Health Consultation

Evaluation of Results from a U.S. Environmental Protection Agency
Investigation of Contaminants in Surface Soil near
Surface Water Drainage Ditches from Memphis Depot

MEMPHIS DEFENSE DEPOT (DEFENSE LOGISTICS AGENCY)
(a/k/a USA DEFENSE DEPOT MEMPHIS)

MEMPHIS, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TN4210020570

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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Prepared by:

Superfund Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

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Introduction

Statement of Issues, Background, and Findings

The Defense Distribution Depot, Memphis, Tennessee (DDMT) consists of 642 acres in a mixed residential/commercial/industrial area in south-central Memphis. The facility is made up of two adjacent sections: Dunn field, an open storage and burial area of about 60 acres, and the main installation. The Depot has conducted numerous operations with hazardous substances with contamination resulting from leakage, spillage, and disposal of out of date materials. Removal actions in 1998-99 excavated small volumes of lead and pesticide contaminated soil at the main installation.

During public involvement in the Public Health Assessment (PHA) process for the Depot by the Agency for Toxic Substances and Disease Registry (ATSDR), local residents indicated that there had been past instances where storm water in surface drainage ways from the Depot had overtopped the banks and flooded adjacent property [1]. This presents a potential migration pathway for hazardous substances, pollutants, or contaminants to have migrated from the depot and been deposited in these areas. ATSDR identified this as a data gap.

The U.S. Environmental Protection Agency (EPA) agreed to collect and analyze soil from areas near the Depot and adjacent to the drainage ways [2]. The purpose of EPA's sampling was to determine whether there may be a current risk of exposure from site-related contaminants in these predominantly residential areas.

In consultation with ATSDR staff, three areas of concern were identified: the Rozelle neighborhood, the southeast drainage ditches, and the Tarrent Branch [2]. These locations are displayed on Figure 1.

As indicated on Figure 1, samples were taken from ten locations in the southeast drainage area [2]. Eight of these ten samples were composites and the other two grab (discrete) samples. The grab samples were obtained just south of the Memphis Depot boundary in the drainage ditches near the intersections of Ball and Mullen Roads and Ball and Ketchum Roads. Four samples were collected from or near the ditch parallel to Mullen Road between Ball and Ketchum Roads. ATSDR staff observed children playing in and around this ditch in February 1999 [3].

In the Tarrent Branch area, one composite sample was collected in the area north of the drainage ditch and west of Sparks Road [2]. In the Rozelle area, four samples were collected. One linear composite sample was collected on the north side of the northernmost ditch in the Rozelle area and east of Rozelle Street. In addition, one linear composite and one discrete sample were collected from the area to the west of the southern end of Rozelle Street and adjacent to the southern-most ditch in the Rozelle area. Another composite sample was taken from this southern-most ditch a little west of Dunn Field. These sampling locations are also displayed on Figure 1.

benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dieldrin, and indeno(1,2,3-c,d)pyrene.

The next step is to calculate the exposure doses and cancer risk for these eight contaminants for the site-specific exposure scenario. Exposure doses, the amount of a contaminant that gets into a person's body, were calculated for children and adults using the following formula.

Dose (mg/kg/day) = C * IR * (EF/365) / BW

where C = the chemical concentration in milligrams per kilogram (mg/kg), IR = soil ingestion rate in kilograms per day (kg/d), EF = exposure frequency in events per year, and BW = body weight in kilograms (kg). For the initial evaluation of this situation, the mean chemical concentration for all the samples was used for C. The soil ingestion rates (IR) used were 0.0002 kg/d for a small child and 0.0001 kg/d for an adult. Body weight (BW) of 10 and 70 kg (22 and 154 pounds) for children and adults, respectively. These are the standard assumptions for ingestion rates and body weight used by ATSDR and EPA (4,5). An exposure frequency of 350 days a year was used.

The mean soil concentration was used in this situation because it represents the best estimate of what an individual might be exposed to over a long period of time [5,6]. Evaluation of maximum levels is appropriate when the concentrations are great enough so that one or two exposures to the maximum would result in health effects. The maximum concentrations in this sampling are far too low for this to happen.

These calculated exposure doses were then compared to an appropriate health guideline for that chemical. Health guidelines were available for arsenic and dieldrin, but not for the other six chemicals. Health guideline values are considered safe doses; that is, health effects are unlikely below this level. The health guideline value is based on valid toxicological studies for a chemical, with appropriate safety factors built in to account for human variation, animal-to-human differences, and/or the use of the lowest adverse effect level. The results of the comparisons of exposure doses for arsenic and dieldrin to their health guidelines are displayed in Table 2 on page 12.

For arsenic and dieldrin, the estimated child and adult exposure doses were less than the health guideline values. Therefore, exposures to arsenic and dieldrin are unlikely to cause a non-carcinogenic health effect. These toxicological values are doses derived from human and animal studies which are summarized in the ATSDR Arsenic and Dieldrin Toxicological Profiles (7,8).

The estimated risk of developing cancer from exposure to the eight contaminants above their comparison values (CVs) was calculated by multiplying the site-specific adult exposure dose by EPA's corresponding Cancer Slope Factor. The results displayed in Table 2 on page 12 estimate the maximum increase in risk of developing cancer after 70 years of exposure to the contaminant.

facilities which adjoin the southern end of this neighborhood.[2] The benzo(a)pyrene levels from the other two locations sampled in EPA's investigation were 1.2 and 0.25 ppm. These locations receive flow only from Dunn Field. Similar results were observed for the other PAHs identified in this investigation.

Conclusions

- It is very unlikely that there will be adverse health effects or excess risk of cancer due to exposure to the contaminants identified in the rest of the samples taken in EPA's investigation of three drainage areas near Memphis Depot. ATSDR identifies this situation as ***No Apparent Public Health Hazard***.

- The available evidence indicates that there are multiple sources for PAH contamination found at the end of Rozelle Street.

Public Comments

This public health consultation (PHC) was available for public review and comment at 3 locations in Memphis, Tennessee (the Cherokee Branch of the Memphis/Shelby County Public Library, the Memphis/Shelby County Health Department, and Memphis Depot Community Reading Room) from October 8, 2002 to March 15, 2003. The comment period for this document originally was October 8 to November 8, 2002. It was extended twice at the request of Mrs. Doris Bradshaw, President of DDMT- Concerned Citizen's Committee.

The public comment period was announced in local newspapers. The PHC was sent to members of DDMT-CCC; the DDMT Restoration Advisory Board (RAB); Memphis-Shelby County Health Department; Tennessee Departments of Environmental Conservation and Health; U.S. Environmental Protection Agency (EPA); DDMT; Defense Logistics Agency (DLA); and Department of Defense (DOD).

Comments were received from the Military Waste Cleanup Program at Hampshire College in Amherst, MA. They can be found in Appendix 3 beginning on page 18 along with ATSDR responses to them.

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[2] This conclusion is based on review of the maps of the drainage from Dunn Field and observations of the author of this report.

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3. Moore B. Site Visit to Memphis to attend Restoration Advisory Board (RAB), and evaluate surface water drainage. February 18-19, 1999. Atlanta, GA: Agency for Toxic Substances and Disease Registry (ATSDR). February 1999.

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8. ATSDR. *Toxicological Profile for Aldrin/Dieldrin. Update.* Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, TP-92/01. 1993.

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10. ATSDR. *Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Update.* Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service. 1995.

11. **CH2MHILL**. Memphis Depot - Dunn Field Remedial Investigation Report. Sections 1 - 18. Huntsville, Alabama: **CH2MHILL** under contract to the U.S. Army Engineering and Support Center. April 2002.

Appendix 1 - Tables

Table 1 - Contaminants above a Comparison Value (CV) in Surface Soil from Three Drainage Areas near Memphis Depot*

Contaminant	Range in Soil in mg/kg[1]	Mean in mg/kg[1]	Samples > DL[2]	Samples > CV	CV	CV Source
Arsenic	3.4 - 23	10	15/15	15/1[3]	0.5/20[4]	CREG[5]/EMEG[6]
Benzo(a)anthracene	ND - 20	2.8	13/15	5	0.9	EPA SSL[7]
Benzo(a)pyrene	ND - 20	3.2	13/15	14	0.1	CREG[5]
Benzo(b)fluoranthene	ND - 28	4.8	13/15	6	0.9	EPA SSL[7]
Benzo(k)fluoranthene	ND - 11	2	13/15	1	9	EPA SSL[7]
Dibenz(a,h)anthracene	ND - 0.59	0.25	4/15	4	0.09	EPA SSL[7]
Dieldrin	ND - 1.3	0.3	13/15	9/0[3]	0.04/3[4]	CREG[5]/EMEG[6]
Indeno(1,2,3-c,d)pyrene	ND - 15	2.1	13/15	4	0.9	EPA SSL[7]

* The source of these data are files provided to ATSDR by EPA in July 2001.
1 - mg/kg = milligrams per kilogram
2 - DL = detection limit
3 - The first number is the samples above the CREG and the second is samples above the EMEG.
4 - The first number is the CREG and the second is the EMEG.
5 - CREG = A cancer risk evaluation guide is the estimated contaminant concentration that would be expected to cause no more than one additional excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors (CSF).
6 - EMEG = A environmental media evaluation guide is estimated contaminant concentrations in a media where no chance exists for non-carcinogenic health effects to occur. The EMEG is derived from U.S. Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk level (MRL).
7 - EPA SSL = EPA's soil screening level is the estimated contaminant concentration in soil at which additional evaluation is needed to determine if action is required to eliminate or reduce exposure.

Appendix 2 - Figures

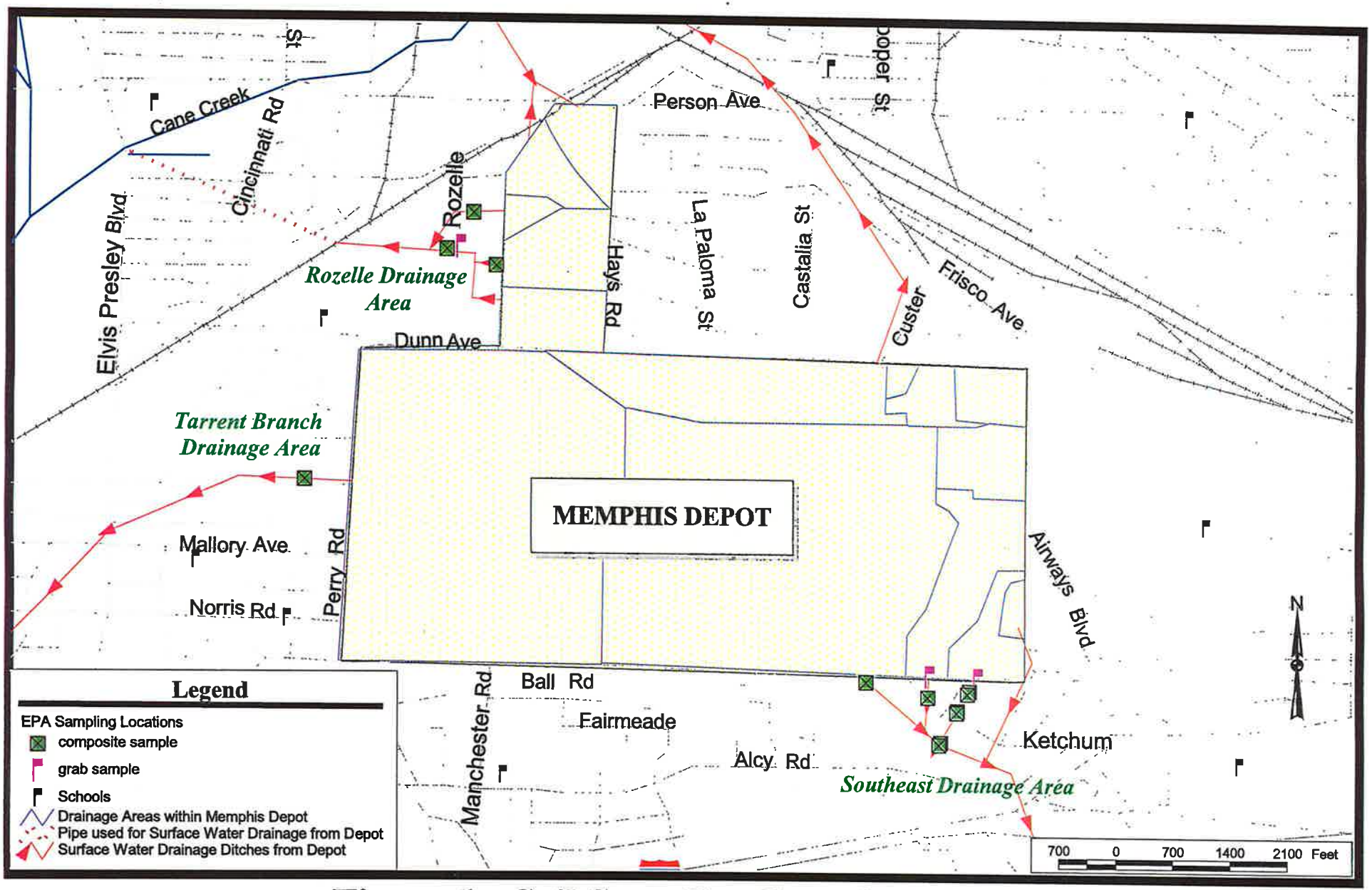

Figure 1 - Soil Sampling Locations in Three Drainage Areas around Memphis Depot

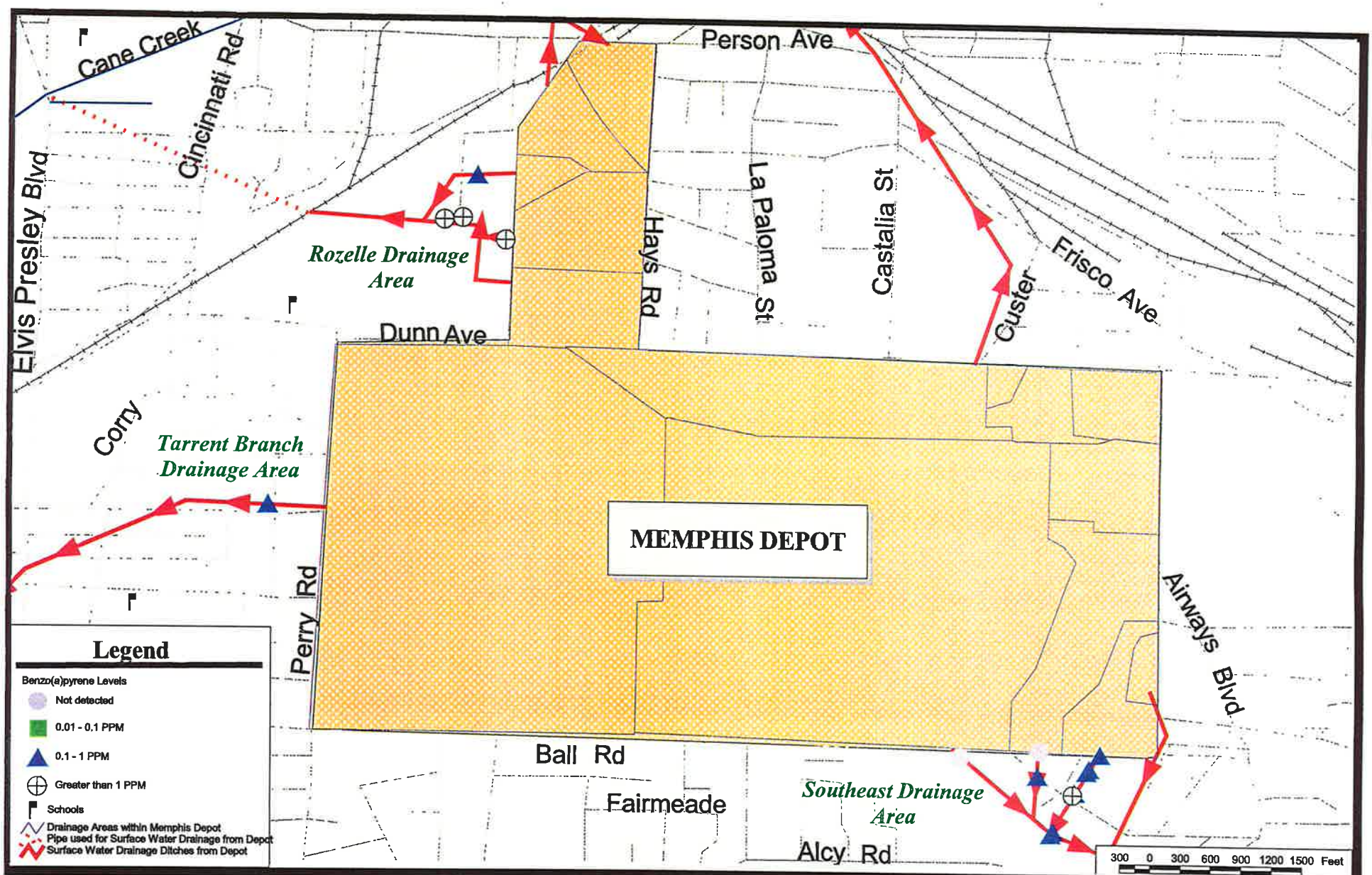

Figure 2 - Benzo(a)pyrene Levels in Three Drainage Areas near Memphis Depot

Appendix 3 – Public Comments

Public Comments

This public health consultation (PHC) was available for public review and comment at 3 locations in Memphis, Tennessee (the Cherokee Branch of the Memphis/Shelby County Public Library, the Memphis/Shelby County Health Department, and Memphis Depot Community Reading Room) from October 8, 2002 to March 15, 2003. The comment period for this document originally was October 8 to November 8, 2002. It was extended twice at the request of Mrs. Doris Bradshaw, President of DDMT- Concerned Citizen's Committee.

The public comment period was announced in local newspapers. The PHC was sent to members of DDMT-CCC; the DDMT Restoration Advisory Board (RAB); Memphis-Shelby County Health Department; Tennessee Departments of Environmental Conservation and Health; U.S. Environmental Protection Agency (EPA); DDMT; Defense Logistics Agency (DLA); and Department of Defense (DOD).

Comments were received from the Military Waste Cleanup Program at Hampshire College in Amherst, MA. They are listed below along with ATSDR responses to them.

Comment 1: This document is a public comment on the Public Health Consultation (PHC) by ATSDR of soil sampling and evaluation in the neighborhoods surrounding the Defense Depot Memphis Tennessee (DDMT) Superfund site. Since the PHC is based on the EPA "Field Sampling Investigation" SESD Project Numbers 01-0211, December 2000, some of the comments will also refer to that document. The third document that is relevant to the PHC is ATSDR's original work plan, referred to below. These three documents must be considered together to assess the PHC document.

On the Public Health Consultation, the first significant point we wish to make is that the original work plan as laid out in ATSDR's "Environmental Media Investigation Work Plan for the Defense Depot Memphis Tennessee Site (CR #40EC)," dated August 23, 1999, seemed like a well-reasoned and thorough plan, responsive to some of the community concerns. However, this plan was apparently not followed completely in the EPA "Field Sampling Investigation" SESD Project Numbers 01-0211, December 2000. Specifically, the ATSDR work plan called for soil vapor gas sampling and exposure pathway investigation, but this does not appear to have been done. Considering newly emerging information on the vapor gas intrusion pathway and solvent contamination, we believe that soil vapor gas and pathway should be examined. Because of the lack of the vapor gas pathway analysis, this PHC is not a complete, multi-route assessment of the impact of the contaminants potentially affecting the health of the community. Additionally, calling for soil vapor gas analysis suggests an underground plume, however, there is no reference to such a plume in the PHC. According to the EPA Federal Facilities Fact Sheet on DDMT: "the [Dunn Field] RI report identified significant source areas for the VOC contamination seen in ground water both on- and off-site." [a] Is there a plume beneath the sampling areas? What kinds of chemicals are contained within the plume?

400 groundwater samples taken in the Dunn Field area. The groundwater plume was detected offsite southwest, west, northwest, and north of Dunn Field. Concentrations of VOCs ranged from less than 0.0001 mg/L to 33 mg/L. Nine chlorinated hydrocarbon compounds were the chemicals most frequently detected in this plume. These 9 were 1,1,1,2-PCA, CCl4, 1,1,2-TCA, chloroform, PCE, cis- and trans-1,2-DCE, total 1,2-DCE, and TCE. It was concluded in this report that, "Since contamination has been detected in selected offsite wells, indoor air exposures are the most pertinent exposure pathway. Risks through this pathway to the offsite residents are well within the acceptable limits, presenting negligible risks…"

ATSDR has reviewed this document and concurs with its conclusion about indoor air exposures. Our review of this issue included an evaluation of EPA's use of the Johnson-Ettinger to analyze vapor intrusion. ATSDR found the use of Johnson-Ettinger was valid. In addition, we found that the results of this modeling, based on the large amount of pertinent data available, made unnecessary the flux sampling proposed by ATSDR in 1999.

Comment 2: A second comment on the sampling that underlies this PHC is the fact that the EPA Field Sampling Investigation report claims that in reference to the drainage ditch running parallel to Mullen Road: "Field observations indicated that the ditch had been recently excavated prior to the initiation of the sampling investigation." This brings into question the usefulness of these samples to the investigation. Were samples able to be gathered from undisturbed locations in the ditch?

Response

The answer to this concern can be found in the EPA Field Sampling Investigation report. As indicated in the sentences that follow the above quote from EPA's report, the EPA investigators took samples from outside of the ditch and from an area of the ditch that had not been excavated. In addition, the report indicated that this area was subjected to considerable overflow which would maximize the amount of contamination. The pertinent sentences from the report are "Additional composite samples were taken outside of the ditch adjacent to each of the bottom samples. One sample, not discussed in the study plan, was collected adjacent to the ditch on the facility side of Ball Street. This area was selected because it appeared it had not been recently excavated. This location, DDE-SE07, also was likely to be inundated in the event of a ditch-overflow situation."

Comment 3: It would be useful to know how the exact sampling locations were determined. Were these areas that the community reported received overflow from the drainage ditches, and thus are suspected "hot spots"? Was there any statistical or other sampling regimen used in determining what locations to test? How were the number of samples to be taken determined?

Guidelines, or on the EPA Cancer Slope Factors. As a result of this analysis, only benzo(a)pyrene was found to have a risk factor higher that 1 in 10,000.

Our first comment on this approach is that ATSDR has established Guidelines[b] for the assessment of chemical mixtures. These guidelines state that "further evaluation of additivity and interactions is necessary for components with risks > 1 x 10^{-6}." It appears that in Table 2 several of the PAHs (and arsenic and dieldrin) have cancer risk factors above this level. Additionally, PAH concentrations were apparently higher for the Rozelle sites and therefore a separate analysis was then conducted for this site. Again, although the report only discusses B(a)P cancer risk for the Rozelle site (the report indicates that it "slightly exceeded 1 in 10,000"), we wonder if the other PAHs at Rozelle would have been above the suggested cutoff of 1 x 10^{-6}, thereby qualifying them for a mixtures or additive assessment. It would be helpful if there were some explanation as to why no consideration was given to an evaluation of these chemicals as a mixture.

Response

*ATSDR has yet to finalize its **Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures** so it was not appropriate to use it in this PHC. The web reference provided by the commenter is to the draft document.*

Comment 6: Since the Rozelle neighborhood is the site for B(a)P exposures, and ATSDR has looked at the Rozelle sampling results separately, we would like to see a table showing each sample and each analysis (e.g., calculated dose compared to Health Guideline or cancer risk) from Rozelle independent from the other sampling sites. We are also curious about how the means for the Rozelle B(a)P samples were calculated. According to the document, the mean for one of the samples was calculated using five times the concentration of a 5-point composite sample (which had a soil concentration of 12 ppm) added to the grab sample (with a concentration of 20 ppm) and divided by 6. Is this a standard technique? Had the sample with 20 ppm received more weight would the calculated cancer risk have more than "slightly exceeded the action level of 1 in 10,000"?

Response

The technique used to calculate the BAP concentration in the Rozelle area was used so that that the grab sample (20 ppm) would be given "more weight". Both ATSDR and EPA calculate cancer risk based on either mean levels or the 95% confidence level of the mean rather on a single data point. This better represents the exposure an individual would receive during a chronic or long-term exposure. Typically, the grab sample would be excluded from an evaluation. Incidentally, the calculated risk for the 13.3 ppm BAP level used by ATSDR is 1.3 in 10,000. The calculated risk for 20 ppm identified in the grab sample is 2 in 10,000.

Comment 7: Although the report does appear to consider children's exposure (and as noted by ATSDR, children would be more likely exposed, given their tendency to play in such ditches) –

animal data indicates that the actual risk of cancer is actually much lower than the calculated number. Therefore, ATSDR does not believe that additional sampling is justified.

Comment 10: ATSDR's comments that "it is unlikely that Dunn Field was the only source for the benzo(a)pyrene..." seems inappropriate and unrelated to ATSDR's mandate to protect human health of the residents of these neighborhoods. Since B(a)P has been found in the Dunn Field site, it must be considered as a potential source of the contamination.

Response

Whatever the source, the BAP concentrations found in the Rozelle area do not represent a public health risk.

Comment 11: Thank you for the opportunity to comment on this Public Health Consultation.

Response

You are welcome.

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[a] http://www.epa.gov/swerffrr/ff/DDmemphis.htm

[b] "Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures," ATSDR, February 2001.

[c] E.g., http://www.atsdr.cdc.gov/toxprofiles/tp69-c2.pdf