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15 August 1997

Mr. James Colter (Code 1821/JC)
Northern Division, Naval Facilities Engineering Command
Mail Stop 82
10 Industrial Highway
Lester, Pennsylvania 19113-2090

RE: Contract No. N62472-92-D-1296, Contract Task Order No. 0074; Draft Remedial Decision Document, Navy Fuel Farm Facility, NASJRB Willow Grove;-Responses to Comments.

Dear Mr. Colter:

EA Engineering, Science, and Technology, Inc. is pleased to provide the following response to comments regarding the above referenced documents for the Navy Fuel Farm Facility at NASJRB Willow Grove. EA has received written comments from RAB member Eric Lindhult and former RAB member Alix Raushman. Attached is a copy of the comments; EA has assigned numbers to the comments to correspond with the response. EA's responses to the comments are given below. The response "comment noted" implies that EA agrees with the comment and the text will be changed accordingly.

Responses to Comments from Alix Rauschman dated 13 June 1997.

In general, the comments received from Alix Rauchman address a lack of detail in the report. A general response to these comments is that the Remedial Decision Document was not intended to be a compilation of previous investigations, but a brief summary of existing conditions and rationale for the proposed remedial technology for LNAPL recovery. The text has been revised to include additional references to refer the reader to previous documents for background information and rationale.

Based on investigations at the Navy Fuel Farm, it has been concluded that the source of the LNAPL is a release from Tanks 115 and 116. These tanks were subsequently taken out of service and removed. During the tank removal, visibly impacted surface and subsurface soil was removed. As a result of these initial investigations and the tank removal, the focus of the pilot study was to recover LNAPL rather than conducting additional site characterization.

As the site of a UST release, the Navy Fuel Farm is appropriately regulated by PADEP under the UST program. However, previous investigations indicate that non-petroleum constituents may be present at this site. Therefore, prior to transferring the Navy Fuel Farm from the IR Program to the state UST program, the EPA and PADEP have requested several additional soil and ground water samples be collected to confirm that non-petroleum related constituents are not present at the site.

This decision document is intended to address the remedy for the petroleum related constituents at the Navy Fuel Farm. Should the additional sampling indicate non-petroleum constituents are of concern, they will be addressed separately as part of the IR program.

Comment 1: Comment noted.

Comment 2: Comment noted.

Comment 3: The reader is referred to the *Final Work Plan for Pilot-Scale Testing of Free-Product Recovery and Aquifer Air Sparging at the Navy Fuel Farm Facility - NAS Willow Grove, EA Engineering, Science, and Technology, November 1993*, for detailed descriptions of the work scope. This document is available for review at NASJRB Willow Grove or at the information repository at the Horsham Municipal Building. The original scope of work included two phases, LNAPL recovery and source and residual hydrocarbon removal, as outlined in the document. A thorough description of pumping alternatives and the rationale for these systems is presented in the Work Plan.

Comment 4: Comment noted.

Comment 5: The reader is referred to the *Final Pilot Study Report for the Product Recovery Pilot System at the Naval Fuel Farm Facility, Naval Air Station Willow Grove, Horsham Township, Pennsylvania (EA, November 1996)* for a detailed discussion of pilot study activities and conclusions. This document is available for review at NASJRB Willow Grove or at the information repository at the Horsham Municipal Building.

Comment 6: The *Final Report, Site Inspection Studies at NAS Willow Grove, Horsham Township, Pennsylvania, Vol I, EA Engineering, Science, and Technology, May 1990*, contains a discussion of the ecological setting of the installation including identification of the potentially sensitive ecosystems. This document is available for review at NASJRB Willow Grove or at the information repository at the Horsham Municipal Building.

The site is located in the central portion of NASJRB Willow Grove. As depicted on Figures 2-2 and 2-3, an aircraft parking apron is located to the south. There are no buildings in the vicinity of the site in the west and south-west directions. The closest buildings are the aircraft hangers (Buildings 330 and 340) and the

National Guard offices (Building 345) to the north and north-east. These buildings are approximately 300-500 ft from the site. While these buildings have the potential to be sources in themselves, releases from Tanks 115 and 116 have been documented and the Navy Fuel Farm is the source for the LNAPL and dissolved phase petroleum hydrocarbons at this site.

Comment 7: Extensive information is not available detailing the fuel release that occurred in 1986. The amount of fuel released is not known. The utility trench is shown on Figure 2-4 located adjacent to the dry well near Building 81. The utility trench was being excavated as part of construction activities unrelated to environmental investigations. Therefore, questions about its effectiveness, size, etc. are not relevant. Between 1989 and 1991, the tanks were emptied and not in use, as stated in the third paragraph of Section 2.4 Most of the site investigations including the recently completed Pilot Study and the planned remedial action are a result of the discovery of LNAPL in this utility trench. Therefore, the cleanup of this "spill" is ongoing.

Comment 8: The drainage ditch is depicted on Figure 2-3 to the north of the existing Fuel Farm. Runoff from the aircraft apron and surrounding roads contributes to a majority of the flow of the ditch which flows to the northeast. Flow in this ditch is intermittent and is typically associated with runoff after a rainfall. The depth of the ditch is approximately 1-2 ft throughout the area. Soil sample locations at this site were based on results of a soil vapor contaminant assessment conducted during the Site Inspection studies.

Comment 9: Three new AST were installed as depicted in Figures 2-2 and 2-3. These tanks were never placed in use.

Comment 10: Several investigations have been completed at the Navy Fuel Farm including a Site Inspection, aquifer tests, and ground water sampling events. Based on these results, the petroleum hydrocarbons are the primary constituents of concern at the Navy Fuel Farm. However, during these investigations low concentrations of several non-petroleum related compounds were reported. As a result, and as stated in the text, an additional sampling event is warranted to confirm the absence non-petroleum compounds at the site. This is being done with the intention of transferring the site from the IR program to the State of Pennsylvania's UST/AST program. A summary of analytical results is presented in sections 2.5.1 and 2.5.2.

Comment 11: As stated in the text, the soil borings around building 340 were conducted "as part of an investigation to assess potential subsurface hydrocarbon contamination in areas planned for future construction". Boring locations are depicted on Figure 2-5.

Additional references have been added to the text. A comprehensive discussion of the sampling events and rationale is provided in these documents. Priority pollutant analysis have historically not been conducted at the site due to the original assessment that the site was a petroleum only site, based on the leaking fuel tanks. Samples were taken around Buildings 340 and 330 because buildings are located down-gradient of the site. Samples were collected prior to the initial construction to assess possible health hazards that may be encountered during the construction activities.

The regulatory guidance criteria are Pennsylvania guidance criteria and the reference will be added to the text.

Comment 12: Methylene chloride and 2-butanone are often associated with lab contamination. However, these compounds were not reported in the associated blanks.

Comment 13: A detailed discussion of the rationale for the sampling event is presented in the referenced document.

Comment 14: To characterize the ground water at the Navy Fuel Farm several ground water sampling events were conducted between 1989 and 1993. To ensure a cost effective site characterization, these sampling events were conducted in a phased approach. Additional references have been added to the text and a detailed discussion of the sampling events and rationale is provided in these documents. Based on the ground water sample results and the presence of LNAPL at the site, the Pilot Study concentrated on the recovery of LNAPL. The approach to site characterization and remediation of the Fuel Farm is consistent with regulatory requirements.

Comment 15: Comment noted. LNAPL was not observed in Well NFFW-19 during the June 1993 sampling event and this well was sampled.

Comment 16: The pilot study was conducted from March 1994 to October 1996. The corrective actions which occurred at the time of the releases included the removal of fuel from the tanks and the subsequent removal of the tanks. During the tank removals, surface and subsurface soil visibly impacted with fuel was also removed. The pilot study was initiated to evaluate remedial options and concurrently recover LNAPL, thereby accomplishing some remediation of the site.

The ground-water samples were collected from the influent of the pilot treatment system to assess system performance and carbon breakthrough, not to characterize the site.

Comment 17: Comment noted

Comment 18: This section is intended to be a risk evaluation and not a risk assessment. As stated in this section, the potential for human exposure to COPC is minimal. Because of its low yield the water table aquifer in this area could be considered as a Class III aquifer, however, for purposes of establishing remedial action objectives the Class II designation would likely be applied. The ecology of the installation is discussed in the *Final Report, Site Inspection Studies at NAS Willow Grove, Horsham Township, Pennsylvania, Vol I, EA Engineering, Science, and Technology, May 1990*. This document is available for review at NASJRB Willow Grove or at the information repository at the Horsham Municipal Building. As stated in the Decision Document, the ground water flow direction is to the north-northeast. The closest discharge point is to the ARE Detention Basin, approximately 2,000 ft away. No LNAPL has been observed seeping into this body of water and based on the dissolved concentrations observed at the Navy Fuel Farm it is unlikely that the ground water is adversely impacting the surface water. In addition, an existing ground water remediation system is located in the area of the ARE Detention Basin. This remedial system would be effective in treating impacted ground water from the Navy Furl Farm and prevent off-site impacts to the environment.

Comment 19: The Navy acknowledges that ground-water has been impacted at the site. However, the focus of the program has been to recover LNAPL. Data has been compared to guidance criteria and extensive risk assessments have not been conducted.

Comment 20: Visibly impacted surface soil was removed during the excavation and removal of the of the tanks. After tank removal, the area was regraded with fill dirt. Therefore, the collection of surface soil samples in this area would not be of value. Because the LNAPL and dissolved phase plume are transported in the subsurface, surface soil outside of the immediate vicinity of the tanks would not be expected to be impacted and collection and analyses of samples would not be cost effective.

Comment 21: See response to Comment 18. As stated earlier, the intention is to transfer this site from the IR program into the more appropriate PADEP UST program.

Comment 22: The Navy does not contend that the cause of the LNAPL at the Navy Fuel Farm is the water table fluctuations. This section states the presence of LNAPL in the wells is related to the ground-water elevation. Based on well gauging records it is also apparent that LNAPL is not present in the wells until the water table elevation drops into the fractured rock. This has contributed to EA's theory that the LNAPL is found in the fractured rock and becomes hydraulically isolated from the wells when the water table elevation is high. In addition, it is readily apparent that LNAPL and impacted ground water have moved off the Navy Fuel Farm site. Answers to the other questions put forth by the reviewer in this comment would provide useful information, however, a significant effort would be required to obtain this information. Sufficient information exists to select a remedial option for this site. Therefore, answering the questions raised would not be cost effective.

Comment 23: The reference should have been to Figures 4-1 and 4-2. This typographical error will be corrected.

Comment 24: Bioslurping is mentioned because it is a viable remedial alternative that was evaluated as part of the pilot study.

Comment 25: No response necessary.

Responses to Comments from Eric Lindhult dated 11 June 1997.

In response to the comments concerning the Sampling and Analysis Plan, EA has the following responses.

Comment 1: The different fractures have not been tested to assess which fractures contain the majority of the LNAPL or dissolved constituents. However, based on gauging results, the LNAPL is present in the wells when the water table elevation falls to the depth of the fractured rock. This depth is frequently near the bottom of the well, indicating that the well installation has not resulted in cross contamination. However, as noted in appendix F of the *Final Pilot Study Report for the Product Recovery Pilot System at the Naval Fuel Farm Facility, Naval Air Station Willow Grove, Horsham Township, Pennsylvania (EA, November 1996)*, the proposed recovery system does not include use of wells deeper than 35-40 ft deep because of the potential for cross contamination of the lower portion of the Stockton Formation which is used as a drinking water source.

During past investigations at the Navy Fuel Farm the wells were purged by pumping 3-5 well volumes and collecting a ground-water sample. The current SAP specifies low flow sampling techniques to be used for the upcoming sampling event. Except for the potential to generate less purge water, the low flow technique is not expected to be impacted by fracture recharge rate.

Comment 2: The LNAPL will be removed by the use of bailers and absorbent socks prior to sampling. With respect to cross contamination among wells after sampling these wells, the wells in which LNAPL is present will be sampled last. EA agrees that the presence of LNAPL is likely to result in a higher detection limit for non-petroleum constituents. However, samples collected from recovery well NFFW-2R during the pilot test indicated relatively low BTEX levels for a well with LNAPL (840 to 1,532 μg/L). As a result, and at the request of the regulatory agencies, wells containing LNAPL will be sampled in an effort to evaluate the presence or absence of non-petroleum compounds at this site.

Remedial Action Plan

In general the comments address the selection of the vacuum enhanced remedial technology over a two phase extraction technology (VE). EA agrees that two-phase VE would be a viable remedial alternative. The VE and vacuum enhanced approach recommended by EA are essentially the same, they just use different mechanical means. Both systems recover LNAPL, ground water and soil vapor. The difference is that the VE has less down well pumps and equipment. However, the VE system also requires an oil/water separator and a vacuum pump capable of pumping both liquids and vapors; usually a liquid ring pump. The capital costs of the liquid ring pump and oil/water separator for a flow rate of up to 45 gpm would exceed $100,000. EA estimates that the cost for the ground-water pumps, LNAPL pumps and associated controls is approximately $60,000. In addition, using the vacuum enhanced configuration allows the existing building and vacuum pump to be used. Other considerations which favored the use of the vacuum enhanced system is the increased potential for creating emulsions that would inhibit the separation process and would adversely affect the ground-water treatment process. As a result, EA has recommended the vacuum enhanced method of recovering LNAPL, ground water and soil vapor over the two-phase VE method.

Upon further review of the system during the design phase, the installation of additional recovery wells was determined not to be necessary. The treatment of the aqueous discharge with granular activated carbon prior to discharge to the sanitary sewer is a requirement of the NAS Willow Grove Department of Public Works.

In conclusion, EA agrees that two-phase vapor extraction would be a viable remedial alternative for the site. However, due to the dramatic fluctuations in ground-water pumping rates that have been observed during the pilot study, vacuum enhanced product recovery was the selected option. The decision was further substantiated by the incorporation of existing equipment into the proposed system.

Other editorial comments offered by Mr. Lindhult (in the form of marked up pages of the report) will be incorporated when they do not conflict with EA style format.

Please review these comment responses and contact me with any questions or comments.

Sincerely,

Carl G. Reitenbach, P.E.
CTO Manager

cc: S. Morekas
S. Dobson
29600.74

ALIX RAUSCHMAN 109 Rogers Road Furlong, PA 18925
215.794.9995

June 13, 1997

Jim Colter
Remedial Project Manager
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop #82
Lester, PA 19113-2090

Dear Mr. Colter:

Enclosed, please find my comments to the Remedial Decision Document (RDD) written by EA Science, Technology, and Engineering. Though I have quit the RAB board, I am happy to still comment on the NASJRB at Willow Grove.

Most EIS and other such reports fail to look at the overall site conditions such that there is a identification of contaminant fate and transport. Coupled with this is often an inaccurate assessment of environmental and human health risks. The manner in which I made comments for this reports was based on those facts; therefore, I have asked for some very detailed information that does not affect the proposed remedial action at the site, but does to pertain to the general information that needs to be reiterated during the process of site risk analysis and closure.

I am happy to help in the public comment phase of the Willow Grove cleanup and closure process. Since I have worked on several Superfund and other sites in regards to clean up procedures, it is from that experience that I make such forward comments.

Thank you for your time. Please call me 215-794-9995 with any questions

Sincerely,

Alix Rauschman
Freelance Consultant

June 13, 1997

To: James L. Colter
Remedial Project Manager

From: Alix J. Rauschman
RAB Member/Consultant

RE: Comments to the Remedial Decision Document for Remedial Action at the Navy Fuel Farm at the Naval Air Station Joint Reserve Base (NASJRB), Willow Grove, Pennsylvania.

Enclosed, please find comments to the aforementioned report as requested by you for NASJRB.

COMMENT #

Comments:

Section 1.1, Purpose.

1 State when the 32-month pilot study began and ended, instead of just having this information at the end of the report.

Section 1.2, Organization of the Report.

2 Section 3 is a brief summary of potential site risks, not a "qualitative evaluation of potential risks to public health and the environment..."

Section 1.3, Pilot Study Scope of Work.

3 Since this section does not describe the work plan activities or the scope of work, this section should go under a different heading like "Summarized Work Plan and Scope of Work," with the following subheadings: 1.31 Phase I-LNAPL Recovery; 1.32 Phase II-Source and Residual Hydrocarbon Reduction.

Describe the difference in pumping alternatives. What is the rationale for using these systems for waste removal in reference to long-terms alternatives for what the site will be used for in the future.

Section 1.3, Pilot Study Scope of Work, Phase I, second bulleted item.

4 The 'I' in 'installation' needs to be capitalized.

Section 1.3, Pilot Study Scope of Work, Phase II.

5 In the last section under "Activities conducted during the Pilot Study," conclusions of the following were not made:

Bullet 1: There was no description in the report as to the actual extent of contamination and whether monitoring well information provided an accurate assessment of actual contaminant migration.

Bullet 2: Actually the effectiveness or non-effectiveness of all of the alternatives were presented.

Bullet 4: The only mention of air monitoring was PID monitoring of the site whereby no measurements of air quality were discussed. The air treatment systems itself was not expounded upon.

Section 2.1 Site Setting.

6 The site setting is the most important part of the report. In order to evaluate the fate and transport of contaminants, it is important to get an idea of what could be impacted at least within a 1 mile radius of the site such as populations that drink groundwater or potentially sensitive environments such as wetlands or rivers. It is also important to specify whether the site has undergone hazardous ranking procedures if it pertains, thereby giving the reader a focus for the upcoming risk analysis and discussion of alternatives.

Please describe exactly, what surrounds the tank farm, for "several other base facilities" could mean anything. These base facilities could also be a potential point source of contamination.

Section 2.4 History of Fuel Storage and Product Releases at the Navy Fuel Farm, Paragraph 2.

7 More information needs to be given regarding the spill which occurred in 1986 including a map with spill location and possible boundaries of contamination. Such questions need to be answered such as:

1. How much fluid leaked from the tank(s)?
2. Where exactly was the utility trench that was excavated, how effective was it, and how large was the trench, and why was a trench excavated only to the west of the tanks?
3. What happened in 1986 to stop the spill, when was it stopped, and did the contaminants migrate off site?
4. What happened between 1989 and 1991 with these tanks if they were not emptied and removed?
5. Was the spill cleaned up? If not, why?

Section 2.4 History of Fuel Storage and Product Releases at the Navy Fuel Farm, Paragraph 3.

8 In March 1989, '... jet fuel was "emanating" from two patches of dead grass on the west side of Tank 115.' Change the word 'emanating' to 'seeping.'

There is no indication on the figures provided as to where the ditch on the north side of the site is located. Did contaminants actually flow across the site to the aircraft parking apron? Where exactly is the ditch and what type of ditch is it? Questions that need to be answered about the ditch are the following:

1. What type of ditch is it? How deep is it? Does it contain water that flows offsite?
2. Where does the ditch originate from, where does it travel to, and what direction does it go?
3. How deep is the ditch and what type of soil is in the ditch?
4. Why wasn't this ditch sampled during the soil sampling phase?
5. It the ditch filled with water on an intermittent basis or year round? What direction does water flow in the ditch?
6. Was the waste oil removed?

Section 2.4 History of Fuel Storage and Product Releases at the Navy Fuel Farm, Paragraph 4.
9 How many ASTS were installed and how many are in use?

Section 2.5 Comparison of Analytical Results to Regulatory Guidance Criteria.
10 Change VOC to VOCs.
Sentence 1:What years were the previous investigations, what were the conclusions of the investigations and why are more investigations warranted now?
Sentence 3:What investigation(s) were the VOCs encountered, and what how much was present?

Section 2.5.1 Soil Samples Paragraph 1.
11 Rewrite the first sentence to say 'In March 1989, EA was contracted by the NASJRB to perform the ___ (how many investigations were performed? This is not the first as suggested) sampling effort at the Navy Fuel Farm whereby a total of 24 samples were collected from 18 borings installed around Building 340. The investigation was recommended by (Governmental Institution) to assess the potential subsurface hydrocarbon contamination in areas planned for future construction.'

Explain the rationale for collecting samples around building 340 when the spills occurred in the Navy Tank farm. Where is the figure to show the sample locations?

Compare sampling results (data) from different sample years. There is no comprehensive discussion of investigations that took place at the Tank Farm nor an accurate history of sample data and sampling rationales. What was the rationale for not doing priority pollutant analysis. There could have been metals, VOCs, and other contaminants worth noting. Explain why samples were not taken around other buildings.

What are the 'guidance criteria' as described in the last sentence? How pertinent are they in comparison to other PA or Federal guidance?

Section 2.5.1 Soil Samples, Paragraph 2.
12 Explain whether or not methylene chloride and 2-butanone are considered present due to lab contamination in the sample.

Section 2.5.1 Soil Samples, Paragraph 3.
13 There is no explanation as to why sampling took place in 1991. The first two paragraphs should have summarized the general findings in order to allow for a rationale for needed sampling in 1991. The following questions need to be answered in this paragraph:

1. How many soil samples were taken, why and where? At what depth?
2. Why were soil samples taken if monitoring wells were installed?
3. Why weren't the samples tested for priority pollutants?

Section 2.5.2 Ground-Water Samples, Paragraph 1,2.
Explain why groundwater samples were collected over the five year span from 1989 to 1993. Where
14 were the samples were collected? Of the 23 groundwater samples collected prior to June 1993, what were the preliminary findings that would suggest further analysis? If the groundwater had contained anything significant, a review of the potential onsite risks plus a fate and transport model are important to characterize contamination patterns at the site. It may be possible that through

migration, groundwater may have taken contaminants away from the spill area, and in the process of depth fluctuation, deposited contaminants in other subsurface areas.

Groundwater samples contained benzene in excess of "guidance criteria." If LNAPL is present at such a level as to inhibit sampling at other monitoring well locations, why isn't there a discussion of what was done to mitigate the situation so that either a risk analysis could characterize the site as a hazardous waste facility which would warrant immediate remediation, or that the samples were taken despite the presence of LNAPL?

When sampling is not completed, then the site cannot be correctly characterized. On army base sites, where minimal impacts are reported, it is necessary that a full sample effort occur so that the data is complete.

Section 2.5.2 Ground-Water Samples, Paragraph 2.
15 This paragraph state that well 19 contained benzene at concentrations in excess of the guidance criteria. However, the last sentence states that well 19 was not sampled due to the presence of LNAPL. This discrepancy should be changed.

Section 2.5.2 Ground-Water Samples, Paragraph 3.
It is unclear when the pilot study took place and why it occurred after sampling efforts between
16 1989 and 1993 showed that the remedial actions discussed in the purpose of this report needed to occur at the time of the spills and not two years after the last sampling phase was completed. What was the rationale for collecting only seven samples. Where were the samples taken, at what depths, and at what time? There was a 1 year and two month difference between April 1995 and July 1996. What samples where taken at what time and why?

Section 3 Risk Evaluation, Paragraph 1.
17 The word 'wether,' needs and "h."

Section 3 Risk Evaluation, Paragraph 2.
If several COPCs exceeded guidance criteria in subsurface soil and groundwater, it is important to
18 describe the fate and transport of contaminants on- and off-site. Despite the fact that the groundwater is not a drinking water source, is the groundwater in that area potable Class I or Class II groundwater? Does groundwater migrate to any nearby ecological areas, such as the Neshaminy Creek, that could possibly be affected by groundwater contamination or by surface water runoff? What other wetlands or sensitive species live in the area? All of this can be referenced if mentioned in another document.

Section 3 Risk Evaluation, Paragraph 3.
19 This paragraph specifically states that groundwater is impacted, therefore justifying the need for further discussion of human health and environmental impacts.

Section 3 Risk Evaluation, Paragraph 4.
Surface soils are soils that migrate, therefore it is important to know what contaminants exist. What
20 is the rationale for not having sampled surface soil during any of the investigations? Surface soils need to be collected in conjunction with subsurface samples in order to examine the downward migration potential of surficial contaminants to lower soil strata and possibly, groundwater.

Section 3 Risk Evaluation, Paragraph 7.

In a situation where hazardous ranking is necessary to characterize a Superfund site for further 21 evaluation, discharge points only 2,000 feet, or less than ½ mile from the point of discharge can literally characterize the site as hazardous according to the scoring methodologies in hazard rank scoring. It is necessary to sample that point of discharge to determine fate and transport of contaminants.

Section 4.2 Occurrence and Distribution of LNAPL, Paragraph 1.

It is incorrect to state that the presence of LNAPL at the Navy Tank Farm are due to ground-water 22 elevations. Contamination has ceased on site. Therefore, it needs to be concluded as to whether or not LNAPL in the soil now is dissipated with the rise in groundwater, and whether it is stagnant during times of low groundwater. How much fluid migrates from the source of contamination each groundwater cycle? How many cycles are there? Since the Navy Tank Farm is 2 acres, and contamination has been encountered in a 4.6 acre area around the farm, it can be assumed that contamination may have gone off-site and that it had spread.

Section 4.2 Occurrence and Distribution of LNAPL, Paragraph 2.

23 This paragraph mentions figures 5-1 and 5-2, which are not present in this report.

Section 5.

24 Why is technique of bioslurping mentioned at this point when the method will not be considered for future use.

Section 6.

25 No Comment

Conclusions:

In general, there are a lot of holes in the data that suggest that the site has not undergone any correct form of characterization in terms of the whole site acting as source of contamination were the fate and transport of contaminants on-site to potential off-site sources is an area of concern. In terms of the report, there is a presentable explanation of the techniques of LNAPL removal and the rationale for choosing the vacuum-enhanced recovery method.

The fact that the sampling efforts are so inconsistent is a large problem because the fact that the site has contained significant contamination without immediate removal is a source of concern. The data for soils and groundwater is inconclusive in that it fails to demonstrate the migrational patterns of on-site contamination which is crucial in the determination of risks in the area of the Naval Base itself.

June 11, 1997

Mr. James L. Colter
Department of the Navy
Northern Division
10 Industrial Highway
Mail Stop # 82
Lester, Pennsylvania 19113-2090

Re: Navy Fuel Farm
NASJRB Willow Grove

Dear Jim:

Per your request, I reviewed the draft reports concerning the Navy Fuel Farm. Due to my schedule, I was only able to briefly review these reports at night. I am submitting some technical questions and comments concerning the reports. I must confess, probably due to the late hour of my review, that I had a difficult time reading the reports, do to the inconsistencies in the writing style, grammar, and technical writing presentation. I am including my once-through review for your information (some of the comments are a difference in style [e.g., 'greatest' vs. 'highest' concentrations], but I believe that most are common usage and presentation in technical environmental reports [e.g., VOCs]). Other problems, such as improperly labeled Figures and Tables, can be easily corrected.

I have two main areas of questions on the draft Sampling and Analysis Plan (SAP). (1) The SAP notes that flow through the upper bedrock formations are different (page 2-2). Has the different fractures been tested to determine which fractures contain the majority of the contamination and to evaluate if packers should be used to minimize cross contamination between contaminated and uncontaminated zones? How is this difference in recharge noted in the purging methods imployed for sampling? (2) The SAP states if LNAPL is encountered, groundwater will be sampled from below the LNAPL (page 3-5). How will this be accomplished without contaminating the samplng equipment when it passes through the LNAPL? What information do you anticipate obtaining from a well containing significant dissolved BTEX concentrations that could mask minute concentrations of other VOCs?

My review of the Remedial Decision Document indicated some problems with figures, such as Figure 2-4, which has wells in the wrong place, improperly sized tanks, and an errant North arrow. Figure 4-1 was not clearly labled and I am not sure what the scale and units should be for the product recovered.

The report indicates that groundwater recovery rates in the wells range from 2 to 15 gallons per minute (gpm). The conclusions noted that the large "fluctuations . . . [in the water table] makes maintaining the pump intake at the proper level very difficult' and that "vacuum-enhanced recovery did increase the amount of petroleum hydrocarbons recovered."

The evaluation of bioslurping, also known as two-phase vacuum extraction (VE), which simultaneous recovers soil gas and groundwater, noted that vacuum pumps are "limited to one atmosphere of [vacuum]" and it was not appropriate due to "the large water table fluctuations." I disagree with this conclusion and, based on the brief review of the report, believe that two-phase VE would be the most cost-effective remediation method for the site. This personal opinion is based on the belief that:

- Two-phase VE simultaneously recovers groundwater, soil gas, and LNAPL, thereby eliminating the need for product pumps, groundwater pumps, electrical conduits, etc.

- Existing wells can be used, so additional wells may not be required.

- Two-phase VE system can be designed to eliminate the impact of water table fluctuations. The inlet can be set near the bottom of the well or the fracture containing the majority of the contaminants, and never be moved, independent of the water table fluctuations.

- Two-phase VE can lift water from great depths, similar to residential jet pumps, especially if a priming technique is used.

- Two-phase VE can remove most VOCs from the recovered water stream, which may eliminate the need to use liquid-phase granual activated carbon (GAC) units prior to discharge to the onsite treatment system.

- Two-phase VE can target the contaminated fractures more effectively, yeilding very combustiable vapors for thermal treatment and reduced groundwater recover.

I have enclosed an article discussing two-phase VE and LNAPL recovery. Please feel free to call me at (215) 830-2059 if you have questions.

Sincerely,

Eric

Eric C. Lindhult, P.E.

CLEANING UP CLAY

ERIC C. LINDHULT
DANIEL A. KWIECINSKI

Using soil vapor extraction to remove volatile organic compounds from ground water and unsaturated soils can achieve faster and more complete cleanups, with reduced equipment costs, than conventional pump-and-treat remediation methods.

In recent years, more treatment options have been developed for pump-and-treat programs to improve efficiency and cleanup time, including two-phase vacuum extraction (VE) and multiphase VE, which treat both soil and ground water. A look at three sites where remediation contractors used two-phase extraction to clean volatile organic compound (VOC) contamination shows how these new systems expand recovery possibilities.

Dames & Moore, Willow Grove, Pa., codeveloped two-phase VE, a patented technology, in 1989 during a remediation program in clay of low hydraulic conductivity. Equipment used in two-phase VE is similar to conventional soil vapor extraction SVE. However, to remove air and liquid phases simultaneously, two-phase VE systems use wells screened in both the vadose and saturated zones. A greater vacuum is required to remove contamination and achieve hydraulic control in low-permeability soils at 20 ft below ground or deeper.

Low pumping rates and slow migration of dissolved contaminants in low permeability soil make it difficult for standard pump-and-treat systems to remove contamination in these formations. A two-phase VE system increases ground-water withdrawal rates by one order of magnitude and increases the recovery well's zone of influence. Tests in clay showed ground-water recovery increases from 0.3 gal./min with standard pumping to 4.1 gal./min with the two-phase VE. Zones of influence of ground-water extraction, measured by ground-water-table drawdown, is often detected more than 100 ft from a recovery well, significantly better than standard pumping.

Two-phase VE systems consist of a vacuum pump, a knockout pot to separate ground water and vapor, a knockout pot pump to remove ground water for treatment or discharge, and vapor treatment, if required. In addition, high vacuum systems use an effluent vapor demister/recirculation tank and a heat exchanger. Typically, ground water and soil vapor are transferred by the two-phase VE system to the knockout pot as water entrained in the vapor flow stream. Due to the vacuum and the surface area created when the water is atomized, a significant portion of the VOCs in the ground water enters the vapor phase during the extraction process. The two-phase VE system offers several advantages:

- Greater ground-water withdrawal rate and zone of capture.
- Simultaneous remediation of soil and ground water.
- Transfer of VOCs from the liquid to the vapor phase.
- Flexibility to adjust the vacuum on selected wells.
- Rapid evaluation of progress.
- Fewer wells and no downhole equipment.

In terms of cost, the two-phase VE system can be more cost-effective and require fewer wells and treatment equipment as well as shorter remediation time than conventional pump-and-treat systems.

MALL REMEDIATION

During a routine phase I environmental audit at a Midwestern shopping mall, subsurface soil samples revealed VOCs in soil borings near a former service station. Concentrations ranged up to 88.7 mg/kg total benzene, toluene, ethyl benzene and xylene BTEX, and 2,000 mg/kg total petroleum hydrocarbon (TPH).

We conducted investigations to estimate the extent of soil and ground-water contamination and evaluate remediation options. Due to the soil's low permeability, we selected two-phase VE as the remediation method.

Significant portions of the soil at the site contained total BTEX concentrations greater than 1,000 ppm. We detected greatest concentrations under the mall entrance road, indicating that the leading edge of the plume had migrated off-site.

Our ground-water analysis found two BTEX plumes, with concentrations as great as 27,400 μg/L, and a downward vertical component to the contaminant migration. We found a thin layer (less than 1 in.) of free product on the water in a shallow well. The plume followed ground-water flow in relatively impermeable, uniform clay. Our information estimated ground-water-flow velocity at 14 ft per year.

We evaluated several remediation technologies according to how well they removed BTEX components from ground water and the soil, minimized disruption to existing site uses, met discharge criteria for the local municipal sewer authority and state permits, and estimated cleanup times.

Plume depth and mall access ruled out excavation as an option. We eliminated bioremediation and air sparging because tight soils complicated delivery of air, nutrients and bacteria. Poor ground-water withdrawal rates eliminated pump-and-treat systems. SVE did not clean ground water.

Based on our experiences cleaning similar sites, we recommended two-phase VE to minimize site disturbance and remove subsurface ground water and soil vapors.

At start-up, the VE system operated on five extraction wells connected by an underground piping manifold. After several weeks of operation, the thin layer of free-

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product gasoline vaporized. We increased efficiency by shutting down different wells to allow the system to concentrate on areas of greatest contamination. We later connected two more wells to increase BTEX removal from the surrounding area.

A maintenance problem arose over clay that came up with the ground water, filling the knockout pot and creating voids near the recovery wells, and causing occasional localized subsidence around the wells.

During the initial 142 operating days, the decrease in total BTEX concentrations in the recovery wells ranged from 93% to greater than 99%. After approximately 500 days of operation, the greatest total BTEX concentration was 35 µg/L, which is less than the regulatory cleanup level for the site. The concentrations in most of the remaining monitoring and recovery wells were observed to be less than laboratory detection limits (5 µg/L). Our data indicates a greater than 99% reduction in BTEX concentrations.

Periodic vapor results were used to evaluate the quantities of BTEX and TPH recovered. In total, we recovered approximately 334 gal. of gasoline. Based on estimated influent concentrations, more than 90% of the BTEX components transferred from liquid to vapor phase by the VE system.

This $350,000 cleanup took 24 months to complete and is currently in postremediation monitoring.

MANUFACTURING FACILITY

At a contaminated former manufacturing facility, we discovered a subsurface dense nonaqueous phase liquid (DNAPL) composed of chlorinated organic solvent. The DNAPL was in the shallow overburden, perched on a dense silt lens below the location of the former underground solvent piping. We estimated the leak occurred more than 30 years earlier. Ground water in the shallow and deep overburden, as well as the bedrock aquifer, contained VOC concentrations greater than 10 mg/L.

Pumping tests of the silty soil in the shallow overburden indicated a limited ground-water yield of approximately 2–3 gal./min per well with a radius of influence of only 40 ft. An on-site bedrock production well, which has been in operation since the early 1950s, had a zone of influence larger than the 11 acre site and appeared to have minimized off-site migration of the VOCs. Its 100–200 gal./min pumping rate probably contributed to contaminant migration through formations to the well.

Crews installed closely spaced pneumatic pumps in the known free product as well as overburden wells of varying depth. We put in a VE system to remove VOC in the vadose zone and increase ground-water removal. Vapor-phase VOC collected and condensed as free product in an on-site steam-regenerable, vapor-phase, activated carbon system. The remedial system began operation in July 1994. In September 1995, we increased the vacuum to approximately 14 in. of mercury to operate the system as a two-phase VE system. Ground-water removal rates from the overburden increased, with approximately 12 gal./min being removed by the two-phase VE system.

> In terms of cost, the two-phase vacuum extraction system can be more cost-effective and require fewer wells and treatment equipment as well as shorter remediation time.

The system removed approximately 3–6 gal./day of VOCs from the recovered overburden and bedrock ground water. After the system began operating as two-phase VE, the VOC recovery increased to 10–25 gal./day (120–300 lb/day). We found that the two-phase VE system not only increased ground-water removal, but also removed residual DNAPL adsorbed in the soil matrix and exposed pockets of DNAPL perched on the dense silt. The recovery rate stabilized at approximately 10 gal./day of VOCs after six months of two-phase VE. Our use of two-phase VE in this application greatly enhanced the removal of DNAPLS from the subsurface compared to pump-and-treat or SVE technologies. We are considering upgrading the equipment to allow for a higher vacuum to be placed on the subsurface during this ongoing remediation.

A common approach to remediation of sites impacted with free product, contaminated soil and ground water is to treat each with separate technologies. The multiphase VE system increases hydrocarbon recovery, reduces equipment requirements and speeds remediation because of high vacuum pressure, which overcomes the relative permeability and viscosity effects associated with subsurface lithology, vapors and liquids. Multiphase VE is especially successful in lower permeability formations and with higher viscosity liquids.

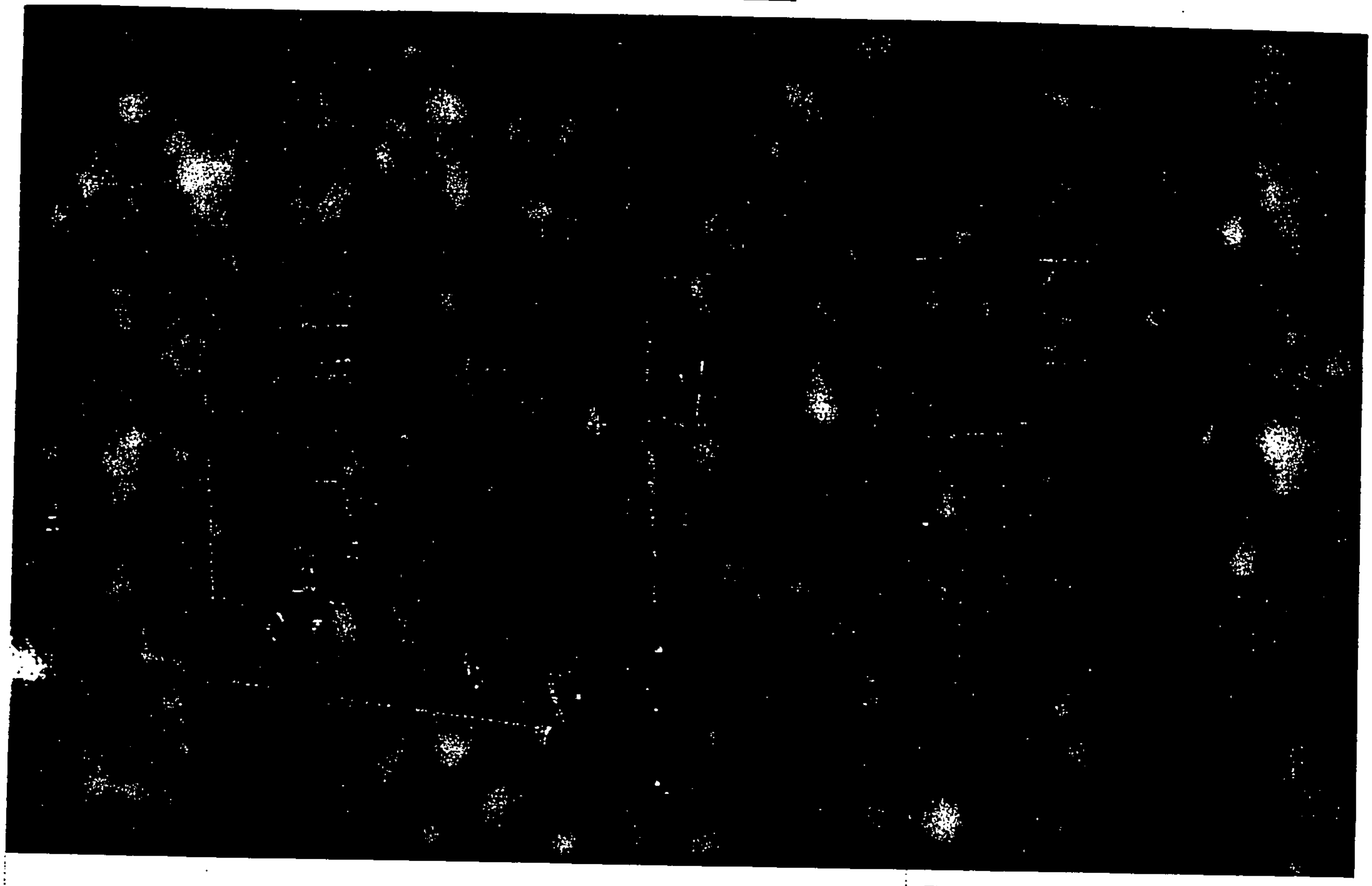
SHIP FUELING DEPOT

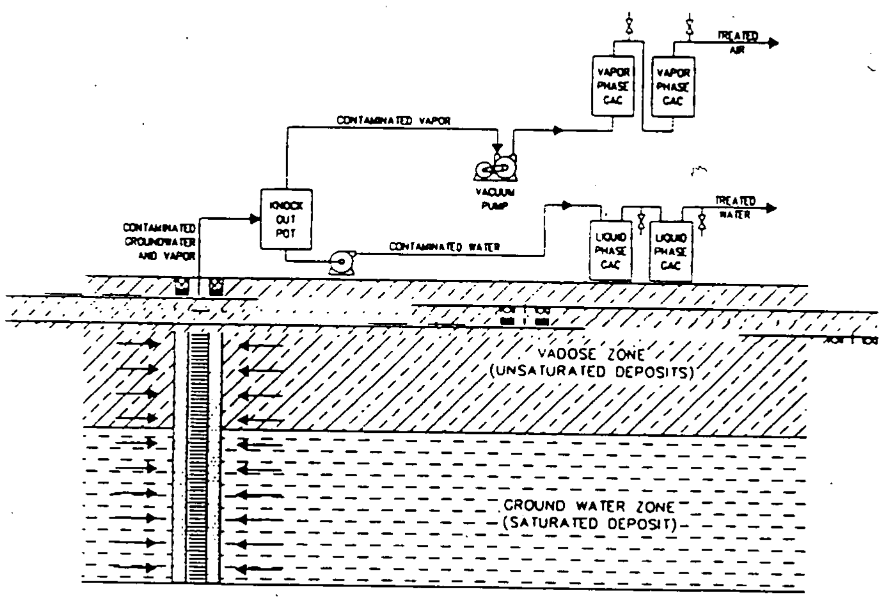
We are using multiphase VE to remediate free-phase diesel and impacted soils and ground water at a ship fueling depot on Red Fish Bay near Corpus Christi, Tex. operated by Tesoro Petroleum Distributing Co. Eleven fueling stations are positioned along a dock, comprising a steel bulkhead retaining wall backfilled with estuary-type sediments. The dock is approximately 8–10 ft higher than the bay water surface.

We observed hydrocarbon sheening on the bay waters during nonfueling events. Upon inspection of the bulkhead, crews observed diesel seeping through sheet-piling joints and corrosion pinholes. Spill crews deployed a 300 ft containment boom with sorbent media; however, tidal fluctuations, boat traffic and loading activities limited the boom's effectiveness. We left the boom system in place until we selected a more effective approach.

To confirm the source of the leak, we dug exploratory test pits during an expedited limited site assessment. Underground diesel piping was leaking. We installed soil borings and ground-water monitoring wells to assess the vertical and horizontal extent of contamination and found phase-separated hydrocarbons with variable product thicknesses, ranging from a sheen in one well to approximately 3 ft in another well. Our estimates placed the contaminated area at 300 by 75 ft. Diesel contamination in the soil extended to the ground-water surface, approximately 8 ft below grade. Ground water at the site is moderately saline.

The subsurface lithology included clays, silts and fine-grained sands. Soil borings suggested that this material was placed in compacted lifts with the predominant borrow material being silt. Field slug tests suggested that the hydraulic conductivity of the fill was approximately 10^{-5} cm/s. The ground-water flow ran toward the bay.





The two-phase vacuum extraction equipment can be portable. Diagram shows the layout of a two-phase system.

Again, we evaluated several remediation alternatives, including pneumatic product pumping, interceptor trench and drain system, ground-water pumping, excavation and multiphase VE.

Regulatory agencies stipulated that hydrocarbon sheening on the bay surface be stopped as soon as possible. Conventional pumping techniques recovered only 40 gal. of product in a week, with persistent hydrocarbon sheening.

We chose multiphase VE because of the performance history of two-phase VE. The system allowed facility operations to continue and minimized installation requirements. Crews installed system piping below grade outside of crane operating areas.

The system initially limited free-phase hydrocarbon concentrations to sheen in most wells. Only one well had a product thickness between 2 and 3 ft. We underestimated the volume of free-phase product, based on sheen thicknesses. Product stayed in pore spaces above the water table, adding to the overall in-place volume. Our initial product recovery ran greater than expected, with more than 600 gal. of diesel recovered in the first week.

During conventional recovery, product suspended in pore spaces above the water table would migrate to the water to be pumped from the aquifer. Multiphase VE accelerated recovery and tidal fluctuations did not affect it.

The multiphase VE on this project recovered more than 9,000 gal. of diesel since June 1993. Recovery decreased from the initial 600 gal./week to 10 gal./week. Sheening on the bay waters ceased, and the system does not hinder facility operations.

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