KELLY AFB
TEXAS

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 3344.20

11 April 00 RAB Action Item/Response

Item: 1

Description: A copy of the executive summary of the Vinyl Chloride Vapor Testing Report was requested.

Requester: Mr. Quintanilla

OPR: Mr. Ryan

Action: Provide summary.

Response: The report did not have an official executive summary, however materials were assembled that would provide a summary of the report. The report was mailed to RAB Members 2 May 00.

11 April 00 RAB Action Item/Response

Item: 2

Description: The question was asked, "Are other bases in the country having basically the same problems as Kelly and are they using natural attenuation.

Requester: Ms. Grybos

OPR: Ms. Crowell

Action: Provide written response.

Response: The Air Force Center for Environmental Excellence produced a report on natural attenuation of chlorinated solvents performance and cost results from 14 demonstration sites at 5 Air Force Bases. Ms. Grybos was provided the complete report. The executive summary follows this page.

In October of 1999 Congressman Rodriguez asked a similar question of the EPA and they provide the following response:

· **Where has natural attenuation worked and not worked?** The EPA reviewed their "Superfund Public Information System" database for Superfund sites where Monitored Natural Attenuation was chosen as the remedy or part of the remedy. These sites included approximately 40 industrial sites or businesses, approximately 25 industrial and municipal landfills, three farms that had illegal dumping, two Department of Energy (DoE) sites, and eight U.S. Air Force (USAF) bases. As the cleanup for these Superfund sites is ongoing, the success of the remedies has not yet been determined. The length of time listed in the database where a contingency remedy would be used if Monitored Natural Attenuation was not performing as expected varied from two to 30 years.

The EPA does not currently have a convenient remedy database for sites that are not Superfund sites. Discussions with the USAF indicate that Monitored Natural Attenuation has been selected or has been recommended as a remedy at a number of bases. USAF bases where Monitored Natural Attenuation has been selected as a remedy include Keesler AFB in Mississippi, Goodfellow AFB in Texas, and Brooks AFB in San Antonio, Texas. Keesler AFB is located in a residential and light commercial area and Brooks AFB is located in a light residential area. Brooks AFB is using a technology called soil vapor extraction to clean up the source of the contamination and Monitored Natural Attenuation for the remainder of the contamination. The cleanup time estimated for this remedy is 12 years for the source control and eight years for the Monitored Natural Attenuation remedy to reach cleanup goals.

NATURAL ATTENUATION OF CHLORINATED SOLVENTS PERFORMANCE AND COST RESULTS FROM MULTIPLE AIR FORCE DEMONSTRATION SITES

TECHNOLOGY DEMONSTRATION TECHNICAL SUMMARY REPORT

October 1999

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base, Texas 78235

Prepared By

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EXECUTIVE SUMMARY

This technical memorandum summarizes the results of natural attenuation treatability studies (TSs) conducted at 14 United States (US) Air Force sites in the Continental US. In June 1993, the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT), in cooperation with the US Environmental Protection Agency National Risk Management Research Laboratory, Subsurface Protection and Remediation Division, and Parsons Engineering Science, Inc. (Parsons ES), began a major initiative to evaluate the effectiveness of monitored natural attenuation (MNA) for remediation of groundwater contaminated with organic compounds. This study is nearing completion, and the results for sites contaminated with fuel hydrocarbons are summarized in *Natural Attenuation of Fuel Hydrocarbons – Performance and Cost Results from Multiple Air Force Demonstration Sites* (Parsons ES, 1999). The results of natural attenuation evaluations at sites contaminated with chlorinated solvents and their associated biodegradation daughter products (referred to as chlorinated aliphatic hydrocarbons [CAHs] in this document) or a mixture of CAHs and other contaminants (principally fuel hydrocarbons) are presented in this document.

The main emphasis of the work described herein was to evaluate the potential for naturally occurring degradation mechanisms to reduce the concentrations of CAHs dissolved in groundwater to levels that are protective of human health and the environment, and to limit the migration of CAH plumes in groundwater. The TSs were not intended to be contamination assessment reports or remedial action plans; rather, they were designed to provide a scientific evaluation of natural attenuation that could be used by individual Air Force bases and their prime environmental contractor(s) for future remedial decision making. Specific objectives included:

- Developing site characterization techniques to more accurately document *in situ* geochemistry and to maximize the quantity and quality of collected field data while reducing overall expenditures of money and time;
- Providing a consistent framework for documenting historical contaminant reductions and geochemical patterns consistent with biodegradation, and determining rates of contaminant degradation;
- Identifying those biological processes most responsible for contaminant attenuation in varied subsurface environments;
- Using analytical or numerical groundwater flow and solute fate and transport models to predict the effects of natural attenuation, both alone and in combination with engineered remedial technologies, on the future migration and persistence of dissolved CAHs;
- Evaluating strategies for using MNA as the sole remedial approach or in combination with other remedial techniques; and
- Developing long-term monitoring (LTM) strategies to verify the progress of natural attenuation over time until appropriate action levels are attained.

The following observations can be made based on the results of the TSs performed under this program:

- CAHs dissolved in groundwater are undergoing natural attenuation under all of the broad range of environmental conditions represented at the 14 Air Force test sites evaluated. Although intrinsic bioremediation (aerobic degradation and/or anaerobic reductive dechlorination) was found to be occurring to some degree at all of the sites studied under this program, the biodegradation of CAHs should not be considered universal. Sites were selected for study under this program only if it was suspected that biodegradation of CAHs was occurring at least in a limited fashion. Sites with no evidence of reductive dechlorination were excluded. This was done to facilitate an understanding of the biological mechanisms of natural CAH attenuation.

- The degree and rate of intrinsic bioremediation of CAHs is highly site specific, and is dependent upon the prevailing bio- and geochemistries of groundwater at a site (i.e., Type 1, Type 2, Type 3, or mixed environments described by USEPA [1998]).

- Eleven of the 14 sites studied exhibited some type of mixed behavior, with nine of the sites exhibiting Type 1 behavior coupled with either Type 2 behavior or Type 3 behavior. Two sites exhibited Type 2 behavior coupled with Type 3 behavior. The remaining three sites exhibited primarily Type 1 behavior. At least a portion of all of the sites were characterized by anaerobic conditions, and all except for F.E. Warren AFB LF-03 were either actively sulfate-reducing or methanogenic in at least a portion of the plume area. In all cases where petroleum hydrocarbons were commingled with CAHs the sites were actively methanogenic, and reductive dechlorination was occurring.

- Eight of the 14 sites had completed receptor exposure pathways.

- Three of the 14 sites appeared to have expanding plumes, six of the sites appeared to have plumes that are either stable or expanding slowly, and the remaining five plumes appeared to be either stable or receding.

- Field-scale biodegradation rate constants for two sites calculated using a conservative tracer (USEPA, 1998) were 3.0×10^{-4} day^{-1} and 7.4×10^{-4} day^{-1} (half-lives of 6.3 and 2.6 years, respectively).

- Field-scale biodegradation rate constants for the 11 sites with potentially stable plumes, calculated for trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), vinyl chloride (VC), and total chlorinated ethenes using the method of Buscheck and Alcantar (1995), ranged from 5.0×10^{-5} per day (day^{-1}) to 1.3×10^{-2} day^{-1} (half-lives of 0.1 year to 38 years), with geometric mean and median values of 4.2×10^{-4} day^{-1} (half-life of 4.5 years) and 4.9×10^{-4} day^{-1} (half-life of 3.9 years), respectively. Where possible, field-scale reductive dechlorination rates also were computed using the method of Moutoux *et al.* (1996). These rates ranged from 2.5×10^{-3} day^{-1} to 4.0×10^{-8} day^{-1} (half-lives of 0.8 year to 47,000 years), with geometric mean and median values of 8.8×10^{-6} day^{-1} (half-life of 221 years) and 1.4×10^{-5} day^{-1} (half-life of 136 years), respectively.

- Some correlation was observed between field biodegradation rates and average groundwater velocities; maximum concentrations of dissolved hydrogen; minimum oxidation-reduction potentials (ORPs); minimum plume sulfate concentrations; plume "hotspot" total organic carbon concentrations; maximum concentrations of total benzene, toluene, ethylbenzene, and xylenes (BTEX); groundwater temperature; and plume length.

- Correlations between field biodegradation rates and maximum methane and CAH concentrations were not apparent.

- Recently developed contaminant fate and transport models are more sophisticated than models used for this initiative, and will allow more accurate simulation of the migration and persistence of CAHs dissolved in groundwater.

- Modeling results (obtained by simulating CAH degradation using first-order kinetics) suggest that, in many cases, conservative groundwater quality standards will not be uniformly achieved throughout the plumes within 100 years without the implementation of aggressive remedial programs that significantly reduce the contamination source and elevated concentrations of dissolved contaminants throughout the plume.

- The average cost per site for completing supplemental site characterization using existing monitoring wells and a Geoprobe®, laboratory analysis, data analysis, fate and transport modeling, and reporting was $122,000. Slightly higher costs would be incurred at sites where conventional auger drilling is required.

- Of the 14 sites studied under this program, natural attenuation processes at two sites were sufficiently efficient to warrant the use of MNA in combination with institutional controls as the sole remedial alternative. In two cases, additional site characterization was recommended to facilitate assessment of the need for engineered remediation. In other cases, some form of engineered remediation was recommended in conjunction with MNA. However, MNA was recommended as the primary treatment alternative for at least a portion of the CAH plume at every site evaluated under this program.

- Recommended LTM programs for MNA included an average network of 17 wells and 3 surface water stations, and the projected average annual monitoring cost to implement MNA was $22,800.

Because of the extremely site-specific nature of CAH biodegradation, quantifying intrinsic bioremediation is more difficult at sites contaminated with these compounds. For these reasons, remedial contractors working for the Department of Defense should critically evaluate the efficacy of MNA as a remedial option for dissolved CAHs. In all cases, engineered alternatives such as source reduction also should be evaluated to determine how they would limit plume migration and/or accelerate attainment of target cleanup levels.

11 April 00 RAB Action Item/Response

Item: 3

Description: The question was asked, "Could I have list of the bases, how long they have been using natural attenuation, what's its steps and whether it is in a large metropolitan area and also the health assessments that went with these."

Requester: Ms. Grybos

OPR: Ms. Crowell

Action: Provide list.

Response: The reports from the Air Force Center for Environmental Excellence and EPA described in the prior response provide some of this information. We have checked within the Air Force and with EPA to identify any health assessments that might have been done on monitored natural attenuation projects. To date, we have not found any health assessments.

11 April 00 RAB Action Item/Response

Item: 4

Description: Would like to see any study on monitored natural attenuation conducted on any area similar to San Antonio.

Requester: Ms Grybos

OPR: Mr. Walters

Action: Provide a study if available.

Response: The available information was provided under action item #2.

11 April 00 RAB Action Item/Response

Item: 5

Description: Would like a report on the groundwater model.

Requester: Ms Grybos

OPR: Mr. Rohne

ACTION: Provide information on the groundwater model.

Response: See the following White Paper.

WHITE PAPER ON GROUNDWATER MODELING AT KELLY AIR FORCE BASE

What is groundwater modeling? Groundwater modeling is the use of mathematical formulas and actual data to predict how groundwater flows and how contaminants travel and change their chemical makeup. Generally, the formulas are coded into computer programs, where the data is converted to a visual format.

How is it used? The model is used in many ways, including contaminant mapping, presentation of geotechnical parameters, groundwater elevation and direction of flow, and contaminant fate and transport. These are explained in the following paragraphs.

The model is used to map plumes so that areas of groundwater contamination are identified. Data is gathered from a large group of monitoring wells located both on and off of Kelly AFB. Kelly itself has over 1400 wells and data is also used from wells from other parties such as TxDOT, USGS and private well owners.

Geotechnical information such as the gravel layer thickness and depth to Navarro clay are important factors in understanding groundwater flow. Groundwater will flow in the path of least resistance. Since the soil around Kelly AFB is clay and gravel, the groundwater will generally flow through the gravel, which is more porous (i.e., has more holes). The Navarro clay is over 600 feet thick and, because of its tight formation (i.e., no holes), prevents groundwater from migrating downward. (The Edwards Aquifer is located below the Navarro Clay). If we know the depth to the Navarro clay and the gravel thickness, we can predict where the groundwater is located.

From the well data, groundwater elevations are obtained. The elevations are mapped at their respective well site and contours can be drawn. Contours are lines connecting points where the elevation is the same. From the contours, groundwater flow is derived. Since water flows down gradient (i.e., from high to low), the direction of groundwater flow is perpendicular to the contours. This tells us which way the water and contamination is moving.

Fate and transport modeling shows us what happens to the contaminants (fate) and how far they travel (transport). Again, existing data is used to reflect current conditions of the groundwater and its potential to degrade contaminants. This information is combined with information from the flow model to predict how contaminants will change in concentration over time.

How is modeling used for decision making? At Kelly AFB, we perform investigations at areas that are suspected to be contaminated. During the investigation, data is gathered from soil and from groundwater monitoring wells. The "nature and extent" of contamination is obtained from this data. Then a study, called the Corrective Measures Study or CMS, is developed. It is in this phase that modeling is used.

Different alternatives for cleanup are presented in the CMS and modeling is used to predict if they will work or not. The "no action" alternative is also modeled for comparison purposes. For each alternative, the model predicts how long it will take to reach a particular cleanup goal. This information is combined with other factors such as cost, technical impracticability and short and long term effectiveness (i.e., will the action remain viable) to come up with a recommended alternative.

After the CMS phase, a design phase occurs. Modeling is also used to refine the location of corrective action systems so that maximum efficiency can be obtained. For example, if a system of groundwater recovery wells is being installed, we would want to place the wells in areas where there is sufficient groundwater.

What specifically has Kelly AFB done? A basewide flow model was developed, which provided geotechnical information, groundwater elevations and direction of flow. Other data such as hydraulic conductivity (how fast the water can move through the soil) was provided.

In addition to the basewide model, two "zoom" models were developed, where a more focused look at certain areas of the base was performed. In the zoom models, additional site-specific data points were added to the model and the grid size was reduced from 300 feet to 50 feet. This reduction in spacing allows better resolution and better results. The two areas where zoom models were developed are Site S-4 on the southeast side of the base and Zone 5 in the northern section of the base. A third zoom model for East Kelly and off base is currently under development.

What key points should I remember?

Modeling is a tool that is used to:

- provide scientific support
- predict the way groundwater flows
- predict the way contaminants flow
- predict what happens to contaminants
- aid in decision making

11 April 00 RAB Action Item/Response

Item: 6

Description: How are the employees being protected from the dirt that's out being captured, like the extra dirt from the digging going on around building 171.

Requester: Ms. Flores

OPR: Mr. Ryan

Action: Request a response.

Response: There has not been any construction at or around Building 171 for more than a year. We mailed a letter requesting clarification to Ms. Flores and have not received any further information. The closest construction at the time the question was asked was being done by Union Pacific Railroad on their property.

11 April 00 RAB Action Item/Response

Item: 7

Description: What reference material show the possibility of stainless steel well screens causing high hits for Chromium. *For EPA contractors.*

Requester: Mr. Rice

OPR: EPA

Action: Request EPA's contractors provide a response.

Response: EPA contractors collected groundwater samples from 22 shallow groundwater monitoring wells between February 7 and February 17, 2000. According to documents provided by KAFB, these monitoring wells are constructed with stainless steel well screens. Analytical results indicate that groundwater from two of the monitoring wells sampled contain concentrations of chromium exceeding the EPA MCL. Analytical results from these same monitoring wells also indicate elevated levels of nickel present in the groundwater (please refer to the analytical results tables provided during the April 11 RAB Meeting). The EPA contractor suggested that because chromium and nickel concentrations were both elevated, these elevated concentrations might be attributable to the natural degradation of the stainless steel well screens.

References which document the potential for chromium and nickel to leach from stainless steel well screens and potentially impact groundwater quality are listed below.

USEPA, 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance, Office of Solid Waste, Washington, DC.

USEPA, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, Office of Research and Development, Washington, DC.

USEPA, 1984. A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling, Office of Research and Development, Washington, DC.

Hewitt, A.D., 1989. Leaching of Metal Pollutant from Four Well Casings Used for Ground-Water Monitoring, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Hewitt, A.D., 1992. Potential of Common Well Casing Materials to Influence Aqueous Metal Concentration, Ground Water Monitoring Review, vol. 12, no. 2, pp. 131-136.

Parker, L.V., A.D. Hewitt and T.F. Jenkins, 1990. Influence of Well Casing Material on Trace-Level Chemicals in Well Water, Ground Water Monitoring Review, vol. 10, no. 2, pp. 146-156.

11 April 00 RAB Action Item/Response

Item: 8

Description: The requestor asked for a cleanup timetable.

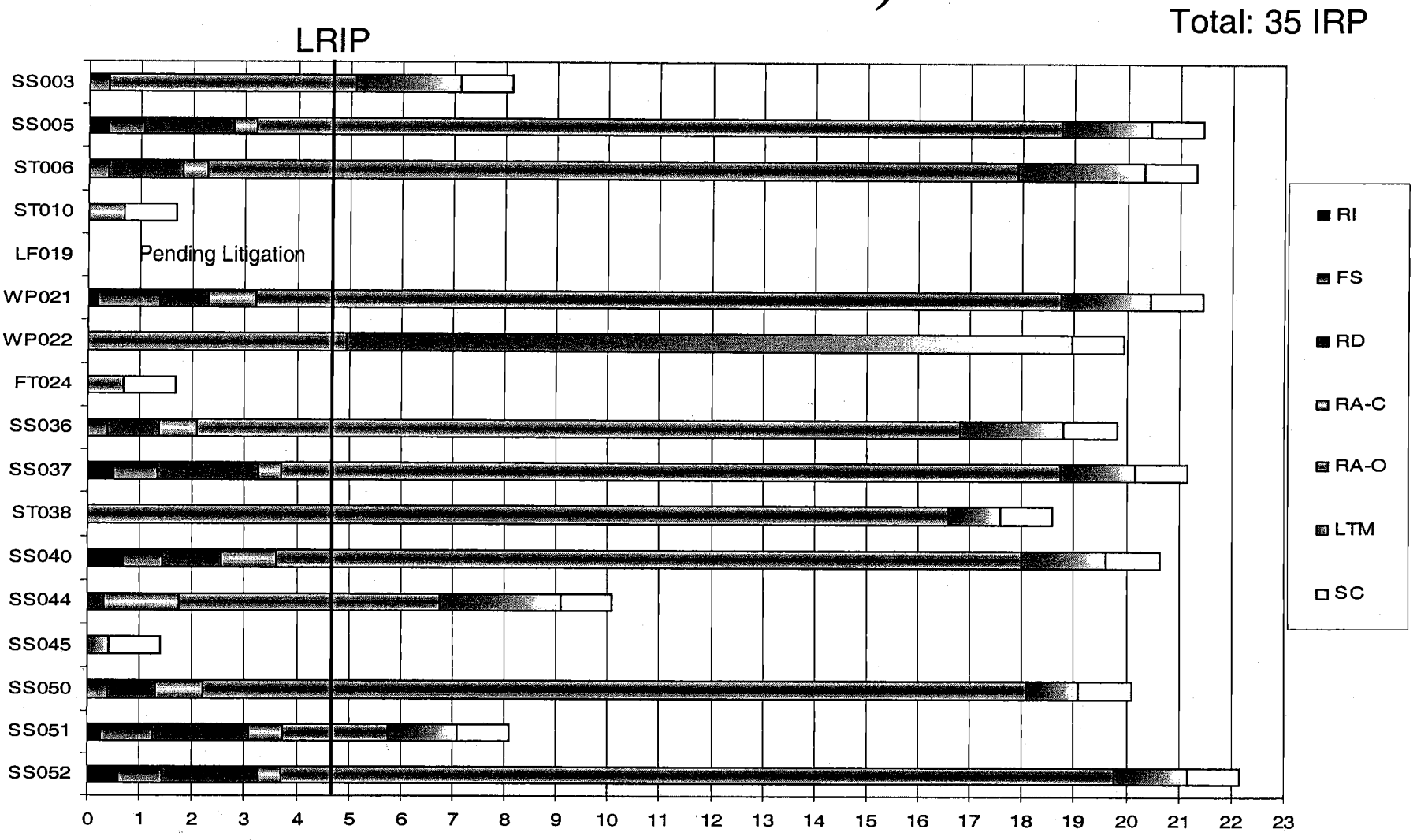
Requester: Mr. Pena

OPR: Mr. Buelter

Action: Provide a timetable.

Response: Timetables were mailed to Mr. Pena. (See attachments)

IRP Site Close-Outs (FY00 to Close-Out)



7 Sites closed by TNRCC: SS004, ST007, ST008, SS009, SS025, ST047 & ST048
11 Sites projected for SC in FY00 & FY01: SS002, SS028, SS030, SS031, SS032, WP033, WP034, SS039, SS042, ST046 & ST049

Current as of 14 April 2000

SCHEDULE TO COMPLETE

'80 '85 '90 '95 '00 '05 '10 '15 '20 '25 '30

STUDY '82-'00

CLEANUP '90-'04 ★ **Last Remedy in Place**

LONG TERM OPERATION **Five Year Reviews**

'00-'30

LONG TERM MONITORING **Site Closeout**

11 April 00 RAB Action Item/Response

Item: 10

Description: Are there any plans for a long-term study of former and present employees of Kelly AFB to determine if they were exposed to contaminants and display any symptoms.

Requester: Ms. Grybos

OPR: Capt. Sassaman

Action: Provide written response.

Response: At this time we do not have plans for such a long-term study. Based on their completed studies ATSDR does not consider it likely that current on-base exposures would result in negative health effects. However, ATSDR is continuing to study air emissions. ATSDR is looking at past and present air emissions at on-base locations where exposures may have occurred. ATSDR uses a refined model using historical air emissions to better evaluate the exposure conditions. They investigate the behavior of air emissions in the immediate vicinity of the sources. Decisions on what needs to be done will be made after ATSDR completes their studies.

Meeting Time: 6:30 p.m., Date: 17 Oct 2000
Location:_____,

Oct 2000

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Meeting Time:_____, Date:_____
Location:_____,

January 2000

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
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7	8	9	10	11	12	13
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28	29	30	31			

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE