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Health Consultation

University of Texas at El Paso (UTEP) Soil Sample Results

EL PASO COUNTY METAL SURVEY

EL PASO, EL PASO COUNTY, TEXAS

EPA FACILITY ID: TX0000605388

AUGUST 24, 2001

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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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EL PASO COUNTY METAL SURVEY

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Prepared by:

Texas Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

Previously, at the request of the U.S. Environmental Protection Agency (EPA), the Texas Department of Health (TDH) and the Agency for Toxic Substances and Disease Registry (ATSDR) reviewed historical data collected in the El Paso area by the Texas Air Control Board in 1989 and by University of Texas at El Paso (UTEP) graduate students in 1993 and 1994. TDH and ATSDR concluded that additional samples were needed to confirm the results of the historical data [1]. EPA collected confirmation samples from various locations in the El Paso, Texas, and Sunland Park, New Mexico, area. Based on the results of the confirmation sampling, TDH and ATSDR suggested that the nature and extent of the contamination on the UTEP campus should be better characterized [2]. EPA collected soil samples from various locations on the UTEP campus and asked TDH and ATSDR to determine the public health significance of the lead and arsenic found in soil.

DISCUSSION

The environmental sampling data that we reviewed for this consultation were collected from the UTEP campus on August 3, 2001. Zero to 1 inch and 0 to 6 inch samples were collected from various locations on the campus. These locations included the bike and dune trails, the soccer and baseball fields, apartments, North Kidd field, Memorial Triangle, Jack C. Vowell Hall, the Geosciences building, Leech Grove, the Liberal Arts building, the Engineering building, the daycare facility, and the library. All samples were analyzed for lead and arsenic.

Combining all the samples from the UTEP property, the concentration of lead in the 0 to 1 inch samples ranged from less than 3.0 milligrams per kilogram (mg/kg) to 1,400 mg/kg, with an arithmetic average concentration of 237 mg/kg [Figure 1]. The concentration of arsenic in the soil ranged from less than 3.0 mg/kg to 51 mg/kg, with an arithmetic average concentration of 8.8 mg/kg [Figure 2]. Looking at the samples by area, the average concentration of lead ranged from 5 mg/kg at the soccer and baseball fields to 727 mg/kg at Leech Grove (Table 1). The average concentration of arsenic at the various locations ranged from less than 3.0 mg/kg to 29.3 mg/kg (Table 1).

Public Health Implications

Lead

We evaluate the public health significance of lead in soil by estimating the potential impact that it may have on the blood lead levels of potentially exposed populations. For this consult we considered potential exposure to adults (UTEP students, faculty, and staff), children, and the developing fetus (of adult females that frequent the campus). In general, lead in soil has the greatest impact on preschool-age children as they are more likely to play in dirt and place their hands and other contaminated objects in their mouths. They also are better at absorbing lead through the gastrointestinal tract than adults and are more likely to exhibit the types of nutritional deficiencies that facilitate the absorption of lead. While lead in soil also can have an impact on adults and the developing fetus (through maternal exposure), the potential impact on these populations is low compared to the potential impact on young pre-school age children.

The Centers for Disease Control and Prevention (CDC) has determined that a blood lead level ≥10 μg/dL in children indicates excessive lead absorption and constitutes the grounds for intervention [3, 4]. While there is no clear relationship between soil lead and blood lead applicable to all sites, a number of models have been developed to estimate the potential impact that lead in soil could have on different populations [5–7]. For children, the predicted 95th percentile blood lead level associated with a soil lead concentration of 500 mg/kg is approximately 10 μg/dL. This means that except in the most extreme cases (i.e., frequent contact by children exhibiting pica behavior, or desire for unnatural foods such as dirt or ashes) children regularly exposed to soil lead levels of 500 mg/kg should have no more than a 5% probability of having blood lead levels greater than 10 μg/dL. Based on the goal of limiting the probability of exceeding a blood lead level of 10 μg/dL to no more than 5%, depending on individual exposure situations, the concentrations of lead in soil where children might have regular contact should be less than 500 mg/kg. Exceeding this value should not be taken to imply that the contaminant will cause harm but does suggest that it warrants further consideration.

Critical blood lead levels for adults are less well established. The Occupational Safety and Health Administration (OSHA) recommends that workers whose blood lead levels exceed 40 μg/dL should have medical evaluations, and workers whose blood lead levels exceed 60 μg/dL be removed from the exposure. In Texas workers, blood lead levels greater than 25 μg/dL must be reported to TDH. For UTEP students, faculty, and staff, we used the same goal of limiting the probability of exceeding a blood lead level of 10 μg/dL to no more than 5 percent.

The average concentration of lead in the soil exceeded the 500 mg/kg screening value for children at three locations; Leech Grove (727 mg/kg), Memorial Triangle (664 mg/kg), and Jack C. Vowell Hall (658 mg/kg). As a college campus, it is unlikely that young (pre-school age) children would regularly come into contact with soil from these areas. The one area where children could regularly come into contact with soil, the daycare facility, had an average soil lead level of 110 mg/kg, a level that does not pose a risk to children. Based on the predicted impact that lead in soil can have on adults and the developing fetus [7], it is not likely that the lead found in the soil at these locations would have a significant affect on blood lead levels. The probability that students, faculty, and staff who regularly ate soil from the area with the highest concentration would have a blood lead level ≥10 μg/dL would be less than 1 percent. For the developing fetus, exposed in-utero through the mother, the probability would be approximately 2 percent. Additionally, any potential risks are further reduced by the presence of grass which limits the potential for exposure to the soil (Figures 3–7). Based on these data we would not anticipate the lead in the soil to present a public health hazard to any of the potentially exposed populations.

Arsenic

To assess the potential health risks associated with the arsenic in the soil, we compared the soil concentrations to health-based screening values specific to arsenic for children and adults. These screening values represent levels in the soil that are considered safe for human contact. Exceeding these screening values does not imply that a contaminant will cause harm, but suggests that potential exposure to the contaminant warrants further consideration.

The screening value that we used for arsenic in soil (20 mg/kg) is based on a child exposure scenario and EPA's reference dose (RfD) for arsenic of 0.3 µg/kg/day [8]. RfDs are based on the assumption that there is an identifiable exposure threshold (both for the individual and for populations) below which there are no observable adverse effects. Thus, the RfD is an estimate of a daily exposure to arsenic that is unlikely to cause adverse non-cancer health effects even if exposure were to occur for a lifetime. For arsenic, the RfD was derived by dividing the identified no observable adverse effects level (NOAEL[1]) of 0.8 µg/kg/day, obtained from human epidemiologic studies, by an uncertainty factor of three. The lowest observable adverse effects level (LOAEL[2]) associated with these epidemiologic studies was 14 µg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [8–10]. We used standard assumptions for body weight (15 kg) and soil ingestion (200 mg per day for a child) to calculate the screening value.

The average concentration of arsenic exceeded the screening value for children at four of the sampling locations–the Bike and Dune Trail (29.3 mg/kg), Memorial Triangle (24.2 mg/kg), Jack C. Vowell Hall (20.8 mg/kg), and Leech Grove (22 mg/kg). Because UTEP is a college campus, it is unlikely that young children would regularly come into contact with soil at any of these locations. The one area where children could regularly come into contact with soil, the daycare facility, had an average soil arsenic concentration of 2.3 mg/kg, a level that does not pose a risk to children. Based on estimated exposures, it is not likely that adults who regularly ate soil from any of these areas would experience adverse non-cancer health effects. Students, faculty, and staff who regularly (everyday) ate 100 mg of soil, from the area with the highest average concentration, would receive a daily dose approximately 7 times lower than the RfD, 19 times lower than the NOAEL, and 334 times lower than the LOAEL. Additionally, any potential risks are further reduced by the presence of grass, which limits the potential for exposure to the soil (Figures 3–7).

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[1]The highest dose at which adverse effects were not observed.

[2]The lowest dose at which adverse effects were observed.

EPA also classifies arsenic as a known human carcinogen based on sufficient evidence from human data. An increase in lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer (non-malignant) were observed in populations consuming water high in inorganic arsenic [8]. We used EPA's cancer slope factor (CSF) for arsenic to estimate the potential increased lifetime cancer risks associated with exposure to arsenic in soil from each of these locations, for both students (four years of exposure) and faculty/staff (30 years of exposure). Qualitatively, we would classify these as no apparent increased risk to an insignificant increased risk (Table 2). Based on these data, we would not anticipate the arsenic in the soil to present a public health hazard to any of the potentially exposed populations.

Uncertainties

General Uncertainties

In preparing this report, we relied on the information provided and assumed adequate quality assurance/quality control (QA/QC) procedures were followed with regard to data collection, chain-of-custody, laboratory procedures, and data reporting. The analysis and conclusions in this report are valid only if the referenced information is valid and complete.

The most likely routes of exposure to the contaminants found in the soil are ingestion (eating the soil) and inhalation (breathing in the soil as windblown dust). Based on the information available for this consult, we would not anticipate the inhalation of windblown dust to be a major contributor to exposure, even though windblown dust may be common in El Paso. The concentrations are generally low and would not result in any significant loading of the air with contaminants. Additionally, the presence of the ground cover further reduces the potential for contaminants in the soil to partition to the air. Air samples reviewed in the previous consultation suggested that the air was not a major exposure pathway at this time [2].

In order for exposure to the contaminants to occur through ingestion, the soil must be physically available. The screening values that we used in this consult assume that the soil is available and that such physical barriers are not present. The presence of the grass in the areas with the highest average concentrations reduces the likelihood that exposure will occur. Individual behavior patterns also are important in assessing risk. The amount of soil that a person eats, how often they eat the soil, and the average concentration of the contaminant in the soil that they eat all are important factors in determining potential public health implications. For this consultation we used assumptions that in most instances overestimate potential exposures.

Specific Uncertainties

There is considerable controversy with respect to assessing potential risks associated with exposure to arsenic. Both the RfD and the CSF are based on human ecological studies that have recognized uncertainties with respect to the assignation of exposure. Such studies find it difficult to avoid errors in assigning people to specific exposure groups. The studies upon which the RfD and the CSF are based also involved exposure to arsenic in drinking water. The ability of the body to absorb arsenic in water is likely higher that the ability of the body to absorb arsenic in soil. In our analysis, we assumed that the arsenic in the soil was 100% absorbed. Assuming that the applied dose (the amount available for absorption) is the same as the internal dose (the amount that has been absorbed), is conservative and, to some unknown extent, over estimates the risk. We also did not consider the kinetics of arsenic in the body in our risk estimates. The RfD and the CSF are based on daily exposures over a lifetime. Since the half-life (the time it takes ½ of the absorbed arsenic to be excreted) is short (40-60 hours), the risk estimates for exposures that occur less frequently than every day also may result in an overestimate of the risks.

With specific respect to the cancer risk estimates, the mechanisms through which arsenic causes cancer are not known; however, arsenic is not believed to act directly with DNA. Since the studies used to derive the CSF are based on exposure doses much higher than those likely to be encountered at this site, it is questionable whether it is appropriate to assume linearity for the dose-response assessment for arsenic at low doses. The actual dose-response curve at low doses may be sublinear, which would mean that the risk estimates in this consult overestimate the actual risks.

ATSDR's Child Health Initiative

We recognize that the unique vulnerabilities of children demand special attention. Windows of vulnerability (critical periods) exist during development, particularly during early gestation, but also throughout pregnancy, infancy, childhood and adolescence–periods when toxicants may permanently impair or alter structure and function [8]. Unique childhood vulnerabilities may be present because, at birth, many organs and body systems (including the lungs and the immune, endocrine, reproductive, and nervous systems) have not achieved structural or functional maturity. These organ systems continue to develop throughout childhood and adolescence. Children may exhibit differences in absorption, metabolism, storage, and excretion of toxicants, resulting in higher biologically effective doses to target tissues. Depending on the affected media, they also may be more exposed than adults because of behavior patterns specific to children. In an effort to account for children's unique vulnerabilities, and in accordance with ATSDR's Child Health Initiative [9] and EPA's National Agenda to Protect Children's Health from Environmental Threats [10], we used the potential exposure of children as a guide in assessing the potential public health implications of the contaminants.

CONCLUSIONS

1. Although the average concentrations of lead and arsenic in soil from several locations on the UTEP campus exceed their respective soil-based screening values for children, this is a college campus and these are areas that are not likely to be frequented by pre-school age children. Based on estimated exposures, it is not likely that other potentially exposed populations, including UTEP students, faculty, and staff, would experience adverse health effects associated with the contaminants found at any of the locations sampled. Potential exposures at the locations with the highest concentrations are further reduced by the presence of grass, which decreases the likelihood of exposure to the soil. Based on available information, we have concluded that the lead and arsenic found in the soil do not pose a public health hazard to any of the potentially exposed populations.

2. The concentrations of lead and arsenic in soil from the daycare facility were well below their respective health-based screening values for children. Thus, the contaminants in the soil from the daycare facility do not pose a public health hazard.

3. Qualitatively, we estimate the potential excess lifetime cancer risk associated with exposure to arsenic in soil from the UTEP campus to range from an insignificant increased risk to no apparent increased risk.

PUBLIC HEALTH ACTION PLAN

Actions Recommended

1. Appropriate environmental health education and risk communication should be provided to any interested parties.

REFERENCES

1. Agency for Toxic Substances and Disease Registry. Health Consultation: Review of historical soil sampling results El Paso County Metal Survey Site, El Paso, El Paso County, Texas. Texas Department of Health. July 20, 2001.

2. Agency for Toxic Substances and Disease Registry. Health Consultation: Heavy metals confirmation sampling El Paso, El Paso County, Texas–Sunland Park, Dona Ana County, New Mexico. Texas Department of Health. August 2001.

3. Centers for Disease Control. Preventing lead poisoning in young children. U.S. Department of Health and Human Services; October 1991.

4. Agency for Toxic Substances and Disease Registry. The nature and extent of lead poisoning in children in the United States: a report to Congress. Atlanta: U.S. Department of Health and Human Services; 1988.

5. U.S. Environmental Protection Agency (USEPA). Memorandum from Mark Maddaloni, chair, technical review workgroup, adult lead subgroup to Pat Van Leeuwen, region 5 Superfund program use of the technical review workgroup Interim Adult Lead Methodology in Risk Assessment, April 1999.

6. Agency for Toxic Substances and Disease Registry (ATSDR). Analysis paper: Impact of lead-contaminated soil on public health. U.S. Department of Health and Human Services; May 1992.

7. Society for Environmental Geochemistry and Health. 1993. Lead in soil, recommended guidelines. Science Reviews.

8. U.S. Environmental Protection Agency. 2000. Strategy for research on environmental risks to children. Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-00/068, Section 1.2.

9. Agency for Toxic Substances and Disease Registry (ATSDR). Child health inititative. Atlanta: U.S. Department of Health and Human Services; 1995.

10. U.S. Environmental Protection Agency. The children's environmental health yearbook; 1998.

Table 1. University of Texas at El Paso Soil Sampling Results (average concentrations for 0-1 inch samples by location)[1]

Location	No. of samples	Lead (mg/kg)	Arsenic (mg/kg)
Bike and dune trails	12	339	29.3
Soccer and baseball	9	5	<3.0
Apartments	5	23	<3.0
North Kidd field	22	121	5.45
Memorial Triangle	12	664	24.2
Jack C. Vowell Hall	7	658	20.8
Geosciences	4	370	2.0
Leech Grove	8	727	22
Liberal Arts	6	143	<3.0
Engineering	6	102	<3.0
Daycare	17	110	2.3
Library	8	22	<3.0

[1] Values reported as below detection limit were taken as ½ the detection limit to compute the average.

Table 2. Estimates of potential excess lifetime cancer risk associated with exposure to arsenic in soil. University of Texas at El Paso

	Faculty / Staff		Students	
Location	**Quantitative[1]**	**Qualitative**	**Quantitative[2]**	**Qualitative**
Bike and dune trail	1.4×10^{-5}	no apparent	1.9×10^{-6}	insignificant
Soccer and baseball area	$<1.4 \times 10^{-6}$	insignificant	$<1.9 \times 10^{-7}$	insignificant
Apartments	$<1.4 \times 10^{-6}$	insignificant	$<1.9 \times 10^{-7}$	insignificant
North Kidd Field	2.6×10^{-6}	insignificant	3.5×10^{-7}	insignificant
Memorial Triangle	1.2×10^{-5}	no apparent	1.5×10^{-6}	insignificant
Jack C. Vowell Hall	9.9×10^{-6}	no apparent	1.3×10^{-6}	insignificant
Geosciences building	9.5×10^{-7}	insignificant	1.3×10^{-7}	insignificant
Leech Grove	1.0×10^{-5}	no apparent	1.4×10^{-6}	insignificant
Liberal Arts building	$<1.4 \times 10^{-6}$	insignificant	$<1.9 \times 10^{-7}$	insignificant
Engineering building	$<1.4 \times 10^{-6}$	insignificant	$<1.9 \times 10^{-7}$	insignificant
Daycare	1.1×10^{-6}	insignificant	1.5×10^{-7}	insignificant
Library	$<1.4 \times 10^{-6}$	insignificant	$<1.9 \times 10^{-7}$	insignificant

[1] Based on an estimated 30 years of exposure, 9 months per year, 5 days per week.

[2] Based on an estimated 4 years of exposure, 9 months per year, 5 days per week.

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CERTIFICATION

This health consultation was prepared by the Texas Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

Lisa C. Hayes

for Chief, State Programs Section, SSAB, DHAC, ATSDR

Figure 1. Distribution of Lead in Soil from the University of Texas at El Paso
(0 to 1 inch samples and 0 to 6 inch samples)

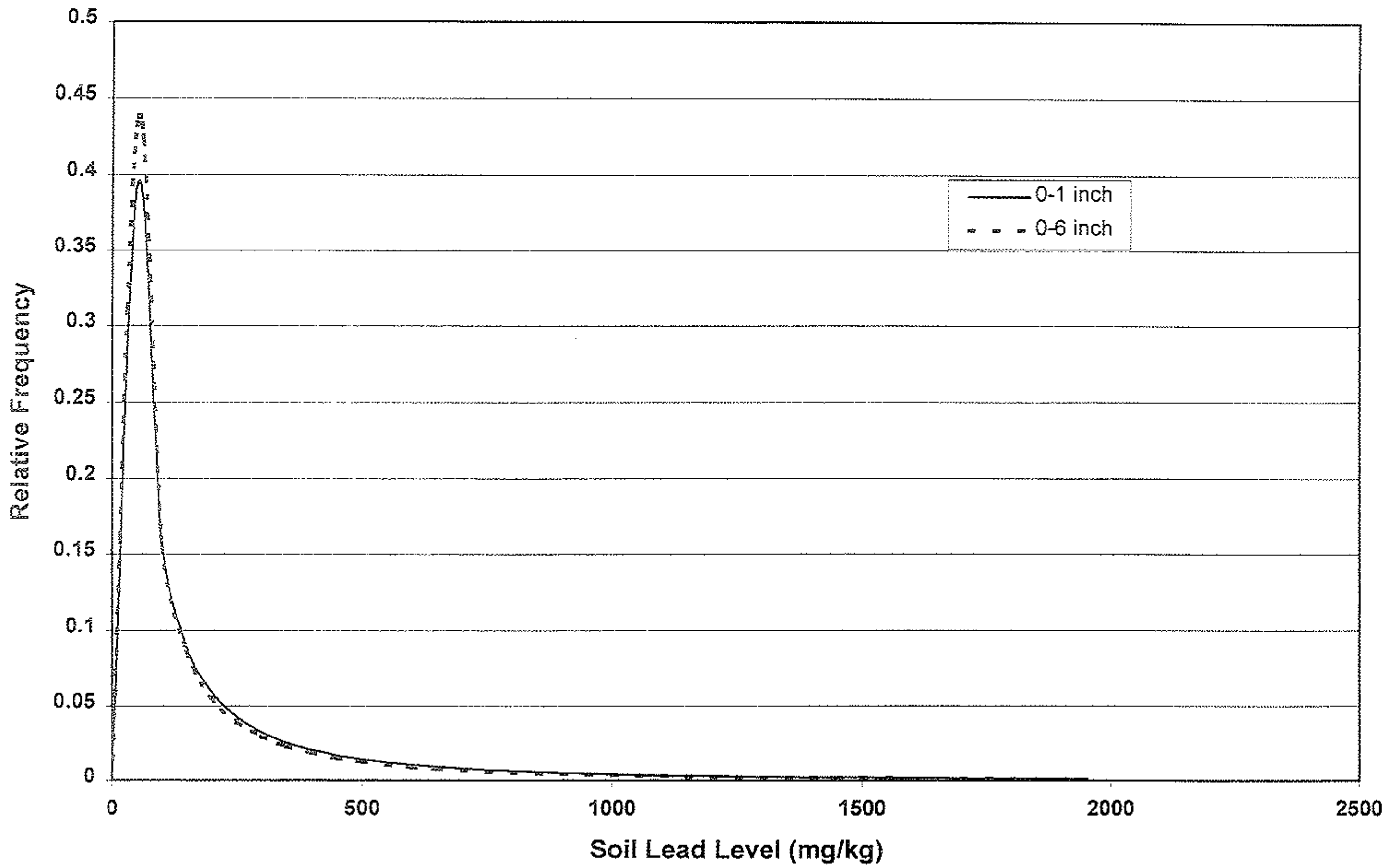

Figure 2. Distribution of Arsenic in Soil From the University of Texas at El Paso
(0 to 1 inch samples and 0 to 6 inch samples)

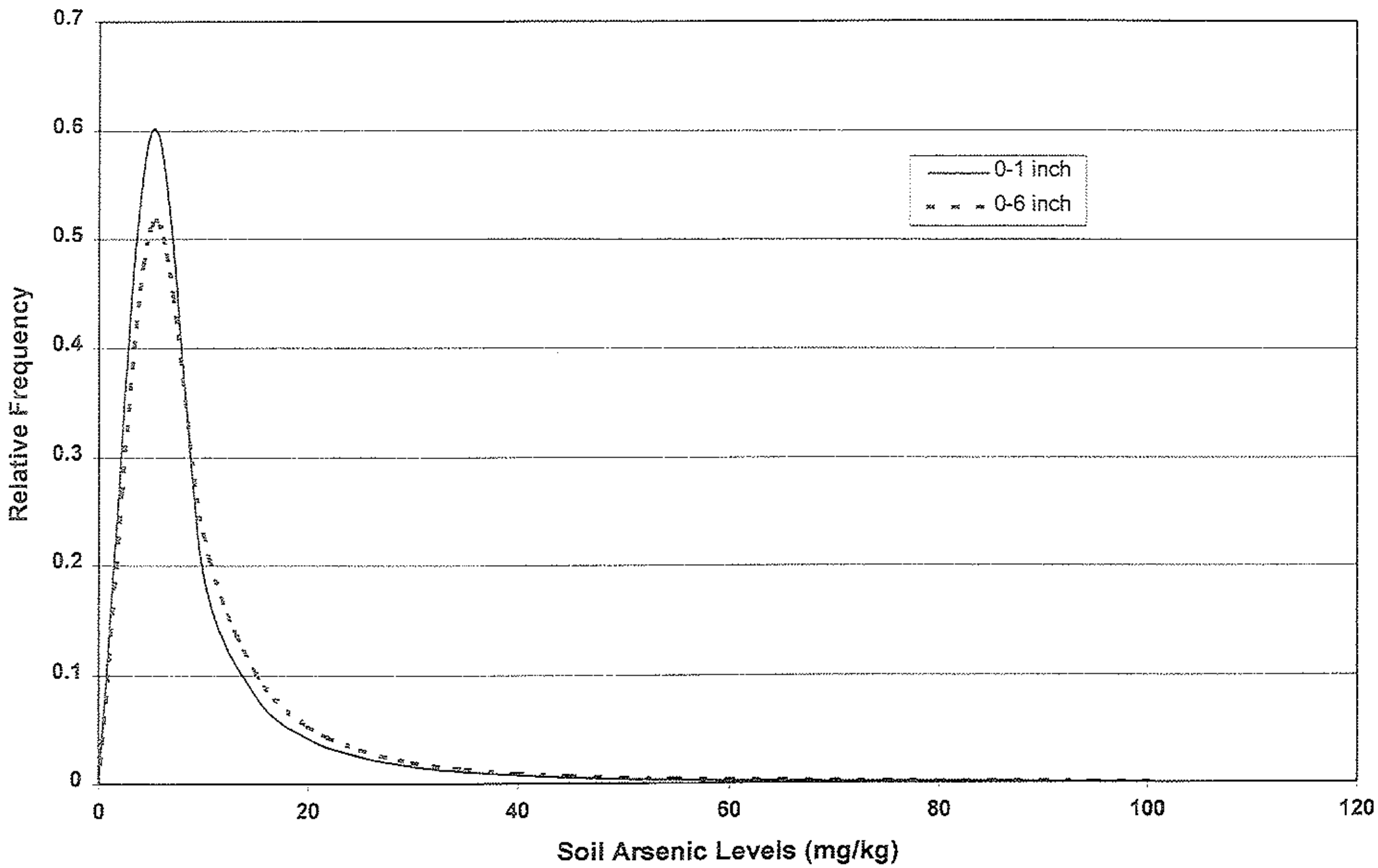

Figure 3. Leech Grove commons area

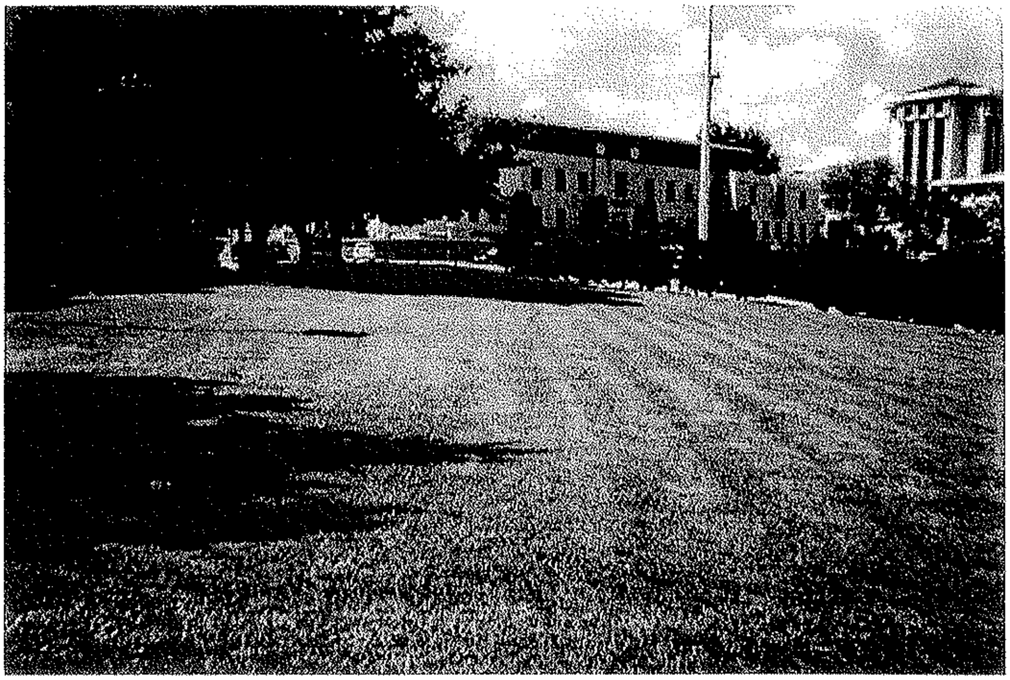

Figure 4. Memorial Triangle commons area

Figure 5. Jack C. Vowell Hall area outside entrance

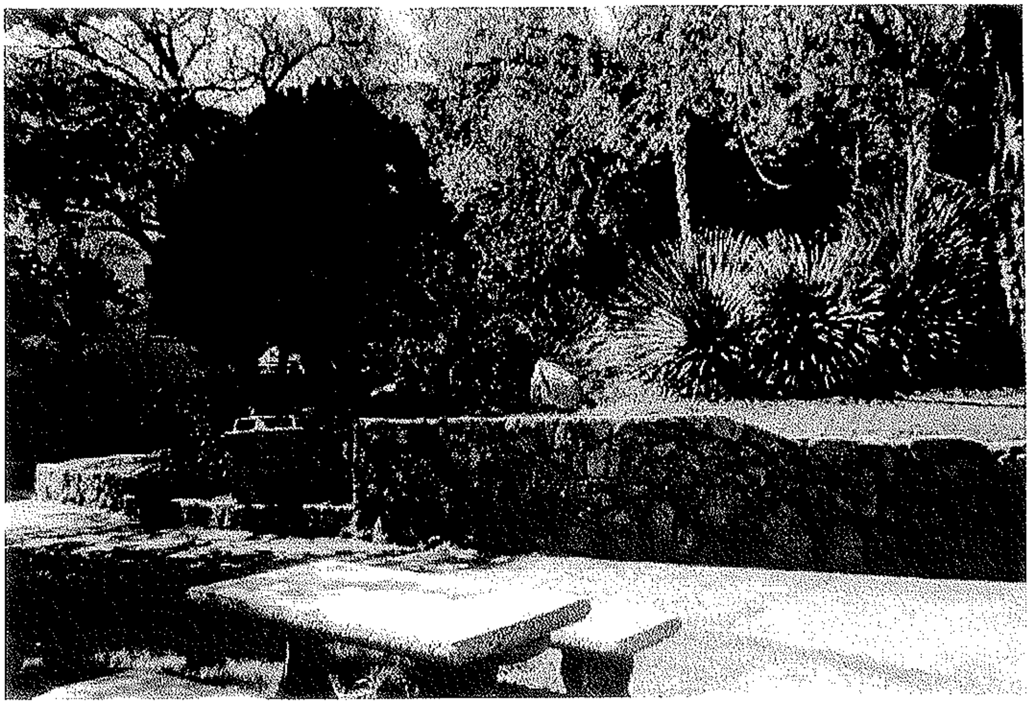

Figure 6. Jack C. Vowell Hall commons area

Figure 7. Jack C. Vowell Hall commons area.