DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

28 December 1994

377 ABW/EMR
2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5659

KAFB II

Ms. Nancy Morlock, Environmental Engineer
RCRA Permits Branch
U.S. EPA Region 6
1445 Ross Ave, Ste 1200
Dallas TX 75202-2733

Dear Ms. Morlock

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Enclosed is a copy of the final report for the one-year pilot bioventing test conducted at SWMU 6-16, Fire Training Area. We apologize for the delay; AFCEE stated they had previously sent the report but that it has apparently been lost in the mail.

Please contact me at (505) 846-2773/0053 if you have any questions.

Sincerely

CHRISTOPHER B. DeWITT, R.P.G.
Chief, Restoration Branch
Environmental Management Division

Attachment:
Final Report, Bioventing Test (w atch)

cc:
~~NMED-HRMB (Mr. Pullen) (wo atch)~~

KAFB1561

File: E/V Kirtland

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE TEXAS

7 Nov 94

MEMORANDUM FOR 37 ABW/EM
ATTN: MS. JANET RICABONO

FROM: HQ AFCEE/ERT
8001 Arnold Drive
Brooks AFB TX 78235-5357

SUBJECT: Completion of One-Year Bioventing Test, Fire Training Area, FT-13

The Air Force Center for Environmental Excellence (AFCEE) one-year bioventing test and evaluation project at the Fire Training Area, FT-13 has been completed. Figure 1 provides general site information and Table 1 provides a summary of initial, three-month, six-month, nine-month, and one-year fuel biodegradation rates measured at several monitoring points. Biodegradation rates which started out on the low side have only varied slightly during the one-year pilot test. Some of these changes can be explained by soil temperature variations. Table 2 provides a summary of initial and final soil and soil gas sampling results for total recoverable petroleum hydrocarbons (TRPH) and benzene, toluene, ethylbenzene, and zylenes (BTEX). Based on the results from our Bioventing Initiative, with 110 sites currently under operation, bioventing is cost-effectively remediating fuel contamination in a reasonable time frame. The results from your site, FT-13, however, are not conclusive as to the overall success or viability of bioventing in this particular case. Further experiments at another desert site with similar results may identify the reason for the low respiration rates experienced at your site. We do, however, recommend you continue to consider use of this technology at other sites on your installation using the criteria in the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, May 92, and Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing-Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential, Feb 94.

The one-year sampling effort was not intended to collect the large number of samples required for statistical significance. It was conducted to give a qualitative indication of changes in contaminant mass. Soil gas samples are somewhat similar to composite samples in that they are collected over a wider area. Thus, they provide a good indication of changes in soil gas profiles and volatile contaminant mass (see Addendum One). Soil samples, on the other hand, are discrete point samples subject to large variabilities over small distances/soil types. This variability, coupled with known sampling and analytical variabilities, would require the collection of a large number of samples to conclusively determine "real" changes in soil contamination. Due to the limited number of final samples collected under this effort, these results should not be viewed as conclusive indicators of bioventing progress or evidence of the success or failure of this technology. In situ respiration tests are considered to be better indicators of hydrocarbon remediation than limited soil sampling.

Data from your base and many others indicate that BTEX compounds are preferentially biodegraded over TPH. Since BTEX compounds represent the most toxic and mobile fuel constituents, a BTEX standard is a risk-based standard. We strongly encourage its use over an arbitrary TPH standard. Our information indicates that New Mexico has specific cleanup standards for BTEX, TAH and/or TPH dependent upon whether the contaminant is gasoline, diesel or waste fuels. As a fire training area, the predominant source of contamination at this site has been reported as JP-4 jet fuel. The information in attachment 5 indicates that New Mexico regulates jet fuel as a heavy fuel or diesel. Accordingly, the current cleanup level is 100 ppm TPH as determined by either EPA Method 418.1 or 8015 Modified. Attachment 3 summarizes the BTEX/TPH issue and attachment 5 will assist you in negotiating for a BTEX cleanup standard.

Generally, quantitative destruction of BTEX will occur over a 1 to 2 year bioventing period. Soil gas surveys and respiration tests can be used as BTEX/TPH destruction indicators. In the event that a non-risk-based/TPH cleanup is chosen, a full-scale system should be operated until respiration rates approach background rates. We recommend that confirmatory soil sampling be conducted 4-6 months after background respiration rates are approached.

Sampling results from FT-13, however, are inconclusive. The respiration rates for this site, as indicated in Table 1, started out moderately low in Apr 93 and then dropped and remained consistently low. Even so, it appears from the soil gas data, shown in Table 2, that there has been a significant drop in the concentrations of the BTEX compounds. The soil sample results, which are subject to the variability discussed above, do not indicate a significant reduction of the contaminant.

It appears that some factor is inhibiting the respiration required to effectively metabolize the fuel contaminants at this site. As mentioned above, we will be conducting further studies at another site which has experienced similar results. Factors we will be investigating are: soil salinity, soil moisture, and nutrient availability. We will inform you of any results obtained from these studies.

With the low respiration rates present at FT-13, continued operation of the bioventing system should not be expected to result in dramatic reductions in TPH. However, due to the low cost of operation, we recommend you continue the operation of the system until some conclusions can be reached from our further studies. In the event that you choose to discontinue the operation of the system, this site might be eligible for closure based upon an exemption rule as described in attachment 5, page 118. This rule indicates that contaminated soils do not have to remediated if there is a documented interval of clean soil of at least 50 feet between the bottom of the contamination and groundwater. With groundwater occurring at a depth of 430 feet below ground surface, there is a very good chance that such a closure could be negotiated.

Because this is a streamlined test and evaluation project, our contract does not provide for additional reports to the base on pilot study results. The interim results report dated Jun 93 contains as-builts and initial data. This letter summarizes all data collected and provides next step recommendations. AFCEE is no longer responsible for the operation, maintenance, or monitoring of this bioventing system. However, we are in the process of awarding a contract vehicle for extended monitoring, design and expansion of bioventing systems installed under the AFCEE Bioventing Initiative. In the event that a solution is found to increase respiration rates at FT-13, this contract could be made available for your use. Please contact Mr. Marty M. Faile, AFCEE/ERT, DSN 240-4342, COM (210)536-4342, to discuss the technical and contractual options for a full scale expansion.

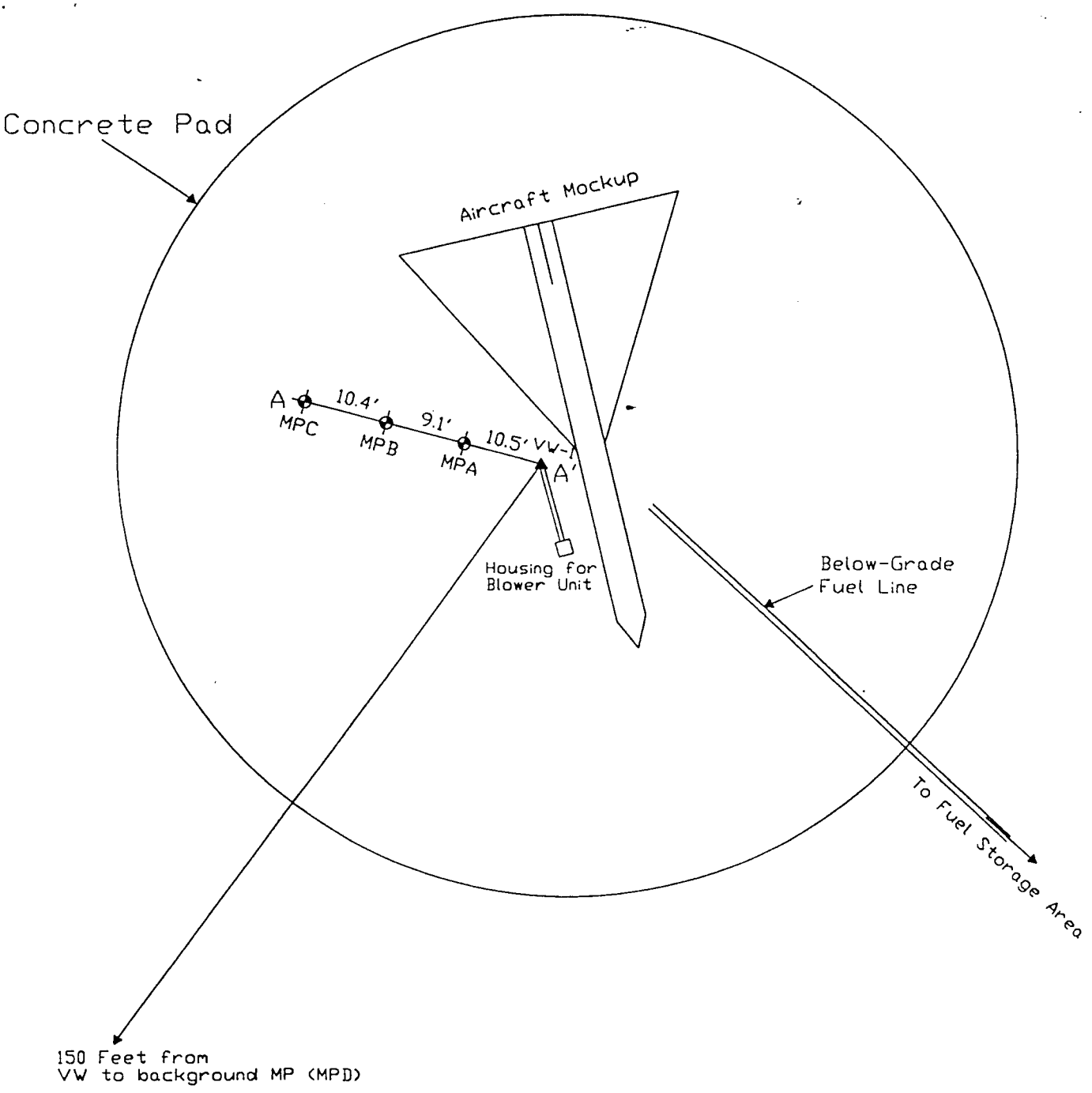
The blower and accessories are now base property and should continue to be used on this or other bioventing sites. Although current equipment is explosion proof, under no circumstances should it be used for soil vapor extraction unless appropriate explosion-proof wiring is provided. If the base does not want to keep the blower or if you have further questions, please contact us.

On behalf of the AFCEE/ERT staff, I would like to thank you for your support of this bioventing test and evaluation project. The information gained from each site will be invaluable in evaluating this technology and will promote its successful application on other DOD and private sites. I have enclosed a customer satisfaction survey. Please take a few minutes to fill it out and tell us how we did. We look forward to hearing from you.

ROSS N. MILLER, Lt Col, USAF, BSC
Chief, Technology Transfer Division

Attachments:
1. Site Map
2. Analytical Results
3. BTEX Paper
4. Addendum One
5. "Use of Risk-Based Standards..."
6. Survey

cc:
HQ AFMC/CEVR
HQ AFCEE/ERD



LEGEND

▲ Vent Well (Air Injection)

⊕ Vapor Monitoring Point

A - A' Location of Geologic Section

0 10 20 40

SCALE: 1" = 20'

FIGURE 1

VENT WELL/
VAPOR MONITORING
POINT LOCATIONS

FORMER FIRE TRAINING AREA
(FT-13)
KIRTLAND AFB, NEW MEXICO

ENGINEERING-SCIENCE, INC.
Denver, Colorado

TABLE 1
SITE FT-13
RESPIRATION AND DEGRADATION RATES
KIRTLAND AFB, NEW MEXICO

Location-Depth	Initial (Apr. 1993)			3-Month (Jun. 1993)			6-Month (Nov. 1993)		
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[a/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)
VW-1 (5-30)	0.0012	300	NS[c/]	0.00014	34	NS	0.00014	34	NS
MPA-6	NS	NS	12.0	NS	NS	20.4	NS	NS	18.5
MPA-15	0.0011	280[d/]	NS	0.00014	34[d/]	NS	0.00015	37[d/]	NS
MPA-24	0.00058	140[d/]	16.3	NS	NS	14.6	NS	NS	16.2
MPB-24	0.00088	220[d/]	NS	0.00017	42[d/]	NS	0.00010	25[d/]	NS
MPC-24	0.0013	310[d/]	NS	0.00034	84[d/]	NS	0.00016	39[d/]	NS

Location-Depth	9-Month (Feb. 1994)			12-Month (May 1994)		
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
VW-1 (5-30)	0.000059	15	NS	0.000030	7.4	NS
MPA-6	NS	NS	10.3	NS	NS	15.8
MPA-15	0.00014	34[d/]	NS	0.000094	23[d/]	NS
MPA-24	NS	NS	14.4	NS	NS	14.7
MPB-24	0.000069	17[d/]	NS	0.000062	15[d/]	NS
MPC-24	0.000096	24[d/]	NS	0.000099	24[d/]	NS

[a/] Milligrams of hydrocarbons per kilogram of soil per year
[b/] Assumes moisture content of the soil is average of initial and final moistures.
[c/] NS=Not Sampled.

TABLE 2
SITE FT-13
INITIAL AND 1-YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS
KIRTLAND AFB, NEW MEXICO

Analyte (Units)[a/]	Sample Location (Depth, feet below ground surface)					
	VW1 (5-30)		MPA-15		MPC-24	
Soil Gas Hydrocarbons	Initial[b/]	1-Year[c/]	Initial	1-Year	Initial	1-Year
TVH (ppmv)	870	15	16000	550	22000	1500
Benzene (ppmv)	0.63	<0.002	45	<0.013	12	0.024
Toluene (ppmv)	5.7	<0.002	110	<0.013	53	<0.016
Ethylbenzene (ppmv)	1.8	0.008	9.1	0.195	14	0.11
Xylenes (ppmv)	7.2	0.037	33	0.45	63	1.2

	VW1 (15-17)		MPA (2-4)		MPB (5-7)		MPC (10-12)		MPD (15-17)	
Soil Hydrocarbons	Initial[d/]	1-Year[e/]	Initial	1-Year	Initial	1-Year	Initial	1-Year	Initial	1-Year
TRPH (mg/kg)	6534	8850	1200	6490	1338	3750	<4.0	6.7	<4.0	NS[f/]
Benzene (mg/kg)	<3.0	<0.14	<0.83	<0.14	<3.1	<.074	<0.002	<0.0005	<0.0004	NS
Toluene (mg/kg)	13	4.9	3.4	3.2	20	0.80	0.007	<0.0005	0.0016	NS
Ethylbenzene (mg/kg)	18	3.9	5.8	13	14	12	<0.002	<0.0005	0.00041	NS
Xylenes (mg/kg)	110	20	38	97	80	33	0.012	0.0030	<0.0015	NS
Moisture (%)	7.6	7.8	16.1	10.6	10.7	15.0	10.4	12.2	6.5	NS

[a/] TVH= total volatile hydrocarbons; ppmv=parts per million, volume per volume;
TRPH=total recoverable petroleum hydrocarbons; mg/kg=milligrams per kilogram.
[b/] Initial soil gas samples collected on 4/7/93.
[c/] 1-Year soil gas samples collected on 5/24/94 and 5/25/94.
[d/] Initial soil samples collected on 4/5/93 and 4/6/93.
[e/] 1-Year soil samples collected on 5/24/94.
[f/] NS=Not Sampled.