,000**

ATTACHMENT A-2

Estimated Installation/Operation Cost for Bioslurping
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Notes:

(a) All costs rounded to the nearest $1000.
(b) Includes construction, electrical, and NPDES permits, and professional fees.
(c) Includes manpower to perform two-day pilot test, equipment rental, water and free product disposal, and data analysis.
(d) Based on 2-inch diameter and 8 ft deep. Includes materials and installation.
(e) Includes vacuum-tight seals, suction/drop tubes, PVC fittings, gate valves, and a vacuum gauges.
(f) Equipment included are air/water and free product separator and transfer pump.
(g) Equipment included are 10-hp liquid ring pump, knockout tank, tap water holding tank, and associated valves and switches.
(h) Based on an oil/water separator rated for 30 gpm and equipped with free product holding tank and float switch.
(i) Equipment included are control panels, 3-hp blower and low profile tray air stripper.
(j) Based on two-200 lbs high pressure activated carbon vessels.
(k) Based on two- 200 lbs vapor phase activated carbon drums.
(l) Based on bimonthly visits.
(m) Includes manpower to collect groundwater, air, and treated effluent samples and laboratory analyses per scheduled sampling period.
(n) Based on transportation and disposal of 200 gallons of free product per month.
(o) Based on one 1- hp transfer sump pump, one 1-hp stripper feed pump, one 10-hp liquid ring pump, one 2-hp discharge pump, and one 3-hp air stripper blower running @ $0.08/kw hr (0.746 kw/Hp).
(p) Based on replacement of two-200 lbs. liquid phase carbon vessels and four 200 bls vapor phase carbon drums per year.
(q) Assume an 8% interest rate and 2 years of operation.
(r) Includes manpower to collect air samples and laboratory analyses per quarter.
(s) Based on one 110-hp liquid ring pump running @ $0.08/kw hr (0.746 kw/Hp).
(t) Based on replacement of two-200 lbs. vapor phase carbon drums per year.
(u) Assume an 8% interest rate and 2 years of operation.

References:

(1) Brown and Root Environmental, 1997.
(2) North Carolina Remediation, 1997.
(3) Carbtrol, 1996.
(4) North East Environmental Products, Inc., 1996.
(5) Filtration Systems, 1996.
(6) Goulds Pumps, Inc., 1996.
(7) Means Building Construction Cost Data, 1996.
(8) Specialized Assays, Inc., 1997.

NOTE: All cost for remedial alternative construction are based on data presented in the Phase I Remedial Investigation Report (B&R Environmental, 1996) and are subject to change once pilot test is performed and design parameters are determined.

ATTACHMENT A-3

Estimated Installation/Operation Cost for In-situ Bioremediation
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Permitting (b)	1	1	job	$4,000	$4,000
2) Treatability Study	1	1	job	$6,000	$6,000
3) Design & Bid Preparation	1	1	job	$6,000	$6,000
4) System Installation					
Recovery Trench (c)	2	1	item	$25,000	$25,000
Collection Sump/Separator (d)	2	1	item	$12,000	$12,000
Infiltration Gallery	2	1	item	$7,000	$7,000
Transfer pump	3	1	item	$2,000	$2,000
Injection Pump	3	1	item	$2,500	$3,000
Nutrients and ORC	4	1	item	$2,000	$2,000
Vacuum Blower and Appurtenances (e)	5	1	item	$6,000	$6,000
Vapor Phase Carbon (f)	6	2	drum	$1,250	$3,000
Soil Disposal	2	120	cu. yd	$100	$12,000
Piping and Trenching	2	300	ft	$15	$5,000
System Controls	5	1	item	$1,000	$1,000
Electrical Service, Wiring	2	1	job	$1,000	$1,000
Equipment Area	7	100	ft2	$35	$4,000
Construction Management	1	1	job	$10,000	$10,000
				Subtotal:	$109,000
				Contingencies (10%):	$11,000
				Total Construction Cost:	$120,000

Annual Operating Costs

Periodic Maintenance (g)	1	24	visit	$400	$10,000
Sampling and Analysis (h)	8	4	job	$400	$2,000
Free Product Disposal (i)	2	12	job	$450	$5,000
Electrical (j)	7	5	hp	$0.08	$2,000
Carbon Usage/Replacement (k)	6	2	drum	$1,000	$2,000
Nutrients and ORC Usage (l)	4	12	item	$500	$6,000
Project Management	1	1	job	$6,000	$6,000
				1 year O&M Cost:	$33,000
				Present Worth Factor (m):	2.577
				O&M Present Worth :	$85,000

Annual Operating Costs After Free Product Recovery Phase Completion

Periodic Maintenance	1	12	visit	$300	$4,000
Sampling and Analysis (n)	8	4	job	$600	$2,000
Electrical (o)	7	1.5	Hp	$0.08	$1,000
Condensate Disposal	2	200	gal	$2.00	$0
Carbon Usage/Replacement (p)	6	1	drum	$1,000	$1,000
Project Management	1	1	job	$3,000	$3,000
				1 year O&M Cost:	$11,000
				Present Worth Factor (q):	1.783
				O&M Present Worth :	$20,000

Total Estimated Project Costs: $225,000

ATTACHMENT A-3

Estimated Installation/Operation Cost for In-situ Bioremediation
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Notes:

(a) All costs rounded to the nearest $1000.
(b) Includes construction, electrical, and Injection/infiltration gallery permits, and professional fees.
(c) Based on a trench dimension of 240 ft long, 2 ft wide, and 4 ft deep. Includes materials and installation.
(d) Based on a 1000-gallon capacity tank equipped with free product skimmer, chamber and floats.
(e) Equipment included are 1-hp blower, 0.5-hp transfer pump, and 40-gallon Knockout tank.
(f) Based on two- 200 lbs vapor phase activated carbon drums.
(g) Based on bimonthly visits.
(h) Includes manpower to collect groundwater, air, and treated effluent samples and laboratory analyses per scheduled sampling period.
(i) Based on transportation and disposal of 100 gallons of free product per month.
(j) based on one 1.5-hp transfer sump pump, one 1-hp vacuum blower, one 0.5-hp sump pump, and one 2-hp injection pump running @ $0.08/kw hr (0.746 kw/Hp).
(k) Based on replacement oftwo-200 bls vapor phase carbon drums per year.
(l) Based on monthly usage.
(m) Assume an 8% interest rate and 3 years of operation.
(n) Includes manpower to collect air samples and laboratory analyses per quarter.
(o) Based on one 1-hp Vacuum blower and one 0.5 Hp sump pump running @ $0.08/kw hr (0.746 kw/Hp).
(p) Based on replacement of one-200 lbs vapor phase carbon drum per year.
(q) Assume an 8% interest rate and 2 years of operation.

References:

(1) Brown and Root Environmental, 1997.
(2) North Carolina Remediation, 1997.
(3) Goulds Pumps, Inc., 1996.
(4) Regensis Bioremediation Products, 1997.
(5) Aim Power & Fluids, 1996
(6) Carbtrol, 1996.
(7) Means Building Construction Cost Data, 1996.
(8) Specialized Assays, Inc., 1997.

NOTE: All cost for remedial alternative construction are based on data presented in the Phase I Remedial Investigation Report (B&R Environmental, 1996) and are subject to change once the treatability study is performed and design parameters are determined.

ATTACHMENT A-4

Estimated Installation/Operation Cost for Passive Product Reocvery
Building 566 Site
Naval Weapon Station Earle
Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Permitting (b)	1	1	job	$1,000	$1,000
2) Design & Bid Preparation	1	1	job	$4,000	$4,000
3) System Installation					
Recovery wells (c)	2	20	well	$600	$12,000
Passive skimmer (d)	3	20	skimmer	$500	$10,000
Vacuum Blower and Appurtenances (e)	4	1	item	$6,000	$6,000
Vapor Phase Carbon (f)	5	2	drum	$1,250	$3,000
Soil Disposal	2	60	cu. yd	$100	$6,000
Piping and Trenching	2	150	ft	$30	$5,000
System Controls	4	1	item	$2,000	$2,000
Electrical Service, Wiring	2	1	job	$3,000	$3,000
Equipment Area	6	100	ft2	$35	$4,000
Construction Management	1	1	job	$6,000	$6,000
				Subtotal:	$62,000
				Contingencies (10%):	$6,000
				Total Construction Cost:	$68,000

Annual Operating Costs

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
Periodic Maintenance (g)	1	48	visit	$500	$24,000
Sampling and Analysis (h)	7	4	job	$800	$3,000
Free Product Disposal (i)	2	12	job	$800	$10,000
Electrical (j)	6	1.5	hp	$0.08	$1,000
Carbon Usage/Replacement (k)	5	1	drum	$1,000	$1,000
Project Management	1	1	job	$14,000	$14,000
				1 year O&M Cost:	$53,000
				Present Worth Factor (l):	3.993
				O&M Present Worth :	$212,000

Total Estimated Project Costs: $280,000

TABLE A-5

Estimated Installation Cost for Excavation and Treatment , Non-hazardous Waste

Building 566

Naval Weapon Station Earle

Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Excavation					
Permitting (b)	1	1	job	$1,500	$2,000
Specifications & Bid Preparation	1	1	job	$9,000	$9,000
Soil Erosion and Sediment control	1	1	job	$6,000	$6,000
Shoring/Sheetpiling (c)	2	480	ft2	$50	$24,000
Drainage Field Excavation (d)	2	1100	yd3	$18	$20,000
Stain/Seep Excavation (e)	2	400	yd3	$20	$8,000
Dewatering (f)	2	500	ft	$35	$18,000
2) Sampling					
Soil Sampling with FID	1	1	job	$1,000	$1,000
Soil Sample Collection and Analysis	4	10	samples	$130	$1,000
3) Transportation and Disposal					
Waste Characterization Sampling and Analysis	1	3	sample	$1,200	$4,000
Contaminated Soil Treatment (g)	3	2550	tons	$45	$115,000
Contaminated Groundwater	3	50000	gallon	$0.3	$16,500
Debris	1	50	yd3	$25	$1,000
4) Site Restoration					
Clean Backfill (h)	2	1,600	yd3	$10	$16,000
Top Soil and Seed/Straw	1	1	job	$3,000	$5,000
Certification Sampling Report	1	1	job	$2,000	$2,000
Construction Management	1	1	job	$10,000	$10,000
				Subtotal:	$246,500
				Contingencies (30%):	$74,000
				Total Construction Cost:	$320,500
				Annual O&M Cost:	$0
				Total Estimated Project Costs:	**$320,500**

Notes:

(a) All costs rounded to the nearest $1000.
(b) Includes building/operating and disposal permits and professional fees.
(c) Includes mobilization/demobilization and setup.
(d) Based on an average excavation depth of 3.5 feet.
(e) Based on an average excavation depth of 1.5 feet.
(f) Based on two 3-inch pumps and up to 1000 ft of well point dewatering system for 48 hours.
(g) Assumes average soil density of 1.5 tons/cubic yard
(h) Includes loading, transporting, placing, and compacting.

References:

(1) Brown and Root Environmental, 1997.
(2) Dodge Unit Cost Data, 1997.
(3) Advanced Remediation and Disposal Technologies, Inc., 1997.
(4) Specialized Assays, Inc., 1997.

TABLE A-6

Estimated Installation Cost for Excavation and Treatment - Hazardous Waste

Building 566

Naval Weapon Station Earle

Colts Neck, New Jersey

Item	Ref	Quantity	Unit	Unit Cost	Cost (a)
1) Excavation					
Permitting (b)	1	1	job	$1,500	$2,000
Specifications & Bid Preparation	1	1	job	$9,000	$9,000
Soil Erosion and Sediment control	1	1	job	$6,000	$6,000
Shoring/Sheetpiling (c)	2	480	ft2	$50	$24,000
Drainage Field Excavation (d)	2	1100	yd3	$18	$20,000
Stain/Seep Excavation (e)	2	400	yd3	$20	$8,000
Dewatering (f)	2	500	ft	$35	$18,000
2) Sampling					
Soil Sampling with FID	1	1	job	$1,000	$1,000
Soil Sample Collection and Analysis	4	10	samples	$130	$1,000
3) Transportation and Disposal					
Waste Characterization Sampling and Analysis	1	3	sample	$1,200	$4,000
Contaminated Soil Treatment (g)	3	2250	tons	$162	$365,000
Contaminated Groundwater	3	60000	gallon	$0.3	$19,800
Debris	1	50	yd3	$25	$1,000
4) Site Restoration					
Clean Backfill (h)	2	1,600	yd3	$10	$16,000
Top Soil and Seed/Straw	1	1	job	$3,000	$5,000
Certification Sampling Report	1	1	job	$2,000	$2,000
Construction Management	1	1	job	$10,000	$10,000
				Subtotal:	$499,800
				Contingencies (30%):	$150,000
				Total Construction Cost:	$649,800
				Annual O&M Cost:	$0
				Total Estimated Project Costs:	**$649,800**

Notes:

(a) All costs rounded to the nearest $1000.

(b) Includes building/operating and disposal permits and professional fees.

(c) Includes mobilization/demobilization and setup.

(d) Based on an average excavation depth of 3.5 feet.

(e) Based on an average excavation depth of 1.5 feet.

(f) Based on two 3-inch pumps and up to 1000 ft of well point dewatering system for 48 hours.

(g) Assumes average soil density of 1.5 tons/cubic yard.

(h) Includes loading, transporting, placing, and compacting.

References:

(1) Brown and Root Environmental, 1997.

(2) Dodge Unit Cost Data, 1997.

(3) Advanced Remediation and Disposal Technologies, Inc., 1997.

(4) Specialized Assays, Inc., 1997.