HEALTH ASSESSMENT

Franklin Elementary School

1645 West McDowell Road
Phoenix, AZ 85007
Maricopa County

October 19, 2000

Arizona Department of Health Services
Office of Environmental Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Foreword

The Agency for Toxic Substances and Disease Registry (ATSDR) was established by Congress in 1980, by the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law [EPA, 1980]. This law set up a fund to identify and clean up our country's hazardous waste sites. The U.S. Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and by states with which ATSDR has cooperative agreements. Arizona is one of the states in which the Arizona Department of Health Services (ADHS) has a cooperative agreement with ATSDR to conduct public health assessments on their behalf.

Exposure: As the first step in an evaluation, scientists from ADHS and ATSDR review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data, but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data are needed.

Health Effects: If the review of the environmental data shows that people have or could have come into contact with hazardous substances, scientists from ADHS and ATSDR evaluate whether or not these contacts may result in harmful effects. ATSDR and ADHS recognize that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR and ADHS consider children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to children is considered first when evaluating the health threat to a community. The health impacts to other high-risk groups within the community (such as the elderly, the chronically ill, and children) also receive special attention during an evaluation.

ATSDR/ADHS use scientific information, which can include the results of medical, toxicological, and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is the case, the evaluation report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high-risk groups (such as children, the elderly, and the chronically ill), they are summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR and ADHS are primarily advisory agencies, so usually these reports identify what actions are appropriate to be taken by environmental agencies and/or other responsible parties**.** However, if an urgent health threat exists, ATSDR and ADHS can issue a public health advisory warning people of the danger. ATSDR and ADHS can also instigate health education activities or pilot studies of health effects, ful-scale epidemiology investigations, disease registries, surveillance studies, or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR and ADHS solicit and evaluate information from numerous city, state, and federal agencies, the companies responsible for clean up, and the community. It then shares its conclusions with them. Other agencies are asked to respond to an early version of the report and to make sure that the data they have provided is accurate and current.

Community: ATSDR and ADHS also need to learn what persons in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR/ADHS actively gather information and comments from persons who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, a preliminary version is also distributed to the public. Their comments are then incorporated into the final report. All comments received from the public are addressed in the final report.

Comments: If after reading this report, you have questions or comments, you are encouraged to contact us. Please address letters to:

Attention: Chief, Office of Environmental Health
Arizona Department of Health Services
3815 N. Black Canyon Highway
Phoenix, AZ 85015

Table of Contents

List of Tables

1.0 Executive Summary

The objective of this health assessment is to provide an evaluation of current and future potential health risks that may result from exposure to residual organochlorine pesticides at Franklin Elementary School in Phoenix, Arizona. The school has been unoccupied for the past 10 years. The historic school building is being restored by the school district, which plans to reopen the building for use as an elementary school for approximately 365 children. Several organochlorine pesticides were discovered in the soil during routine environmental sampling done in conjunction with the renovation. In particular, chlordane and dieldrin, banned by the U.S. Environmental Protection Agency (EPA) for use in the United States in the early 1980's, were present in concentrations above screening levels.

Environmental data indicate that soil concentrations as high as 2,270 milligrams per kilogram (mg/kg) of chlordane and 0.71mg/kg of dieldrin remain on the property. The maximum indoor air concentration of chlordane at the site was 0.00099 milligrams per cubic meter (mg/m^3). No pesticides were detected in outdoor air samples. This report evaluates the potential environmental pathways of human exposure to the contaminated media. These contaminants of concern are further evaluated to determine the level of human health effects that may result from exposure. Particular consideration is given to child health issues and community concerns in the health assessment.

Chronic health effects in adults and children are evaluated using reasonable maximum-exposure scenarios that are based upon reported site usage and observations from site visits. The analysis includes an examination of possible inhalation, ingestion, and dermal absorption of the organochlorines by humans. The potential chronic health effects resulting from exposure to the chemicals found are evaluated. This evaluation assumes a transient exposure period of six years for children and thirty years for adults. Standard default exposure factors are used when site-specific information is unavailable.

The potentially complete routes of exposure to the contaminants of concern are inhalation, ingestion, and dermal contact with soils, as well as the inhalation of the chemicals directly emitted from the soil into the air. The exposure assumptions used in the analysis are: (1) occupational exposures for adult workers and (2) residential exposures for children, for both current and proposed future conditions at the site.

The results of the analysis suggest that the site as it currently exists does not pose an apparent health hazard to nearby residents. The highest concentrations of chlordane are below the building's subflooring, but the building is currently unoccupied and is secured by a locked gate. The front yard area with dieldrin contamination is accessible, but the levels present are not high enough to cause adverse health effects. Future use as an elementary school for young children is also not anticipated to pose any health risks from organochlorines. The remediation plans call for capping both of the contaminated areas with a concrete slab, thereby reducing air emissions within the building to negligible levels and removing any direct contact with the soil. The future use of the Franklin Elementary School site after planned remediation is completed will present **no apparent health hazard**.

2.0 Purpose and Health Issues

The Arizona Department of Health Services (ADHS) was asked by the Phoenix School District #1 to evaluate the current and future potential health effects from chlordane and dieldrin detected at Franklin Elementary School. ADHS was asked what types of health effects the children and staff of the school may face once the abandoned school is reopened, and what follow-up measures would be necessary to ensure a healthy environment at the school.

3.0 Background

Franklin Elementary School is located at 1645 W. McDowell Road in Phoenix, Arizona, near the intersection of 17th Avenue and McDowell Road. The school is approximately 5 miles north of the main downtown area along state highway I-17 and is located in an urban community. [See Appendix for site location map.] The Phoenix School District initiated plans to begin the redesign and reopening of this unoccupied school in the Willow District, a historic neighborhood of downtown Phoenix. During Phase I environmental sampling, the district discovered that levels of chlordane and dieldrin in the soil exceeded Arizona soil remediation levels (SRLs) [see Table 1].

The Phoenix metropolitan area has a current population of more than 2 million people. The neighborhood housing the elementary school is inhabited mainly by families with young children, predominantly of Hispanic origin. An equal number of two-parent families and single-parent families (with the mother present) live in the area. The majority of children enrolled in schools are of elementary or high school age (28%), and approximately 69% of area children are reportedly not attending school. [U.S. Census, 1990].

From historical accounts and information from school district personnel, the existing building on the site was constructed in four phases between 1926 and 1946. In 1926, the original rectangular building on the north side of the current structure was constructed. In 1935, additions were added to the east and west sides, and, in 1943, actual wings were added to the east and west sides, forming a U- shaped structure. Finally in 1946, extensions that elongated the wings further south were completed. [See site map in Appendix].

The plan for Franklin Elementary School includes complete remodeling and renovation of the existing structure, retaining only the exterior brick shell as the original building, which qualifies as a historic landmark. All other interior and exterior features will be replaced because they have deteriorated over the years. The school has remained closed for the past 10 years and occasionally was used by the district for storage of equipment from other schools in the district. The front yard of the school was also leased periodically over the years for use as a parking lot during events occurring at the Veteran's Memorial Coliseum Stadium located across the street. [See Appendix for future site plan]. Termiticides were used at the site, but no records remain on file with the Phoenix Elementary School District for dates of application, total amount or concentrations used.

Currently, no active remediation is occurring on the site. The school district is anticipating entering the voluntary remediation program offered by the Arizona Department of Environmental Quality

(ADEQ). The school district is concerned about the safety of the building for future use and about meeting proper clean-up requirements.

3.1 Environmental Sampling Data

Upon initial inspection of the site, it was noted that many small holes had been drilled into the flooring that are characteristic of pesticide injection holes. Representative soil samples were collected throughout the school property to evaluate the extent of contamination [see Appendix for soil sampling map]. Samples were taken at various depths below the structure: 0-6 inches, 12-18 inches, 18-24 inches, and 24-30 inches. Samples collected in the courtyard, playground, and corners of the lot provided background pesticide concentrations.

In July of 1999, soil samples were collected at the school up to 30 inches in depth in order to characterize the location and extent of contamination by pesticide compounds. All the soil samples were analyzed for organochlorine pesticides using EPA Method 8081A. The majority of the 126 soil samples taken in July 1999, were taken at a depth of 6 inches below surface. The soil samples were taken from underneath the flooring throughout the interior of the building and along the stem wall outside the building. The only area where subsurface samples were not taken was below one room where a concrete basement housed the furnace. Of the 128 samples collected, 68 contained levels of chlordane that ranged from 3.8 to 2,270 mg/kg, all of which exceeded the SRL of 3.4 mg/kg**.** No other pesticides were found above detection limits. All samples were analyzed by a state-certified laboratory.

4,4-DDE, endosulfan, dieldrin, and chlordane were detected [Table 1]. However, only the pesticides chlordane and dieldrin were present at levels above Arizona Soil Remediation Levels (SRLs). Dieldrin was detected at a level above the SRLs in only two soil samples taken from a depth of 0-6 inches in the northeast portion of the front yard [see site map in Appendix]. The area is covered with grass and bounded by a chain-link and steel post fence. Chlordane was detected only in soil beneath the wood flooring of the building, where direct human contact with the soil would not likely occur. Background organochlorine concentrations were at nondetectable levels [Table 1].

Composite soil samples were taken from 30 borings at a depth of zero to thirty inches in late-September 1999. These samples were analyzed for total pesticides and organochlorine pesticides, using EPA methods 8081A and 8081A/1311, respectively. Samples were analyzed at an accredited laboratory and followed proper quality assurance/quality control. The results indicate a toxicology characteristic leaching procedure (TCLP) concentration of chlordane of 0.43 micrograms per liter (mg/L). The EPA regulatory level for hazardous waste is 0.03 mg/L**.**

After meeting with the school district in early-October 1999, ADHS suggested that ambient air samples also be collected indoors and outdoors in order to determine whether any of the pesticides might have vaporized from the soil into the air, creating a potential inhalation risk. A contractor hired by the school district sampled ambient air for chlordane and dieldrin. [See **Appendix for air** sampling map]. Samples collected revealed chlordane was present at various concentrations throughout the school, ranging from 0.00020 mg/m^3 to 0.00099 mg/m^3 . These values are compared

to the ATSDR intermediate MRL comparison values(CVs), a screening value to determine whether further evaluation is necessary. The air sampling results are summarized in Table 2. [Dominion Report, October 27, 1999].]

Table 1: Soil Sampling Results, July 1999

Contaminant	Maximum Concentration Detected (mg/kg)	SRL* (mg/kg)	Chemical of Concern?
4,4-DDE	0.18	13	No
Chlordane	2270	3.4	Yes
Dieldrin	0.71	0.28	Yes
Endosulfan	0.27	390	No

* SRL = Residential Soil Remediation Level as described in the Arizona Administrative Code, Title 18, Chapter 7, Article 2, Appendix A.

Table 2: Air Sampling Data (mg/m^3), October 8, 1999

Location	Chemical	Detection Limit	Concentration Detected in Air	CV*
Indoor sample #1	Chlordane	0.00002	0.00020	0.0002
Indoor sample #2	Chlordane	0.00002	0.00099	0.0002
Indoor sample #3	Chlordane	0.00002	0.00070	0.0002
Courtyard sample	Chlordane	0.00002	ND†	0.0002
Field blank	Chlordane	0.00002	ND	0.0002

* CV = Comparison value.

† ND = not detected or not measurable, as the concentration was less than 0.02 ug/m^3.

The contractors sampled the air for chlordane inside the school as well as outside in the courtyard area. The indoor samples were taken in classroom areas where the soil concentrations of chlordane in the top 0-6 inches of soil were the highest, and the samples were also taken at three equally dispersed areas inside the building. Samples were collected over an 8-hour period in a sorbent sample tube using constant flow sampling pump. The time-weighted averages used a flow rate of 1 liter per minute and a total throughput of 480 liters in accordance with U.S. Occupational Safety and Health Administration (OSHA) Method 67. The samples were collected at a height of approximately 3 feet in the center of the rooms tested. No air was drawn through the field blank,

which was located on the table adjacent to sample #1. The pump was calibrated and rechecked with a spare sampling tube using a flow calibrator.

The site is situated on relatively flat land that is comprised mainly of alluvial soils, which are highly variable and range from dense sand to gravel, silts, and clays. During soil sampling, engineers noted that the top 30 inches of soil on the property consisted mostly of a sandy clay with silt. The depth to groundwater at the site was approximately 80 feet below surface in 1992. No groundwater samples were taken. [Dominion Report, 1999].

Surface run off from the site flows to the south at a gradient of approximately 0.3%. The principal drainage near the site is the Salt River, located 3 miles south of the site, which is usually dry. The site is located within the 100-year flood plain. However, the hydrophobic nature of the organochlorines makes the chemicals extremely insoluble in water. Moreover, the areas contaminated with pesticides are going to be capped with a concrete barrier during remodeling, and none of the areas will remain exposed. Surface water runoff is not expected to impact the property. [Dominion Report, 1999].

3.2 Physical Hazards

The site is located in an inner city area and is bounded by residential streets on three sides and a main city street on the fourth side. Heavy traffic from the busy road, and the close proximity to the Veterans Memorial Coliseum on one side of the site and a residential neighborhood on the other, may increase the chance of persons coming into contact with the contaminated soil or drainage pipes.

The abandoned buildings contain old furniture and rickety wooden floors, but the building remains locked, with access restricted to school district personnel. However, the lack of complete fencing on the property makes the front yard, which contains high dieldrin concentrations, a potential play area for children. Until all renovations are complete, the soil contaminated with dieldrin is partially covered with grass, but the surface soil is accessible to children playing in this unfenced portion of the yard. Old playground equipment has been removed from the grounds so that children will not be attracted to the site.

4.0 Discussion

4.1 Contaminants of Concern

The contaminants of concern were selected on the basis of the concentration levels of the contaminants, the quality of the data, the comparison of concentrations of contaminants with background levels, the comparison of concentrations of contaminants with health-based comparison values; and upon community concerns.

The contaminants of concern will be further evaluated in the pursuing sections using a toxicological evaluation as well as health outcome data in order to determine the public health implications of the chemicals. The contaminants of concern, based upon the concentrations in soil and air at the school

are dieldrin and chlordane. No community concerns exist that need to be addressed at this time.

Estimates of exposure concentrations and pathway-specific doses will be calculated to quantify human exposures to each of the contaminants of concern. Exposure scenarios will be determined according to usages of the site. Then, exposures through ingestion, inhalation, and dermal contact will be evaluated for the chemicals of concern if appropriate.

4.2 Exposure Pathways

A pathway analysis was performed in order to determine the scenarios under which persons may be exposed to chlordane and dieldrin at the site. The analysis identifies the source of contamination, the transport of the contaminant through environmental media, an exposure point, a potential route of exposure, and the existence of a receptor population. Completed exposure pathways in which all of these elements were present were subsequently analyzed more closely to determine the doses at which human exposure may be occurring. Both current [Table 3] and future potential pathways [Table 4] were evaluated.

4.3 Completed Pathways of Exposure

Completed pathways demonstrate the link between the environment and human exposure. A combination of site visits, analysis of land use patterns, and information gathering were used to determine how humans may be coming into contact with contamination in the environment.

Once reasonable exposure pathways were determined, chronic daily intake was quantified in milligrams of chemical per kilogram body weight per day. The chronic daily intake (CDI) is the quantity of a chemical which is available to the body for absorption at a membrane exchange boundary through exposure by ingestion, dermal contact, or inhalation.. It is different from the absorbed dose, which is a direct measurement of the concentration of a chemical in the blood.

Occupational exposure factors were used to quantify exposure for adults working at the school. More conservative residential factors were used for children. Exposure dose equations found in EPA Superfund Guidance [EPA, 1991] were used to quantify the daily dose for children and adults, given particular exposure scenarios and media. (See Appendix for daily intake formulas). A dermal absorption factor of 10% for organics is used to calculate the dose of a chemical received through the skin [ADHS, 1996]. When exact data is not available for determining exposure, default assumptions are made on the basis of EPA exposure factors and other current data or appropriate models (see Appendix for standard default exposure factors table).

The daily doses of chemicals taken in by individuals are compared with health-based guidance levels to determine whether the daily doses may pose a relative health risk to the individuals exposed. ATSDR has derived minimal risk levels (MRLs) that are defined as the dose of a chemical that is unlikely to cause any adverse health effects over a given period of time.

Table 3: Current Exposure Pathway Summary

Potential Population Exposed	Exposure Point	Exposure Route	Pathway Evaluated ?	Exposure Likelihood	Rationale
SOIL					
Teachers/ Workers	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No current use of site
		Ingestion	Yes	Incomplete pathway	
		Dermal	Yes	Incomplete pathway	
Students	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No current use of site
		Dermal	Yes	Incomplete pathway	
		Ingestion	Yes	Incomplete pathway	
Off-site residents (adults & children)	Contaminated soil in yard	Inhalation (fugitive dust)	Yes	potential	Side yard with dieldrin is accessible
		Ingestion	Yes	potential	
		Dermal	Yes	potential	
INDOOR VAPORS					
Teachers/ Workers	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No current use of site
Students	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No current use of site

Table 4: Potential Future Exposure Pathways Summary

Potential Population Exposed	Exposure Point	Exposure Route	Pathway Evaluated ?	Exposure Likelihood	Rationale
SOIL					
Teachers/ Workers	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No accessible surface soils
		Ingestion	Yes	Incomplete pathway	
		Dermal	Yes	Incomplete pathway	
Students	Contaminated soil on site	Inhalation	Yes	Incomplete pathway	No accessible surface soils
		Dermal	Yes	Incomplete pathway	
		Ingestion	Yes	Incomplete pathway	
Off-site residents	Contaminated soil in yard	Inhalation	Yes	Incomplete pathway	Side yard with dieldrin will not be accessible (covered concrete playground)
		Ingestion	Yes	Incomplete pathway	
		Dermal	Yes	Incomplete pathway	
INDOOR VAPORS					
Teachers/ Workers	Contaminated soil on site	Inhalation	Yes	Potential pathway	Possible inhalation of chemicals through constructed barrier
Students	Contaminated soil on site	Inhalation	Yes	Potential pathway	Possible inhalation of Chemicals through constructed barrier

Samples were analyzed for organochlorine pesticides using EPA Method 8081A. Of the 128 samples, 68 contained levels of chlordane ranging from 3.8 to 2,270 mg/kg, all of which exceed the SRL of 3.4 mg/kg. Chlordane is present in the soil beneath the building, which is kept locked, so current exposure from this area is not of concern.

Chlordane, also known as Octachlor and Velsicol 1068, is an organochlorine pesticide that has been used in the United States from 1948 to 1988. Most commonly, it was effectively used as a agent to control termites, as it bonds tightly to soil particles and does not dissolve easily in water, and therefore did not have to be reapplied as often. Most chlordane leaves the soil by evaporation into the air, but because of its ability to remain in soil for over 20 years, it is often detected 5 or more years after application. Under field conditions, the mean degradation rate is observed to range from 4% to 28% a year, with a mean half life of 3.3 years [ATSDR Toxicological Profile,1994].

Dieldrin is a polychlorinated cyclodiene used to control soil insects, termites, and many other pests. Use of dieldrin on crops was canceled by the U.S. Environmental Protection Agency (EPA) in 1974, and its use extermination of insects was voluntarily discontinued by the manufacturer in the United States in 1987. It is considered a class B2 chemical (i.e., a probable human carcinogen. Other commonly used names for dieldrin include HEOD, Alvit, Quintox, and Octalox. Dieldrin is stable and highly persistent in the environment with a half life of 723 days in water.

Dieldrin was present at levels above the residential SRL in the front yard area of the school property, which is accessible and covered by patches of grass. The highest concentration of dieldrin present was 0.71 mg/kg, and intake from various exposure scenarios is extrapolated in Table 5 [see Appendix for intake formulas].

Table 5 : Current Daily Intake of Dieldrin for Soil Exposures (mg/kg/day)

Exposure Route	Concentration of Dieldrin (mg/kg)	Acute Oral MRL*	Chronic Oral MRL	Adult's Daily Intake	Child's Daily Intake
SOIL INGESTION					
	0.71	$7e^{-5}$	$5e^{-5}$	$4e^{-6}$	$9e^{-6}$
PARTICULATE INHALATION					
	0.71	$7e^{-5}$	$5e^{-5}$	$7e^{-9}$	$4e^{-8}$
DERMAL ABSORPTION					
	0.71	$7e^{-5}$	$5e^{-5}$	$2e^{-6}$	$1e^{-5}$

*MRL = Maximum risk level (established by ATSDR).

Daily intake levels of dieldrin for children and adults from ingestion, dermal absorption, or particulate inhalation are both below the MRL levels; i.e., no adverse health effects would be expected [see Table 5]. The total additive intake from all of the pathways combined ($6e^{-6}$ mg/kg/day

for adults and $2e^{-5}$ mg/kg/day for children) also falls below the MRL. No specific inhalation or dermal MRLs exist, so the oral MRL was used for comparison.

4.3.2 Future Potential Exposure Scenarios

The remedial plan for the front yard of the school includes a concrete playground in the area containing dieldrin concentrations that exceed SRLs. This will cover the dieldrin-contaminated soil and make it inaccessible to children. Even without remediation, daily intake level of the organochlorine is below the MRL, indicating that it is unlikely to pose any health risk.

Composite soil samples, taken f rom 30 borings at depths of zero to 30 inches in late-September 1999, were analyzed for total and organochlorine pesticides using EPA Method 8081A and 8081A/1311, respectively. Samples were analyzed at a state-accredited laboratory that followed proper quality assurance/quality control methods. The results indicate a toxicology characteristic leaching procedure (TCLP) concentration of chlordane of 0.43 mg/L. The EPA hazardous-waste regulatory level is 0.03 mg/L, so any contaminated soil that is removed from the property will have to be treated as a hazardous waste disposal.

Currently, the building on this site is unoccupied, therefore no complete pathway exists for exposure to the chlordane-contaminated soil beneath the building. Without remediation, the levels of chlordane vapors pervading through the soil and into the air do exceed the levels at which health effects are seen. However, after the proposed remedy (concrete playground covering the soil) is in place, at which time the building would be occupied by a potentially exposed population, the concentration of chlordane present in the air would be well below both the intermediate and chronic concentrations that correspond to the MRLs [see Table 6].

The level of concentration in indoor air following remediation and remodeling was estimated by reducing the amount of floor surface area (through which soil gas may enter) by the area that will be covered by the addition of a concrete floor slab. Whenever flooring is added above contaminated soil, the surface area of soil available is greatly reduced. A paraseal waterproofing material will be applied directly onto the soil before the slab is poured. The paraseal membrane is a high-density polyethylene and bentonite material that will provide an additional barrier. For buildings with concrete slab floors, the fraction of floor space through which soil gas may enter is estimated to be 0.1% of the total surface area [ASHRAE, 1981]. The amount of vapor present in the air from soil emissions is assumed to be directly proportionate to the amount of surface area of soil exposed. Air concentrations after installation of the slab were calculated by multiplying current indoor air concentrations by a conversion factor of 0.001(no units) [see Table 6].

Table 6: Future Potential Exposure from Indoor Vapor Resulting From Chlordane Daily Intake versus Minimum Risk Levels (MRLs)

Time Period	Maximum Concentration of Chlordane	Intermediate Inhalation MRL	Chronic Inhalation MRL	Adult's Daily Intake	Child's Daily Intake
Before remediation	9.9e-4	2e-4	2e-5	1.9e-4	9.4e-4
After ~~(remediatio)~~ [remediation] (0.1%)	9.9e-7	2e-4	2e-5	1.9e-7	9.4e-7

The chronic oral MRL for chlordane is $2e^{-5}$ mg/m^3, and no adverse health effects have been reported at $9.9e^{-7}$ mg/m^3, the maximum concentration of chlordane detected at the site. Therefore, the concentration of chlordane that would be present after remediation would not be at a level that would cause serious health effects from inhalation after the school is reopened.

5.0 Child Health Initiative

The ATSDR child health initiative recognizes the unique vulnerabilities of children exposed to environmental chemicals. Children cannot simply be characterized as small adults, and they have greater opportunities for exposure, increased potential for health problems, and less ability to avoid hazards than adults. The child health initiative, launched by ATSDR in 1996, recommends evaluating a site for exposures that may be of particular concern to children [ATSDR, Child Health Initiative, 1997].

Children are more likely to be sensitive to the effects of chemicals due to their developing physiology and their low body weight. Pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults. Thus, conservative variables were used in dose calculations to account for children's greater susceptibility.

Organochlorines in particular are known to pose a higher risk for children at lower levels due to the heightened sensitivity of their developing nervous systems to pesticides that tend to attack neurotransmitter-related mechanisms in the body. Additionally, children's immature physiology makes them less able to metabolize and excrete toxic chemicals, the method by which the body detoxifies most contaminants. Recent studies have shown that in diseases with previously unknown etiologies, over an extended period of time chemicals in the environment may later act as a "trigger" mechanism for development of diseases later in life. Moreover, children tend to have increased hand-to-mouth behavior, and they play closer to the ground, and thus have the potential to ingest more pesticide-laden soil than older children and adults.

Children can be exposed to pesticides in the soil, air, or food (even breast milk). The National Research Council estimates that 50% of all pesticides a person ingests during their lifetime occurs

in the first 5 years of life. Given the increased susceptibility of children, a conservative approach was taken by ADHS at the Franklin School site in evaluating the potential exposure of children. However, no evidence exists at the site of dose-specific adverse health effects for children, either currently or in the future.

Aside from children, other subpopulations of concern are sensitive groups who may be more susceptible to chemical exposure than the average adult. They may include infants, the elderly, or individuals with respiratory problems, depending on the chemicals and the nature of the exposures. Exposure points for sensitive receptors often include hospitals, nursing homes, schools, and daycare centers where these populations gather. Because the site is proposed to be used as an elementary school, all toxicological evaluations were particularly carried out for children of the age group that will be using the facility, instead of the normal, adult calculations that would apply to the other inhabitants of the building.

No physical hazards are present on site that might pose any additional risk to children. The abandoned buildings contain old furniture and rickety wooden floors, but the building remains locked and restricted to access by school district personnel. However, the lack of complete fencing on the property makes the yard, which contains high concentrations of dieldrin, a prime target and potential play area for curious children. Furthermore, the location of the site on a busy road, bounded by the Coliseum on one side and a residential neighborhood on the other three sides, may increase the chance of unsuspecting persons coming into contact with the contaminated soil or open runoff pipes. Old playground equipment has been removed from the grounds to avoid drawing the attention of children.

6.0 Conclusion

The Arizona Department of Health Services concludes that **no apparent public health hazard** currently exists at the Franklin Elementary School. Chlordane is present in the soil and the air, but the building is currently unoccupied. Dieldrin-contaminated soil present at the site is a potential exposure risk, but the doses at which exposures are occurring pose **no apparent public health hazard**. After the planned renovations are made to the building's flooring and playground area, no exposure to the organochlorines is expected. The school will not reopen to children and other occupants until after these remedial actions are completed.

The concentrations of organochlorines detected, do not constitute a dose that is known to cause any health symptoms. Samples taken were adequate in quantity and location and meet all quality control measures. Therefore, despite low level concentrations of chlordane and dieldrin detected at Franklin Elementary School, the site meets all ATSDR criteria to be classified "**no apparent public health hazard**," for current and future potential use.

7.0 Recommendations

Exposure to chlordane is not occurring at the Franklin Elementary School site while the building remains unoccupied. Exposure to dieldrin-contaminated soil is not expected to present any adverse

health effects at present levels. Future potential exposure is also not expected to cause any adverse health effects after the proposed remedial plans (constructing concrete barrier flooring and a concrete playground area) are completed. These remedial plans are part of a larger remodeling project proposed by the Phoenix School District for reopening the school to approximately 300 elementary school children.

Architects and engineers working for the school district have proposed renovation and remedial plans that retain only the exterior brick shell of the historic structure. All other porous materials inside the building are to be replaced, and the wood flooring that now covers the chlordane-contaminated soils would be removed. In its place, a concrete slab that meets current remediation guidelines, would cap the soil and essentially remove any potential for human exposure to chlordane at the site. Levels of chlordane in the soil were highest beneath the building, but levels around the perimeter near the foundation also exceeded SRLs. The addition of concrete walkways extending a few feet beyond the contamination would ensure that no contact with the soil may inadvertently occur after remediation.

Dieldrin-contaminated soil in the front yard of the school will be covered with a concrete surface, because it is proposed to be used as a future playground for the school children. Essentially all future exposure to organochlorines present at the site would be removed when these proposed measures are completed before the school reopens.

After the construction is complete and before the reopening the school, ADHS recommends that the school resample the air inside the building to verify that the pesticides are not vaporizing from the soil through the constructed barricade. Soil samples of any exposed areas near the building's perimeter should also be taken to ensure that no contaminated soil remains exposed.

8.0 Public Health Action Plan

ACTIONS PLANNED:

1. Remediation of the contaminated soil by capping with a concrete foundation or some other acceptable method will eliminate off-gassing of the pesticides into the air and completely barricade the soil from direct human contact. All remediation activities conducted by the Phoenix School District #1 must meet all health and safety standard practices, and any hazardous waste must be properly disposed of in order to minimize public health risk.

2. If land use changes, or if new data showing accedences become available, the site will be reassessed by ADHS for human exposure potential.

3. The Phoenix School District and neighboring community will be notified by ADHS of the findings of the human health assessment in a public comment release of the health assessment document, and creation/distribution of a 1-page fact sheet summarizing the report.

4. ADHS will present the findings of the human health assessment at a Maricopa County superintendent's school board hearing, assist the school district in procuring approval of proposed renovation/remediation plans, and testify regarding site-related health issues.

ACTIONS COMPLETED:

1. ADHS has reviewed sampling data and requested additional air sampling needed to adequately complete the human exposure assessment.

2. ADHS has met with Phoenix School District personnel several times to assist them in interpreting environmental data and understanding current state and federal environmental health regulatory measures. Various remedial options were evaluated by the ADHS for their efficacy in reducing health risks.

Public Comment Period

ATSDR provided an opportunity in the final draft stage of this document for the general public to comment on Agency findings or proposed activities. This comment period lasted from June 20, 2000 through August 30, 2000. During that time no comments were received.

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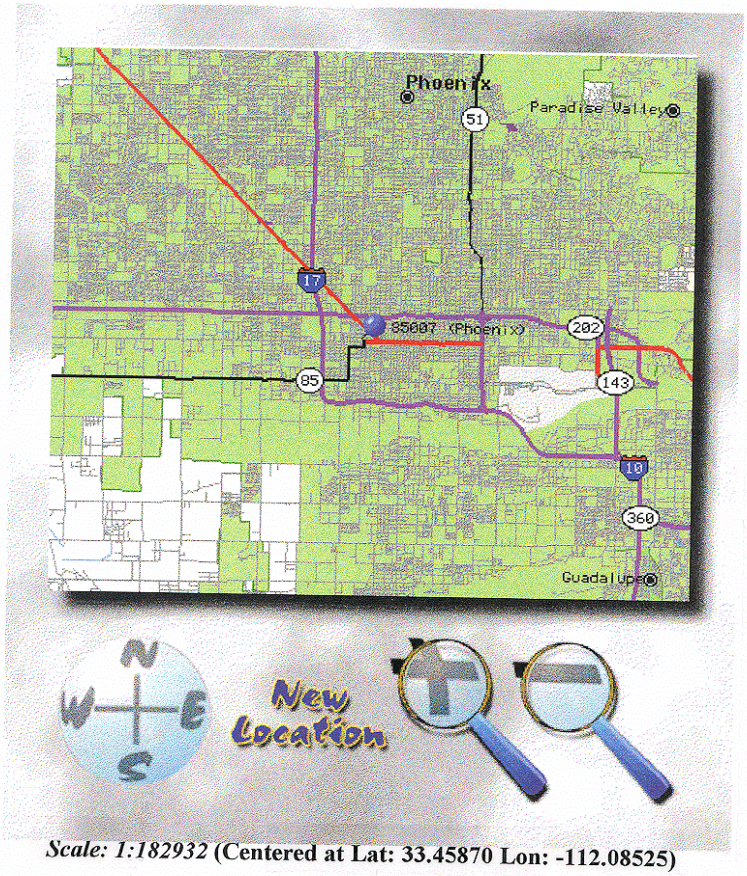
Location of the Site



Scale: 1:182932 **(Centered at Lat: 33.45870 Lon: -112.08525)**

LEGEND

State
County
City/Town
% of Pop Age 5-9
0.0
0.1 - 5.5
5.6 - 10.9
11.0 - 16.4
16.5 - 21.8
21.9 - 28.6

Lake/Pond/Ocean
Street
Expressway
Highway
Connector
Stream
County

Scale 1:182932
0 1 2 3 4 5 6 mi
0 2 4 6 8 10 km
*average--true scale depends on monitor resolution

Click on the legend to download it as a GIF file.

Place a marker on this map:

Latitude(deg): 33.452298
Longitude(deg): -112.0893
Symbol: Purple Stickpin
Label: 85007 (Phoenix)
Marker URL:

Map Census Statistics:

Level: Places
Theme: % Age 5-9
Classify Method:
○ Quintiles or ◉ Eq Interval

Enter precise coordinates:

Latitude(deg): 33.45870
Longitude(deg): -112.0852
Map Width(deg): 0.200
Map Height(deg): 0.200

http://tiger.census.gov/cgi-bin/n

Current Site Map

Soil Sampling Locations

Air Sampling Locations

Site Photographs

Future Site Plan

Chronic Daily Intake Formulas

- ***Equation 1: Inhalation of {Fugitive} [fugitive] dust emissions***

  $$CDI = [(Conc_{surface\ soil})(PEF)(IR)(EF)(ED)] \ / \ [(BW)(AT)]$$

  CDI: chronic daily intake (mg/kg/day)

  PEF : particulate emission factor (kg/m^3)

  IR: intake rate (m^3/day)

  EF : exposure frequency (days/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (days)

- ***Equation 2: Ingestion of chemicals in soil***

  $$CDI = [(CF)(IR)(EF)(ED)] \ / \ [(BW)(AT)]$$

  CDI: chronic daily intake (mg/kg/day)

  CF: conversion factor (10^{-6} kg/mg)

  IR: intake rate (mg/day)

  EF: exposure frequency (days/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (days)

- ***Equation 3: Dermal contact with soil***

  $$CDI = [(conc_{soil})(CF)(SA)(SAF)(AF)(EF)(ED)] \ / \ [(BW)(AT)]$$

  CDI: chronic daily intake (mg/kg/day)

  CF: conversion factor (10^{-6} kg/mg)

  SA: Skin surface area (cm^2/event)

  SAF: Skin adherence factor

  AF: absorption factor

  EF: exposure frequency (event/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (event)

- ***Equation 4 : Inhalation of chemicals in air***

  CDI = [(SA)(Kp)(CF)(EF)(ED)] / [(BW)(AT)]

  CDI : chronic daily intake (mg/kg/day)

  SA: skin surface area(cm^2)

  K_p: diffusion constant (cm/day)

  CF: conversion factor (10^{-3} l/cm^3)

  EF: exposure frequency (days/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT: Averaging time (days)

Standard Default Exposure Factors]

Symbol	Definition (units)		Default	Reference
CSFo	Cancer slope factor oral (mg/kg-d)		-	IRIS, HEAST†
CSFi	Cancer slope factor inhaled (mg/kg-d)		-	IRIS, HEAST
RfDo	Reference dose oral (mg/kg-d)		-	IRIS, HEAST
RfDi	Reference dose inhaled (mg/kg-d)		--	IRIS, HEAST
BWa	Body weight, adult (kg)		70	RAGS‡ (Part A) EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)		15	Exposure Factors EPA 1991 (OSWER No. 9285.6-03)
]ATc	Averaging time - carcinogens (days)		25550	RAGS(Part A), USEPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)		ED*365	
SAa	25% Surface area, adult (cm^2/day)		5000	Dermal Assessment EPA 1992(EPA/600/8-91/011B)
SAc	25% Surface area, child (cm^2/day)		2000	Dermal Assessment EPA 1992 (EPA/ 600/8-9/011B)
AF	Adherence factor (mg/cm^2)		0.2	Dermal Assessment EPA 1992 (EPA/600/8-9/011B)
ABS	Skin absorption (no unit):			
	--Inorganics		0.01	PEA Cal-EPA (DTSC, 1994), ADHS SRLs
	–Organics		0.1	PEACal-EPA (DTSC, 1994), ADHS SRLs
IRAa	Inhalation rate - adult (m^3/day)		20	Exposure Factors EPA 1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m^3/day)	10	RAGS (Part A)0	EPA 1989 (EPA/540/1-89/002)
IRSa	Soil ingestion - adult (mg/day)	100	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day),	200	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
EDr	Exposure duration - residential (years)	30[c]	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)

	Exposure duration - child (years)	6	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:			
IFSadj	Ingestion factor, soils [mg ! yr]/[kg ! d]) 114	RAGS Part B)		EPA 1991 (OSWER No. 9285.7-01B)
IFSADJ	Skin contact factor, soils ([mg ! yr]/[kg ! d])	503	By analogy to RAGS (Part B)	
InhFadj	Inhalation factor ([m^3 ! yr]/[kg ! d])	11	By analogy to RAGS (Part B)	
PEF	Particulate emission factor (m^3/kg) 1.396 x 10^{+9}	Soil Screening Guidance	EPA 1996a	

{SRLs = }
*IRIS =
†Heast =
‡RAGS =
SRLs = Residential Soil Remediation Levels as described in the Arizona Administrative Code, Title 18, Chapter 7, Article 2, Appendix A.