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VACUUM-ENHANCED SKIMMING PILOT STUDY LETTER REPORT FOR FREE PRODUCT  
RECOVERY AT BUILDING R-12 NWS EARLE NJ  
4/19/2001  
FOSTER WHEELER ENVIRONMENTAL CORPORATION

**VACUUM-ENHANCED SKIMMING  
PILOT STUDY LETTER REPORT  
FOR FREE PRODUCT RECOVERY AT BUILDING R-12  
NAVAL WEAPONS STATION - EARLE  
COLTS NECK, NEW JERSEY**

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*Prepared for:*

Department of the Navy  
Engineering Field Activity, Northeast  
Naval Facilities Engineering Command  
10 Industrial Highway  
Lester, PA 19113

*Prepared by:*

Foster Wheeler Environmental Corporation  
2300 Lincoln Highway  
One Oxford Valley - Suite 200  
Langhorne, PA 19047 - 1829

REMEDIAL ACTION CONTRACT N62472-94-D-0398  
DELIVERY ORDER NO. 0051

## **1.0 INTRODUCTION**

Foster Wheeler Environmental was tasked with completing a vacuum-enhanced skimming pilot study at Building R-12 of Naval Weapons Station Earle. Foster Wheeler Environmental had been operating and maintaining a oil skimming pump at several recovery wells (RW-1, RW-2, and RW-3) on the northeast corner of Building R-12.

This Letter Report is being submitted to satisfy the post-construction submittal requirements included in paragraph 1.2.1, Pre- and Post-Construction Documentation of the Statement of Services for Delivery Order No. 0051 under Remedial Action Contract No. N62472-94-D-0398.

This letter report summarizes the operation of the vacuum-enhanced skimmer pilot study and offers and evaluation of the technology as it applies to this site.

## **1.2 OBJECTIVES**

The objective of the vacuum-enhanced skimming pilot study were to determine if this remedial technology should be considered for application at the Building R-12 Site. A passive oil skimming pump had been in operation for approximately 10 months prior to initiating the vacuum-enhanced pilot study.

## **2.0 PROJECT LOCATION AND DESCRIPTION**

Naval Weapons Station Earle (NWS-Earle) is located in Monmouth County in east-central New Jersey. The NWS-Earle base consists of a Mainside Area and a Waterfront Area occupying a total of 11,134 acres. The Mainside of the base is located approximately 10 miles inland from the Atlantic Ocean. The Mainside and the Waterfront areas of the base are linked by a narrow tract of land that serves as a right-of-way for a government road and railroad line.

NWS-Earle is responsible for furnishing ammunition tot he Naval fleet, and coordinates all port services and logistical support for home-ported and visiting ships. The Base also conducts safety inspections, supervises ammunition loading for the United States Coast Guard, and provides marine fire fighting capability and standby tug services. The Waterfront consists of an ammunition depot, and associated piers for loading and servicing the Naval fleet.

Building R-12 is located in the Waterfront area of NWS-Earle along Road R-1. The area of concern (AOC) is behind Building R-12, at the northeast corner of the building. A former heating oil underground storage tank (UST) was abandoned in place at this location. During the UST closure, it was discovered that the bottom of the UST was encased in concrete, and located very close to the Building R-12 foundation. The UST

was abandoned in place because it could not be removed without potential damage to the building foundation.

## **2.1 SITE CONDITIONS**

### **2.1.1 NATURE AND EXTENT OF CONTAMINATION**

A previous remedial investigation (RI) conducted by Tetra Tech NUS Inc. (TtNUS) indicated that contamination and free product existed in the vicinity of the UST that was abandoned in place. Three recovery wells were installed based upon the free product plume delineated during the RI. Based on the RI, the free-phase plume was estimated to cover an area of 560 square feet. The three recovery wells were constructed of 4-inch diameter PVC to a depth of 20-feet below ground surface, with 15-foot screened intervals. After the well installation in 1998 the apparent product thicknesses in the wells ranged from 0.46 ft to 1.37 feet.

### **2.1.2 GEOLOGY**

NWS-Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The Coastal Plain consists of a series of seaward-dipping unconsolidated sediments of Cretaceous through Quaternary Age. The Coastal plain sediments were deposited in continental, coastal, and marine environments, and consist of numerous sequences of sand, gravel, silt and clay. Previous investigations conducted at Building R-12 indicate that soils in that area are part of the Englishtown Formation. The Englishtown Formation consists of tan and gray, fine and medium grained sand with local clay beds. Previous boring logs at the site describe the soils as silty, clayey, fine-grained sand and silty fine-grained sand with some silty clay layers (TtNUS, 1999). Shallow groundwater at Building R-12 occurs at a depth of 9 to 11 feet below ground surface.

## **3.0 VACUUM-ENHANCED PILOT STUDY**

### **3.1 SCOPE OF WORK**

The goal of the pilot study was to evaluate the use of vacuum-enhanced recovery (VER) to potentially increase the product recovery in the wells near Building R-12. A passive skimmer pump was operated in three recovery wells in the vicinity of Building R-12 several months prior to the VER pilot study. The objective of the study was to use the down-the-hole skimming pump in conjunction with a vacuum pump to evaluate any potential product recovery rate changes due to the use of the two combined technologies.

The skimmer pump uses a hydrophobic filter on a self-adjusting float assembly that enables the product to enter the filter as the water table rises and falls. Compressed air is used to lift the product from the collection chamber of the pump to the surface where it is

stored in a drum within secondary containment. This product removal method is a passive method, which does not create a significant pressure head differential to draw product towards the well.

The significant feature of the VER is that the vacuum induced on the well creates a pressure gradient around the well to enhance the product flow to the well.

### **3.2 PILOT STUDY OPERATION**

From October 2, 2000 to October 17, 2000, A VER pilot study was conducted using a skid-mounted blower unit and a passive skimmer pump. The following equipment was used to complete the VER-pilot study:

- (1) Rotron™ regenerative blower (1.5 horsepower with a vacuum range of 0 to 85-inches of water);
- (1) Xitech passive skimmer pump;
- Air compressor unit;
- (2) vapor-phase granular activated carbon drums;
- Air-tight well seal and associated product tubing and piping;

A Xitech skimmer pump was placed in recovery well RW-3, which historically demonstrated the best recovery. An air compressor was used to supply air to the skimmer pump, and the product line was discharged to a drum inside a secondary containment area. The skid-mounted blower unit was set up near Building R-12 in order to place a vacuum on the recovery well. RW-3 was chosen for the pilot study because the previous operations of the skimmer pump demonstrated that this well had the best recovery and recharge rate of the three existing wells. The vacuum was connected to the top of the well using PVC piping and a compression cap that allowed the tubing for the pump to exit the well, but maintained an airtight seal. The exhaust of the skid-mounted blower was fitted with two granular activated carbon drums in series to treat the air being extracted from the well during the pilot study. Appendix A contains a photograph log of the VER-pilot study components, and a schematic.

The vapor stream before, between and after the granular activated carbon drums was measured with a photo-ionization meter (PID) during the pilot study. The PID readings prior to the carbon were 0 to 0.6 ppm and 0 ppm between the first and second carbon drum and after the second carbon drum. Air samples were also obtained in Summa canisters™ prior to (R10-VD01) and after the carbon (R10-VD02) and analyzed for volatile organic compounds (VOCs) via EPA Method T014 ) at Apollo Analytics laboratory. The laboratory results, contained in Appendix B, did not reveal any detectable concentrations of VOCs.

A vacuum of 15-inches of water was applied to Recovery Well RW-3. The 15-inches of water vacuum on the recovery well caused a slight mounding of the water in the well which is not conducive to product recovery. While no product was detected in the well

during the VER skimming operation, the water level in the well rose 0.08 feet. The vacuum on the well was decreased from 15-inches of water to 5 to 7-inches of water over the two-week pilot study period to establish the most effective operating vacuum. A vacuum of 15-inches of water on the well tended to mound the water in the well, which could potentially prohibit the migration of product into the well. After incremental vacuum adjustments, it was determined that 5-inches of water vacuum allowed for the best product recovery while not mounding the water in the well.

The product recovery rates from the recovery wells exhibited a decline over the past year of operation. In the two weeks prior to the pilot study, no product was being recovered with the skimmer pump, and the recovery well in which the pump was installed only contained a sheen, with no measurable product. The product recovery rate of the skimmer system in the four months prior to conducting the pilot study (October 2000) averaged approximately 0.79 gallons per week. During the two-week pilot study, the product recovery rate was approximately 0.67 gallons per week. While the average weekly recovery rate appeared to decline, it is important to note that no product was being recovered in the two weeks prior to the pilot study.

#### **4.0 CONCLUSIONS**

As previously discussed, the product recovery rate of the skimmer pump in RW-3 was zero for the two weeks immediately prior to the pilot study. Prior to that two-week period, the average weekly recovery rate was approximately 0.79 gallons. The depth to product in RW-3 on September 8, 2000 was 9.08 feet, with a product thickness of 0.42 ft. Prior to the startup of the VER pilot study on October 2, 2000, the depth to water in RW-3 was 10.42 feet with no measurable product. According to the water level measurements taken in the weeks prior to the VER-pilot study, the water table level rose 1.34 feet before the start of the pilot study. Product is typically trapped in the saturated zone as the water table rises. When the water table rises and falls, there is usually a lag time that begins when the water level starts to change to when the product is available for recovery.

When compared to the average product recovery rates of the skimmer system in the months previous to the pilot study, the VER-skimming did not result in a significant increase of product recovery. When compared to the product recovery rate of the well in the two-week period immediately prior to the pilot study, the VER-skimming did increase product recovery. The additional costs of operating and maintaining a vacuum-enhanced skimmer system at this site would not be justified based on the amount of product recovered using this technology, and the anticipated available free-phase product available for removal.



Photo 1: Photo depicting the blower unit connected to the well and the activated carbon drums.



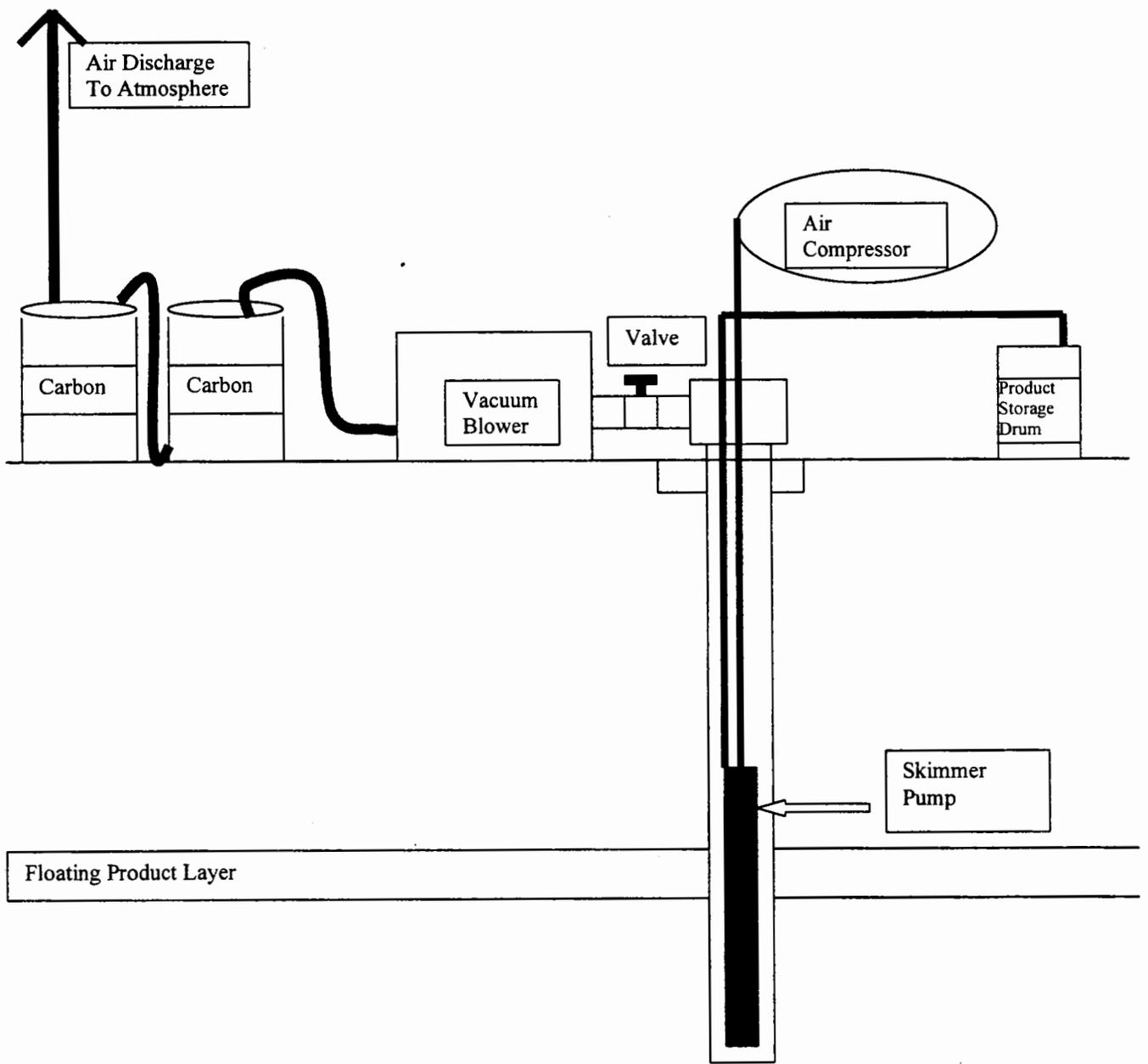
Photo 2: Photo of vacuum system and product line extending back to the product recovery drum.

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Photo 3: Close up of blower unit used for the pilot study test.

**Figure 1: Vacuum-Enhanced Product Skimming Pilot Study Schematic**



**VOLATILE ORGANIC ANALYSIS**

<b>CLIENT NAME:</b>	Foster Wheeler Company	<b>CLIENT SAMPLE ID:</b>	Method Blank
<b>PROJECT #:</b>	—	<b>AAI RFS#</b>	0027702
<b>PROJECT NAME:</b>	Product Recovery Bid: R-10 N.W.S.E.	<b>AAI ID#:</b>	Method Blank
<b>MATRIX:</b>	Air/Canister		
<b>SAMPLE VOLUME:</b>	0.1 Liter	<b>DATE SAMPLED:</b>	N/A
<b>INITIAL PRESSURE:</b>	1.00 psia	<b>DATE RECEIVED:</b>	N/A
<b>FINAL PRESSURE:</b>	1.00 psia	<b>DATE ANALYZED:</b>	10/15/2000
<b>PRES. DILUTION :</b>	1.00		
<b>DILUTION FACTOR:</b>	1	<b>ANALYTICAL METHOD:</b>	EPA TO14 (GC/MS)

CAS NUMBER	COMPOUND	CONCENTRATION			
		mg/m3	PQL	ppm(v)	PQL
74-87-3	Chloromethane	ND<	0.050	ND<	0.024
74-83-9	Bromomethane	ND<	0.050	ND<	0.013
75-01-04	Vinyl Chloride	ND<	0.050	ND<	0.020
75-00-3	Chloroethane	ND<	0.050	ND<	0.019
75-69-4	Freon 11	ND<	0.050	ND<	0.009
75-35-4	1,1-Dichloroethene	ND<	0.050	ND<	0.013
76-13-1	Freon 113	ND<	0.050	ND<	0.007
75-09-2	Methylene Chloride	ND<	0.050	ND<	0.014
75-35-3	1,1-Dichloroethane	ND<	0.050	ND<	0.012
156-60-5	trans-1,2-Dichloroethene	ND<	0.050	ND<	0.013
156-59-2	cis-1,2-Dichloroethene	ND<	0.050	ND<	0.013
67-66-3	Chloroform	ND<	0.050	ND<	0.010
71-55-6	1,1,1-Trichloroethane	ND<	0.050	ND<	0.009
56-23-5	Carbon Tetrachloride	ND<	0.050	ND<	0.008
71-43-2	Benzene	ND<	0.050	ND<	0.016
107-06-2	1,2-Dichloroethane	ND<	0.050	ND<	0.012
79-01-6	Trichloroethene	ND<	0.050	ND<	0.009
78-87-5	1,2-Dichloropropane	ND<	0.050	ND<	0.011
10061-02-6	trans-1,3-Dichloropropene	ND<	0.050	ND<	0.011
108-88-3	Toluene	ND<	0.050	ND<	0.013
10061-01-5	cis-1,3-Dichloropropene	ND<	0.050	ND<	0.011
79-00-5	1,1,2-Trichloroethane	ND<	0.050	ND<	0.009
127-18-4	Tetrachloroethene	ND<	0.050	ND<	0.007
106-93-4	Ethylene Dibromide	ND<	0.050	ND<	0.007
108-90-7	Chlorobenzene	ND<	0.050	ND<	0.011
100-41-4	Ethylbenzene	ND<	0.050	ND<	0.012
1330-20-7	m,p-Xylene	ND<	0.050	ND<	0.012
95-47-6	o-Xylene	ND<	0.050	ND<	0.012
100-42-5	Styrene	ND<	0.050	ND<	0.012
79-34-5	1,1,2,2-Tetrachloroethane	ND<	0.050	ND<	0.007
108-67-8	1,3,5-Trimethyl Benzene	ND<	0.050	ND<	0.010
95-63-6	1,2,4-Trimethyl Benzene	ND<	0.050	ND<	0.010
541-73-1	1,3-Dichlorobenzene	ND<	0.050	ND<	0.008
106-46-7	1,4-Dichlorobenzene	ND<	0.050	ND<	0.008
100-44-7	Chlorotoluene	ND<	0.050	ND<	0.010
95-50-1	1,2-Dichlorobenzene	ND<	0.050	ND<	0.008
67-64-1	Acetone	ND<	0.050	ND<	0.021
78-93-3	2-Butanone	ND<	0.050	ND<	0.017
108-10-1	4-methyl-2-pentanone	ND<	0.050	ND<	0.012
591-78-6	2-Hexanone	ND<	0.050	ND<	0.012
<b>Surrogate Recovery</b>		<b>% Recovery</b>			
1,2-Dichloroethane-D4 (SS1)		130		70-130	
Toluene-d8 (SS2)		98		70-130	
4- Bromofluorobenzene (SS3)		108		70-130	

ND- Not detected

\*Value outside QC limits due to matrix interference.

TR - Trace

Approved by: \_\_\_\_\_ Date: \_\_\_\_\_

After Carbon

**VOLATILE ORGANIC ANALYSIS**

CLIENT NAME: Foster Wheeler Company  
 PROJECT #: ---  
 PROJECT NAME: Product Recovery Bld: R-10 N.W.S.E.  
 MATRIX: Air/Canister  
 SAMPLE VOLUME: 0.1 Liter  
 INITIAL PRESSURE: 14.70 psia  
 FINAL PRESSURE: 16.90 psia  
 PRES. DILUTION: 1.15  
 DILUTION FACTOR: 1

CLIENT SAMPLE ID: R10 VD002  
 AAI RFS# 0027702  
 AAI ID#: 0027702-002

DATE SAMPLED: 10/1/2000  
 DATE RECEIVED: 10/3/2000  
 DATE ANALYZED: 10/15/2000

ANALYTICAL METHOD: EPA TO14 (GC/MS)

CAS NUMBER	COMPOUND	CONCENTRATION			
		mg/m3	PQL	ppm(v)	PQL
74-87-3	Chloromethane	ND<	0.057	ND<	0.028
74-83-9	Bromomethane	ND<	0.057	ND<	0.015
75-01-04	Vinyl Chloride	ND<	0.057	ND<	0.022
75-00-3	Chloroethane	ND<	0.057	ND<	0.022
75-69-4	Freon 11	ND<	0.057	ND<	0.010
75-35-4	1,1-Dichloroethene	ND<	0.057	ND<	0.015
76-13-1	Freon 113	ND<	0.057	ND<	0.008
75-09-2	Methylene Chloride	ND<	0.057	ND<	0.017
75-35-3	1,1-Dichloroethane	ND<	0.057	ND<	0.014
156-60-5	trans-1,2-Dichloroethene	ND<	0.057	ND<	0.015
156-59-2	cis-1,2-Dichloroethene	ND<	0.057	ND<	0.015
67-66-3	Chloroform	ND<	0.057	ND<	0.012
71-55-6	1,1,1-Trichloroethane	ND<	0.057	ND<	0.011
56-23-5	Carbon Tetrachloride	ND<	0.057	ND<	0.009
71-43-2	Benzene	ND<	0.057	ND<	0.018
107-06-2	1,2-Dichloroethane	ND<	0.057	ND<	0.014
79-01-6	Trichloroethene	ND<	0.057	ND<	0.011
78-87-5	1,2-Dichloropropane	ND<	0.057	ND<	0.012
10061-02-6	trans-1,3-Dichloropropene	ND<	0.057	ND<	0.013
108-88-3	Toluene	ND<	0.057	ND<	0.015
10061-01-5	cis-1,3-Dichloropropene	ND<	0.057	ND<	0.013
79-00-5	1,1-2-Trichloroethane	ND<	0.057	ND<	0.011
127-18-4	Tetrachloroethene	ND<	0.057	ND<	0.008
106-93-4	Ethylene Dibromide	ND<	0.057	ND<	0.007
108-90-7	Chlorobenzene	ND<	0.057	ND<	0.012
100-41-4	Ethylbenzene	ND<	0.057	ND<	0.013
1330-20-7	m,p-Xylene	ND<	0.057	ND<	0.013
95-47-6	o-Xylene	ND<	0.057	ND<	0.013
100-42-5	Styrene	ND<	0.057	ND<	0.014
79-34-5	1,1,2,2-Tetrachlorethane	ND<	0.057	ND<	0.008
108-67-8	1,3,5-Trimethyl Benzene	ND<	0.057	ND<	0.012
95-63-6	1,2,4-Trimethyl Benzene	ND<	0.057	ND<	0.012
541-73-1	1,3-Dichlorobenzene	ND<	0.057	ND<	0.010
106-46-7	1,4-Dichlorobenzene	ND<	0.057	ND<	0.010
100-44-7	Chlorotoluene	ND<	0.057	ND<	0.011
95-50-1	1,2-Dichlorobenzene	ND<	0.057	ND<	0.010
67-64-1	Acetone	ND<	0.057	ND<	0.024
78-93-3	2-Butanone	ND<	0.057	ND<	0.020
108-10-1	4-methyl-2-pentanone	ND<	0.057	ND<	0.014
591-78-6	2-Hexanone	ND<	0.057	ND<	0.014
<b>Surrogate Recovery</b>		<b>% Recovery</b>			
1,2-Dichloroethane-D4 (SS1)		105		70-130	
Toluene-d8 (SS2)		111		70-130	
4- Bromofluorobenzene (SS3)		102		70-130	

ND- Not detected  
 TR - Trace

\*Value outside QC limits due to matrix interference.

Approved by: \_\_\_\_\_ Date: \_\_\_\_\_