1D-00587

Technical Memorandum

Date: January 31, 1997

To: NSA Memphis, BRAC Cleanup Team

From: Larry Hughes, E/A&H

Re: PROPOSED FINAL FIELD INVESTIGATION; SWMU 7 and Apron Area Chlorinated Solvents in the Fluvial Deposits; Naval Support Activity Memphis, Millington, Tennessee

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Introduction

This memorandum proposes additional investigations needed to complete the investigation of the NSA Memphis apron area. The conclusions and proposed investigative approach in this document are based upon comments made by the BRAC Cleanup Team (BCT) at the meetings of 21-23 October and 16-17 December 1996, the meeting of 20-21 January 1997, and upon the data summary distributed 16 December to team members (*Summary of Results to Date and Proposed Action, SWMU 7...*, hereafter referred to as the "16 December memo"). The assumptions of this document are as follows:

1. There is a strong body of evidence that the Memphis aquifer is protected from downward migration of fluvial-aquifer contaminants in the vicinity of the apron area. Therefore the present concern is the fluvial deposits contamination.

2. The contaminant distribution and sources appear to be so complicated that full nature and extent of contamination cannot be reasonably determined.

3. If present, it is unlikely that free-phase DNAPL will be directly encountered even in focused drilling (Cherry, 1996; Cohen & Mercer, 1993). It is substantially less likely that all the numerous DNAPL sources possibly present in the apron area could be located as free-phase product.

4. There is no available technology which will reduce DNAPL mass sufficiently to achieve MCLs, even if the DNAPLs could be located (Ward, 1996; Cherry, 1996; Nelson et al., 1996).

5. Natural attenuation, in the forms of dispersion and bioattenuation, appears to be occurring in some areas at NSA Memphis.

6. Natural attenuation is the most viable alternative to the ineffective approach of DNAPL removal. If natural attenuation is demonstrated to be preventing off-base expansion of the plume, a network of point-of-compliance monitoring wells and a deed restriction preventing use of fluvial deposits water could be an effective way to achieve the goal of protecting the public health.

7. A final phase of investigation is needed to justify the suggested investigative approach and test the geochemical conceptual model upon which it is based; the model and proposed approach are outlined in this memorandum.

8. Following this final phase of investigative effort, the work will move directly to the corrective measures study phase.

Geochemical Conceptual Model

A geochemical conceptual model has been developed as a working hypothesis to explain the complex data collected to date (the data and reasoning processes were described at the last two BCT meetings and associated memos). The salient features of the model are:

1. Multiple sources and multiple plumes are present.

2. Plumes are stratified at different levels within the fluvial deposits.

3. Plume geometries vary with hydrologic circumstances; some are narrow and others fan-shaped.
4. Bioattenuation occurs at different rates across the property.

Figure 1 shows the plumes for the PCE-TCE-DCE contaminant group. Red plumes are for the upper fluvial deposits, blue for the lower fluvial deposits. The blue dots show the sampling control to date. Other plume maps, presented at the past three BCT meetings but not shown here, were prepared for the TCA and carbon tetrachloride contaminant groups.

The geochemical conceptual model is a reasonable but unproven hypothesis which needs confirmatory evidence. In particular, the downgradient extent of the plumes, their widths, stratification, and probable source types require testing.

Investigation Objectives

It is not the objective of this work to define nature and extent of all the plumes, including those that have yet to be identified, nor to find all the sources. Instead, the objective is to test the **key assumptions which will affect the success of the natural attenuation approach.** Accordingly, three main objectives are proposed for this phase of work:

1. Test the assumption that DNAPL is the most likely mechanism for creating the many lower-fluvial plumes theorized by the model. Although it is unlikely DNAPL will be found in free-phase form, it is possible that high dissolved-phase concentrations might be found, from which DNAPL could be inferred.

2. Test hypotheses concerning plume geometry, such as: are there truly multiple plumes?; how are the plumes stratified within the fluvial deposits?; are they narrow?; how far downgradient do they extend, i.e., how effective is natural attenuation?

3. Where would be the best positions for point-of-compliance wells and natural attenuation monitoring wells?

Tests are proposed for the two areas of highest contamination, located at hangars N-126 and N-6. At N-126, a north-south transect is proposed along the flow path representing the highest contamination found to date, the farthest northern extent of contaminants confirmed, and the least likely area for bioattenuation. As such, it represents a worst-case test of how far out the contaminants might be traveling, and whether or not they are contained by dispersive (i.e., non-biological) mechanisms of natural attenuation. The transect also occurs along postulated multiple source areas, making it a good test of the multiple-plume hypothesis. An east-west transect perpendicular to the flow path is also designed. The N-6 tests are proposed in the second worst area of known contamination in the apron area, where a UST source has been identified and where upgradient and downgradient information is inadequate.

Figures 2 through 4 show the proposed sampling points as a function of objective, keyed to the objectives outlined in Table 1. Figure 2 shows the DNAPL search locations. Two intersecting transects are designed to sample contaminants downgradient of the several possible source areas at and south of N-126; two transects are also proposed for N-6 downgradient of the two sources indicated there. Figure 3 shows the locations designed to confirm the conceptual model.

Figure 4 shows the locations which will help establish point-of-compliance wells and natural-attenuation monitoring wells. The looping transect (black line) connects the control points which may serve as point-of-compliance wells or the screening samples which will help guide the drilling of additional point-of-compliance wells. Some of these wells, once their positions at the outer fringe of the plumes is confirmed, may also serve as sensitive monitors of the effectiveness of natural attenuation over time.

Proposed Technical Approach

Based upon previous experience at NSA Memphis and discussions at the last three BCT meetings, it is proposed that all samples be obtained by Rotasonic drilling combined with direct-push sampling. Viability of this approach was partially demonstrated at a test conducted on 28 January at Point #4, although the ability to collect a suitable lower-fluvial deposits sample needs to be proven. Alternatives include previously discussed sampling with Geoprobe and Hydropunch.

If none of these approaches are successful, there are no known alternatives that would yield the same amount of information in a cost-effective manner. Thus, use of alternative technologies will likely result in a significant change in strategy. Possible alternatives include:

1. Passive soil-gas monitoring in grassy areas north of the Apron area (this would address only the point-of-compliance well location objective).

2. Conventional groundwater monitoring wells.

3. Multi-level monitoring wells.

The proposed technical approach addresses all three remaining objectives as follows:

1. Test the DNAPL mechanism. Ten sample points (Figure 2) will test for the presence of DNAPL in two likely source areas.

2. Test plume-geometry hypotheses. Eighteen proposed sample points (Figure 3) will test key assumptions of plume width, depth, etc.

3. Find positions for point-of-compliance wells and natural-attenuation monitoring wells (Figure 4). Six sample locations are planned to examine the edges of the two most significant plumes detected to date. This will optimize point-of-compliance well placement during the followup corrective measures study. The data should be sufficient to install a network of wells which monitors all downgradient positions with respect to the detected apron contaminants. Several existing wells could serve as a part of this network.

We propose to perform this final round of sampling and move directly to the corrective measures study phase of this project.

Table 1
Rationale For Proposed Sampling Locations
(Figures 2-4 show locations)
note: POC = point-of-compliance well

	Sampling Objectives						
	Find Source	**Test Conceptual Model**				**Find POC**	
Point	**Look for DNAPL**	**Test Multiple Plume**	**Test Strati-fication**	**Test Plume Width**	**Plume Extent & Test NAT**	**Best Well Loc.**	**Sampling Depth (UF=upper fluvial, MF=middle, LF=lower)**
				N-126 Hangar Area			
1	■		■				Every 5'; test for free-phase DNAPL
2	■	■	■				MF/LF; supplements existing UF data; suspected source area
3	■	■	■				MF/LF; supplements existing UF data; suspected source area
4							UF; compare Rotosonic test with nearby DPT data
5	■	■	■				UF/MF/LF; near possible source area(s) at N-126
6	■	■	■				UF/MF/LF; downgradient of possible source area(s) at N-126
7		■					LF
8				■	■	■	LF; points 8 & 9 ensure a narrow plume not missed by 007G010
9				■	■	■	UF/LF
10					■	■	UF/LF
11					■	■	UF/LF
				FORMER N-6 HANGAR AREA			
12	■	■	■	■			Every 5'; test for free-phase DNAPL; suspected source area (UST)
13	■	■	■	■			MF/LF; supplements UF data at 007G0035; suspected source area (weed control spraying)
14	■	■	■	■			UF/MF/LF
15	■	■	■	■			UF/MF/LF
16	■	■	■	■			UF/MF/LF
17					■	■	UF/LF
18					■	■	UF/LF

References

Cherry, J.A. (1996) Conceptual Models for Chlorinated Solvent Plumes and their Relevance to Intrinsic Remediation. Symposium on Natural Attenuation of Chlorinated Organics in Groundwater, USEPA, Dallas, p.29-30.

Cohen, R.M., and Mercer, J.W. (1993) DNAPL Site Evaluation. USEPA document.

Nelson, M.J.K., Udaloy, A.G., and Deaver, F. (1996) Development of an Intrinsic Bioremediation Program for Chlorinated Solvents at an Electronics Facility. Symposium on Natural Attenuation of Chlorinated Organics in Groundwater, USEPA, Dallas, p.146.

Ward, C.H. (1996) Introductory Talk: Where Are We Now? Moving to a Risk-Based Approach. Symposium on Natural Attenuation of Chlorinated Organics in Groundwater, USEPA, Dallas, p.1-3.

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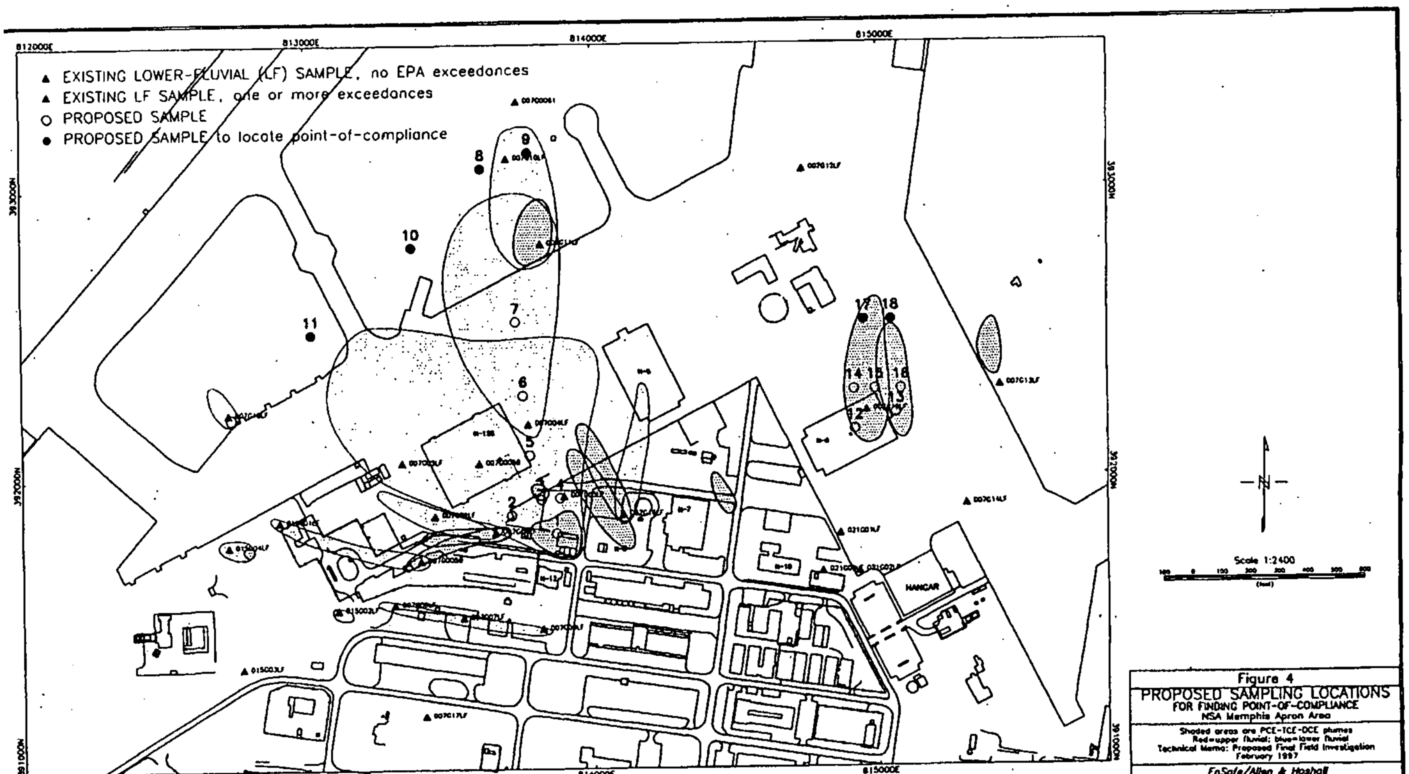

Figure 4
PROPOSED SAMPLING LOCATIONS
FOR FINDING POINT-OF-COMPLIANCE
NSA Memphis Apron Area

Shaded areas are PCE-TCE-DCE plumes
Red=upper fluvial; blue=lower fluvial
Technical Memo: Proposed Final Field Investigation
February 1997

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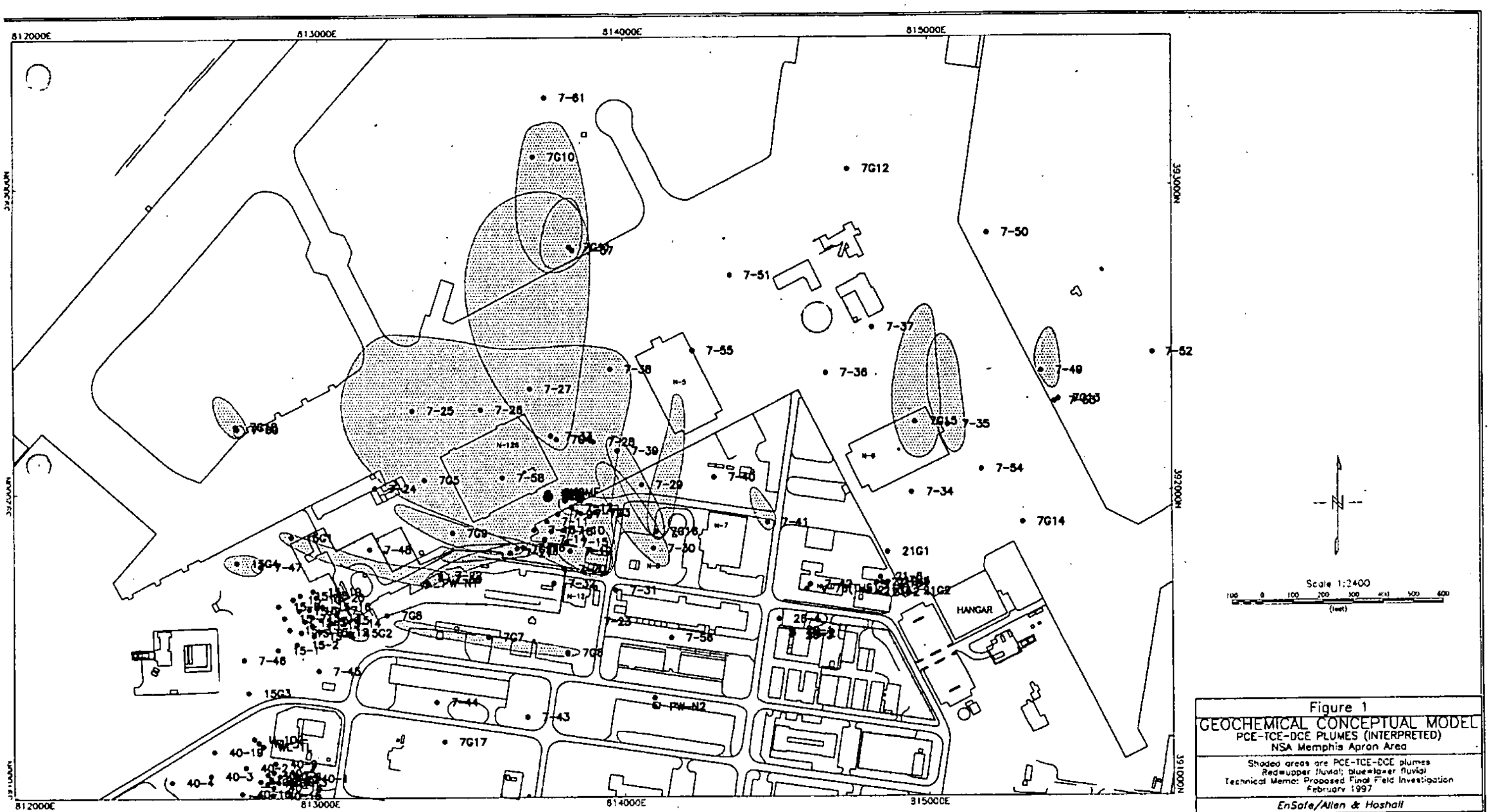

Figure 1

GEOCHEMICAL CONCEPTUAL MODEL
PCE-TCE-DCE PLUMES (INTERPRETED)
NSA Memphis Apron Area

Shaded areas are PCE-TCE-DCE plumes
Red=upper fluvial; blue=lower fluvial
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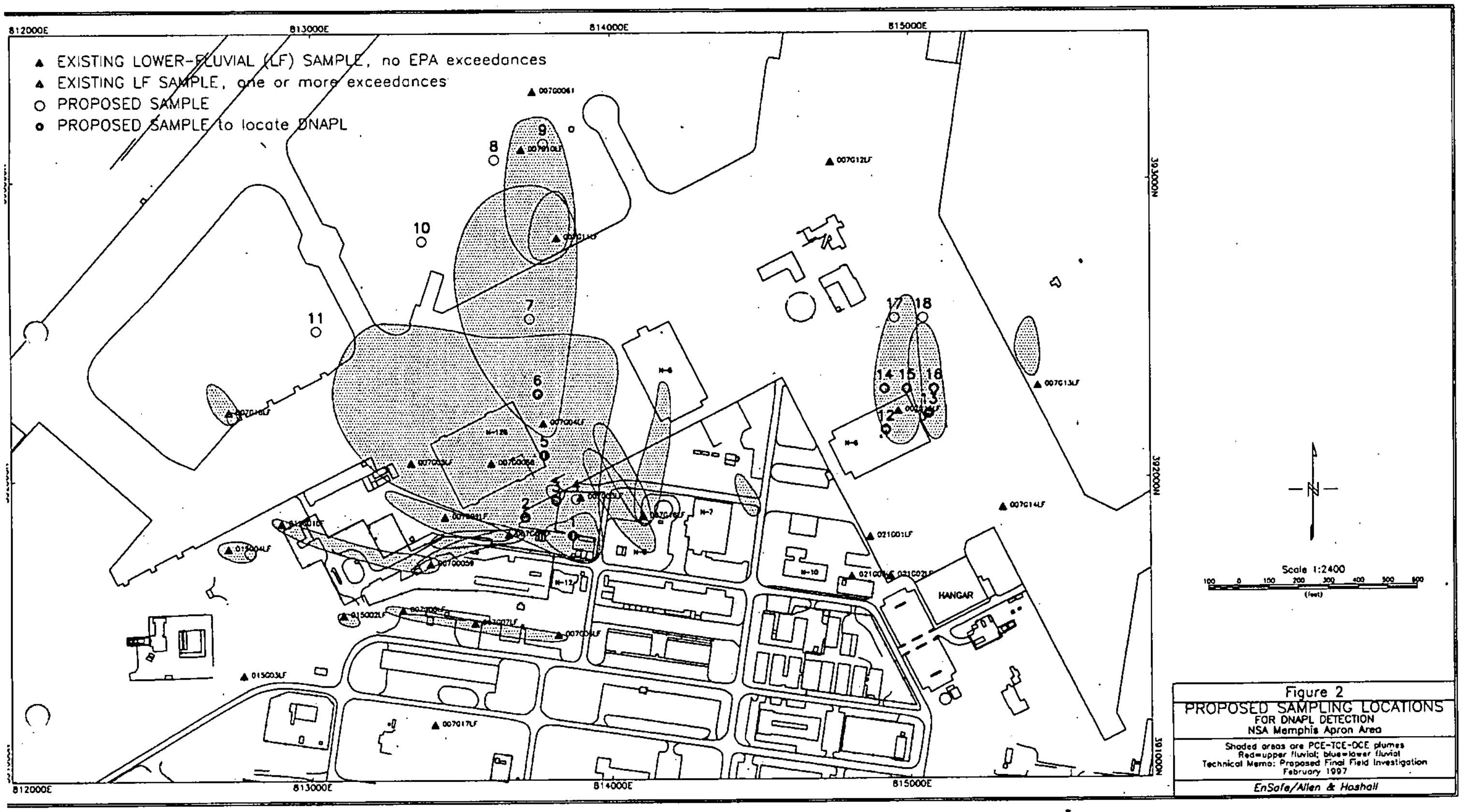

Figure 2
PROPOSED SAMPLING LOCATIONS
FOR DNAPL DETECTION
NSA Memphis Apron Area

Shaded areas are PCE-TCE-DCE plumes
Red=upper fluvial; blue=lower fluvial
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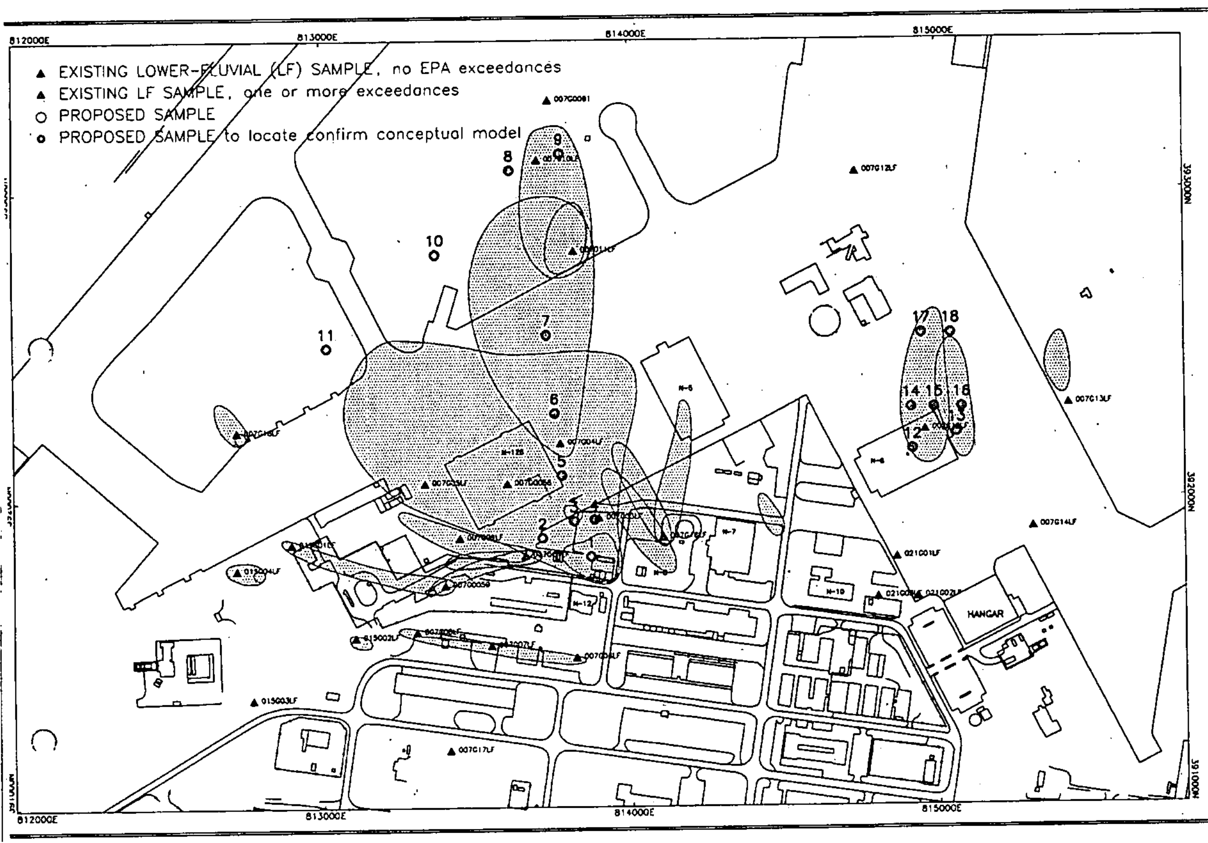

Figure 3
PROPOSED SAMPLING LOCATIONS
FOR CONFIRMING CONCEPTUAL MODEL
NSA Memphis Apron Area

Shaded areas are PCE-TCE-DCE plumes
Red=upper fluvial; blue=lower fluvial
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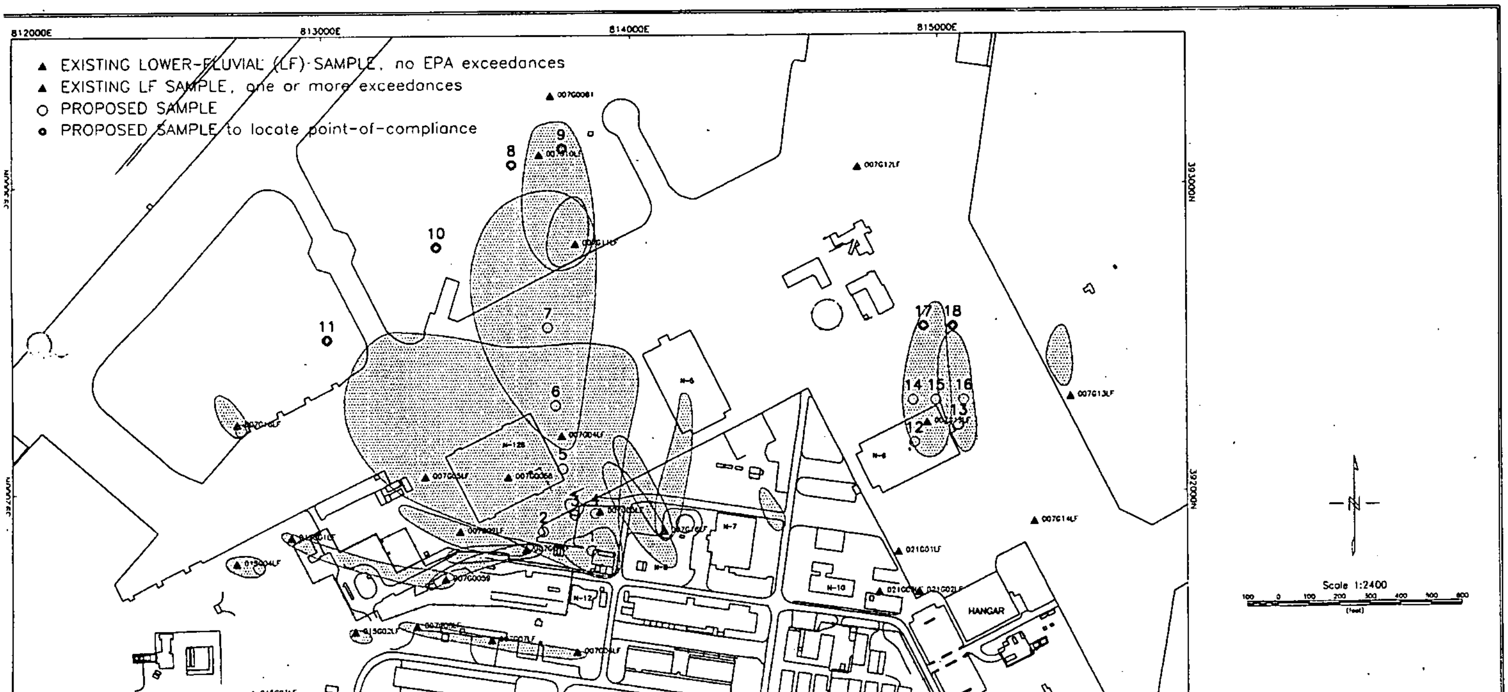

Figure 4
PROPOSED SAMPLING LOCATIONS
FOR FINDING POINT-OF-COMPLIANCE
NSA Memphis Apron Area

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