Health Consultation

WESTWIND PRIMARY SCHOOL

PHOENIX, MARICOPA COUNTY, ARIZONA

Prepared by the
Arizona Department of Health Services

JULY 1, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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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 or ATSDR's Cooperative Agreement Partner 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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Prepared By:

Arizona Department of Health Services
Office of Environmental Health
Environmental Health Consultation Services
Under a Cooperative Agreement with the
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Summary

In the Westwind Primary School, the Arizona Department of Health Services' (ADHS') top priority is to ensure that the school students and staff have the best information possible to safeguard their health.

The Pendergast School District asked the ADHS to conduct this health consultation. The purpose of this health consultation is to evaluate the public health risk for school students and staff who may have come into contact with contaminants found in the soil and in air.

The structures of the Westwind Primary School were originally built in 1974. The school district plans to tear down the intermediate school to make way for a new campus for Grade 5-8, capable of housing about 950 students. As a part of the permitting process, soil samples were collected from the school and the testing results indicated signs of historical use of pesticides, which pre-dated the District's ownership of the property. After investigation, it is found that the school buildings sit on an old crop-dusting airport used until the late 1960s. Until recently, state law did not require district to test the soil before building a school. Site characterization and remediation activities for the entire site are being overseen by the Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program.

All the data analyzed in this health consultation were collected by the Dominion Environmental from April to June 2009. In an attempt to characterize the nature and degree of the contamination that would impact the health of students and staff, ADHS reviewed all the data available from the Dominion Environmental.

ADHS reached two conclusions about the Westwind Primary School in Phoenix, Arizona:

- The measured levels of pesticides in soil were below their respective health screening values for adverse health effects. Based on the detected levels and the amount of time spent in the school, these chemicals are not expected to harm people's health. That includes students and staff at the Westwind Primay School.

- The detected concentrations of total dust and DDE were within their respective health screening values for adverse health effects. For dieldrin and toxaphene, the estimated theoretical cumulative excess lifetime cancer risks are within the range of public health guidelines (10^{-6}~10^{-4}) for protection of human health as suggested by EPA. Therefore, the detected levels of total dust and pesticides in the air are not expected to harm people's health. That includes students and staff at the Westwind Primary School.

To ensure the health and safety of students and staff, ADHS recommend the Pendergast School District develops a safety and pollution control plan during renovation process.

Purpose

This report represents an assessment of human health risks from exposure to contaminated soil at Westwind Primary School, Phoenix, AZ. The school structures were built about 35 years ago. During the expansion and renovation process, preliminary soil sampling results showed that concentrations of organochlorine pesticides were above the Arizona Soil Remediation Level (SRL) for schools. Therefore, the Pendergast School District contacted the Arizona Department of Health Services (ADHS), and requested assistance in addressing concerns about contaminated soil at the Westwind Primary School. ADHS performed a health consultation to evaluate whether exposure to contaminants in soil could harm students' health.

Background and Statement of Issues

The Westwind Primary School is located at 9040 West Campbell Road, Phoenix, AZ. The school structures were originally built in 1974 by the Tolleson Union High School District. In 1980, the Pendergast School District purchased the buildings. Both Westwind Primary and Westwind Intermediate Schools were included in the acquisition. The school district plans to tear down the intermediate school to make way for a new campus for Grade 5-8, capable of housing about 950 students.

As a part of the permitting process, soil samples were collected from the Westwind Primary and Westwind Intermediate schools. The testing results indicated signs of historical use of pesticides, which pre-dated the District's ownership of the property. After investigation, it is found that the school buildings sit on an old crop-dusting airport used until the late 1960s. Until recently, state law did not require district to test the soil before building a school. Current site characterization and remediation activities for the entire site are being overseen by the Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program.

For all those years, thousands of students, parents and teachers played baseball in the fields or dug in the sand around the slides. The school district and parents have concerns regarding the exposure and potential health risks. This health consultation will focus on the impact of organochlorine pesticides on the health of Westwind Primary School students and staff.

Discussion

General Assessment Methodology

ADHS generally follows a two-step methodology to comment on public health issues related to environmental exposures. First, ADHS obtains environmental data for the site of concern and compiles a comprehensive list of site-related contaminants. Second, ADHS used health-based comparison values to identify those contaminants that do not have a realistic possibility of causing adverse health effects. For the remaining contaminants, ADHS reviews recent scientific studies to determine if the extent of environmental contamination indicates a public health hazard.

Available Environmental Data for the site

Soil

Grab soil samples were collected at surface, 6-inch below ground surface (bgs), 18-inch bgs, and 36-inch bgs by the Dominion Environmental and analyzed by Environmental Science Corporation from April 30th to June 4th 2009. See Appendix A, Figure 1 for the sampling locations. These samples were tested for organochlorine pesticides by using EPA Method 8081A. ADHS also reviewed information on Quality Assurance (QA)/Quality Control (QC) specifications for field data quality and laboratory data quality to verify the acceptability and adequacy of data. For example, ADHS reviewed available chain of custody sheets, project narratives, and laboratory certifications. The laboratory analysis methods and the QA/AC procedures were appropriate.

This health consultation evaluates the scenario in which students are most likely come into contact with chemicals. Therefore, focus will be placed on surface soil samples (i.e. samples: N1, N3, O1, P1, P2, P5, R1, R2, R3, and R5.)

Air

Based on the soil sampling results, limited airborne pesticides and particle monitoring activities were conducted to address the potential health risks associated with students' activities during class breaks. Three types of samples were collected: total dust samples, airborne pesticide samples and aggressive samples. See Appendix A, Figure 2 for sampling locations.

The total dust (total suspended particles) samples were collected by using a low volume sampling pump with tared 37-mm, 5-µm PVC (Polyvinyl Chloride) filter cassettes, and the pesticide samples were collected by using a low volume pump and OVS (OSHA Versatile Sampler; OSHA: Occupational Safety and Health Administration) sorbet tube with a quartz prefilter. These samples were collected at a height of 1 to 4 feet from the ground over a period of 360 minutes. The samples were tested for total dust using a modified NIOSH Method 0500 by Test America Laboratories, Phoenix, AZ. Based on previous soil detects, concentrations of DDE, Dieldrin and Toxaphene were also tested using NIOSH Method 5600 by Data Chem Laboratories, Salt Lake City, UT.

Exposure Pathway Analysis

Identifying exposure pathways is important in a health consultation, because presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant, thereby allowing the contaminant to be a threat to public health. Exposure pathways have been divided into three categories: completed, potential, and eliminated. There are five elements considered in the evaluation of exposure pathways: (1) a source of contamination, (2) a media such as soil or ground water through which the contaminant is transported, (3) a point of exposure where people can contact the contaminant, (4) a route of exposure by which the contaminant enters or contacts the body, and (5) a receptor population.

Completed pathways exist when all five elements are present and indicate that exposure to a contaminant has occurred in the past and/or is occurring presently. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In eliminated pathways, at least one of the five elements is or was missing, and will never be present. Completed and potential pathways, however, may be eliminated when they are unlikely to be significant. Identifying an exposure pathway does not admit the presence or concentration of potential contaminants; it is simply a way of determining the possibility of exposure as if the contaminants were present in the medium.

The most likely exposures among students are occasional ingestion or infrequent dermal contact with contaminated surface soil. This exposure occurs when students have direct contact with soil in their environment. For instance, when students play outside contaminated soil or dust, particles cling to their hands. Students can then accidentally swallow the contaminants when they put their hands on or into their mouths, as children often do. Factors that affect whether or not students have contact with contaminated soil include the amount of grass cover, weather conditions, the amount of time spent outside, and personal habits. While dermal and inhalation exposure can sometimes be a concern for soil and dust, the primary pathway of concern is ingestion. Table 1 summarizes the pathways for this site. If one or more of the exposure pathways are potential or complete, ADHS then considers whether exposure to the chemicals present may be harmful to people.

Table 1. Exposure pathway evaluation

Exposure Pathway Elements					Time Frame	Type of Exposure Pathway
Source	Media	Point of Exposure	Route of Exposure	Estimated Exposed Population		
Spills	Soil	On-site	Incidental ingestion, inhalation, skin contact	Students, Staff	Past	Completed
					Current	Completed
					Future	Potential
	Air	Ambient air	Inhalation	Students, Staff	Past	Completed
					Current	Completed
					Future	Potential

Selection of Chemicals of Interest: Comparison to health-based comparison values

The health-based comparison values are screening tools used with environmental data relevant to the exposure pathways. The health-based comparison values are concentrations of contaminants that the current public health literature suggest are “safe” or “harmless.” These comparison values are quite conservative, because they include ample safety factors that account for most

sensitive populations. ADHS typically uses comparison values as follows: if a contaminant is never found at levels greater than its CV, ADHS concludes the levels of corresponding contamination are "safe" or "harmless." If, however, a contaminant is found at levels at greater than its comparison value, ADHS designates the pollutant as a *contaminant of interest* and examines potential human exposures in greater detail. Comparison values are based on extremely conservative assumptions. Depending on site-specific environmental exposure factors (e.g. duration and amount of exposure) and individual human factors (e.g. personal habits, occupation, and/or overall health), exposure to levels greater than the comparison value may or may not lead to a health effect. Therefore, the comparison values should not be used to predict the occurrence of adverse health effects.

Soil

Concentrations of the tested chemicals were below their method reporting limits except dichlorodiphenyldichloroethylene (DDE), Dieldrin and Toxaphene. The method reporting limit is the lowest amount of an analyte in a sample that can be quantitatively determined with acceptable precision and accuracy. Therefore, when laboratories report that a chemical was below its reporting limit in a sample that does not mean that the chemical was not present. Rather, it means that chemical was not present at levels that can be reliably measured by the analytical method, and the actual concentration is somewhere between 0 and the reporting limit. ADHS took a common approach by using one-half of the detection limits to represent the exposure concentration.

Table 2. Summary of tested pesticide soil concentrations and their respective comparison values (CVs) in milligrams per kilogram (mg/kg)

Chemical	Number of Samples	Range of detected concentration (mg/kg)	Averaged concentration (mg/kg)	Health-based CVs[a] (mg/kg)	Type of CV	Is it a chemical of interest?
Aldrin	10	< 0.02	0.01	0.032	RSRL[b]	No
α-BHC[c]	10	< 0.02	0.01	0.1	RSRL	No
β-BHC	10	< 0.02	0.01	0.36	RSRL	No
δ-BHC	10	< 0.02	0.01	0.1[d]	RSRL	No
γ-BHC	10	< 0.02	0.01	0.5	RSRL	No
Chlordane	10	< 0.2	0.1	1.9	RSRL	No
DDD[e]	10	< 0.02	0.01	2.8	RSRL	No
DDE[f]	10	< 0.02 — 0.17	0.061	2.0	RSRL	No
DDT[g]	10	< 0.02	0.01	2.0	RSRL	No
Dieldrin	10	< 0.02— 0.048	0.014	0.034	RSRL	No
Endosulfan I	10	< 0.02	0.01	370	RSRL	No
Endosulfan II	10	< 0.02	0.01	370	RSRL	No
Endrin	10	< 0.02	0.01	18	RSRL	No
Hexachlorobenzene	10	< 0.02	0.01	0.34	RSRL	No

Chemical	Number of Samples	Range of detected concentration (mg/kg)	Averaged concentration (mg/kg)	Health-based CVs[a] (mg/kg)	Type of CV	Is it a chemical of interest?
Heptachlor epoxide	10	< 0.02	0.01	0.12	RSRL	No
Methoxychlor	10	< 0.02	0.01	310	RSRL	No
Toxphane	10	< 0.4 — 0.5	0.26	0.5	RSRL	No

a. Note that the health-based CVs refer to an average concentration. Average soil concentrations are used for screening and dose assessment because exposure to soil occurs over a large area and duration of time.
b. RSRL: Arizona Residential Soil Remediation Level
c. BHC: Benzene hexachloride
d. α–BHC is used as a surrogate
e. DDD: dichlorodiphenyldichloroethane
f. DDE: dichlorodiphenyldichloroethylene
g. DDT: dichlorodiphenyltrichloroethane

Air

The analytical results showed that concentrations of total dust and pesticide in air samples collected from the school and from an off-site location south of the school are at similar levels. Concentrations of the total dust and tested chemicals were below their respective method reporting limits. One-half of the detection limits were used to represent the exposure concentrations. In addition, all dust particles are assumed to be respirable. These assumptions are conservative and may overestimate the health risks. Table 3 indicated that dieldrin and toxaphene exceed their respective CVs. Thus, they were kept for further evaluation.

Table 3. Summary of total dust and pesticide concentrations and their respective comparison values (CVs) in milligrams per kilogram (μg/m^3)

Chemical	Number of Samples	Range of detected concentration (μg/m^3)	Averaged concentration (μg/m^3)	Health-based CVs[a] (μg/m^3)	Type of CV	Is it a chemical of interest?
Total dust (4' from ground)	4	< 264 — < 291	140	150	NAAQS[b]	No
DDE[c] (4' from ground)	5	< 0.0098—< 0.011	0.0052	0.025	RSL[d]	No
Dieldrin (4' from ground)	5	< 0.0098—< 0.011	0.0052	0.00053	RSL	**Yes**
Toxaphene (4' from ground)	5	< 0.49 —< 0.53	0.256	0.0076	RSL	**Yes**

a. Note that the health-based CVs refer to an average concentration. Average soil concentrations are used for screening and dose assessment because exposure to ambient air occurs over a large area and duration of time.
b. NAAQS: National Ambient Air Quality Standard for particulate matter 10 (PM_{10}). All dust particles are assumed to be respirable.
c. DDE: dichlorodiphenyldichloroethylene
d. RSL: US Environmental Protection Agency, Regional Screening Level of Chemical Contaminants

Public Health Implication

Soil

ADHS used averaged concentrations to evaluate the potential health effects because they are most representative of the concentration that would be contacted at a site, over time. For example, if we assume that an exposed individual moves randomly across an exposure area, the spatially averaged soil concentration can be used to estimate the true average concentration contacted over time. In this example, the average concentration contacted over time would equal the spatially averaged concentration over the exposure area. While an individual may not actually exhibit a truly random pattern of movement across an exposure area, the assumption of equal time spent in different parts of the area is a reasonable approach.

As shown in Table 2, none of the averaged concentrations of detected chemicals exceeded their respective health-based comparison values. Therefore, ADHS does not expect to see harmful effects from exposure to chemicals in the soil.

Air

Dieldrin

Dieldrin is an organochlorine insecticide. From the 1950s until 1970, dieldrin was widely used as a pesticide for crops such as corn and cotton. Dieldrin was also used to control locusts and mosquitoes and as a wood preservative. Because of concerns about damage to the environment and potentially to human, US Environmental Protection Agency (EPA) banned all uses of dieldrin in 1974, except to control termites. In 1987, EPA banned all uses. EPA considers dieldrin to be a persistent, bioaccumulative, toxic pollutant. Sunlight and bacteria biodegrade the related pesticide, aldrin, to dieldrin. Both pesticides bind tightly to soil and evaporate slowly. In both soil and water, dieldrin breaks down very slowly. (ATSDR 2002)

Animals exposed to high levels of dieldrin experienced nervous system effects. Studies showed that some workers exposed to moderate levels in the air for a long time has headaches, dizziness, irritability, vomiting, and uncontrolled muscle movement. Workers removed from the source of exposure rapidly recovered from most of these effects. Dieldrin is carcinogenic in animals via oral exposure, but this effect appears to be specific to the mouse liver. The International Agency for Research on Cancer (IARC) has categorized dieldrin as Group 3 (unclassifiable as to human carcinogenic potential) chemicals. Based on the finding of liver tumors in mice, EPA classified dieldrin as B2, probable human carcinogens; however, current mechanistic data suggest that the mouse carcinogenicity data may not be highly relevant to humans. Based on the animal data, EPA estimates the dieldrin unit risk (the excess cancer risk associated with lifetime exposure to 1 $\mu g/m^3$) is 0.0046 per $\mu g/m^3$ through inhalation exposure (ATSDR 2002).

ADHS used a mathematical model to estimate a theoretical opportunity of a person developing cancer from inhalation exposure. Appendix B shows the formula and assumptions used to calculate the theoretical inhalation cancer risks. The theoretical inhalation cancer risk is 4.1×10^{-7} for students and 1.1×10^{-6} for staff (See Table 4). These cancer risks are considered to be very

low for students and low for staff based on the qualitative ranking of cancer risk estimates (See Appendix C).

Toxaphene

Toxaphene was a widely used pesticide on cotton, other crops, and in livestock and poultry. In 1982, most of its uses were stopped, and in 1990, all uses were stopped in the US. At very high levels, long-term inhalation exposure to toxaphene in humans results in reversible respiratory toxicity. Studies in animals show that long-term exposure (1-2 years) to toxaphene can damage the liver, kidneys, adrenal glands, and immune system, and may cause minor changes in fetal development (ATSDR 1996).

With regards to cancerous health effects, a study by the National Toxicology Program reported an increase in liver tumors in mice and an increase in thyroid tumors in rats when fed toxaphene in the diet. Several human studies were unable to conclude the incidence of cancer associated with inhalation exposure to a number of pesticides, including toxaphene, due to lack of information on exposure levels and concurrent exposure to other pesticides. ADHS' calculations showed that the theoretical inhalation cancer risk is 1.4×10^{-6} for students, and 3.8×10^{-6} for staff. These cancer risks are considered to be low based on the qualitative ranking of cancer risk estimates (See Appendix C).

Cumulative Risk

To address the potential for cumulative effects from multiple chemicals occurring through more than one exposure pathway, ADHS assumed the adverse health effects are additive and calculated the theoretical cumulative risk by summing the theoretical cancer risk for each contaminant. For students, the estimated theoretical cumulative excess lifetime cancer risk is 1.8×10^{-6}. For staff, the estimated theoretical cumulative excess lifetime cancer risk is 4.9×10^{-6} (See Table 4). Both of the estimated theoretical cumulative excess lifetime cancer risks are considered to be low based on the qualitative ranking of cancer risk estimates (See Appendix C). In addition, they are within the range of public health guidelines (10^{-6}~10^{-4}) for protection of human health as suggested by EPA. Therefore, ADHS determined it is unlikely that staff at the school would experience harmful effects from dieldrin and toxaphene in the air. For students, the estimate childhood exposures are not expected to contribute to cancer effects at anytime later in life.

Table 4. Theoretical cancer risks due to air inhalation.

Chemical	Students	Staff
Dieldrin	4.1×10^{-7}	1.1×10^{-6}
Toxaphene	1.4×10^{-6}	3.8×10^{-6}
Total Cancer Risk	1.8×10^{-6}	4.9×10^{-6}

ATSDR Child Health Concern

ADHS considers children in its evaluations of all exposures, and we use health guidelines that are protective of children. In general, ADHS assumes that children are more susceptible to chemical exposures than are adults. Children six years old or younger may be more sensitive to the effects of pollutants than adults. Children generally have lower body weights, breathe more air by body weight and air that is closer to the ground, and are more often in contact with the ground than adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. The CVs used in this health consultation were developed to be protective of susceptible populations such as children.

Conclusions

Soil

The detected levels of pesticides in soil at Westwind Primary School are not expected to harm the health of students and staff because the measured levels were below their respective health screening values for adverse health effects. Based on the detected levels and the amount of time spent in the school, ADHS does not consider that there is a health threat to students and staff at the Westwind Primary School.

Air

The detected levels of total dust and pesticides in the air are not expected to harm the health of students and staff. The detected concentrations of total dust and DDE were within their respective health screening values for adverse health effects. For dieldrin and toxaphene, the estimated theoretical cumulative excess lifetime cancer risks are considered to be low based on the qualitative ranking of cancer risk estimates (See Appendix C). In addition, they are within the range of public health guidelines (10^{-6}~10^{-4}) for protection of human health as suggested by EPA. Therefore, ADHS does not consider that there is a health threat to students and staff at the Westwind Primary School.

Recommendations

- Develop a safety and pollution control plan to ensure the health and safety of the students and staff during renovation process.

Public Health Action Plan

- ADHS will continue to review and evaluate data provided for the site.
- ADHS will attend public meeting, make presentation, and develop handout literature as requested by the school.

References

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Certification

This Health Consultation entitled *Westwind Primary School, Maricopa County, Arizona* was prepared by the Arizona Department of Health Services 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. Editorial review was completed by the cooperative agreement partner.

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The Division of Health Assessment and Consultation, Agency for Toxic Substance and Disease Registry, has reviewed this health consultation and concurs with its findings.

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Appendix A

Sample location circles are not shown to scale - the actual locations are smaller diameter.

Figure 1. Westwind Primary School Soil sampling location map.

Sample Locations from April 30, 2009

Figure 2. Westwind Primary School air sampling location map.

Appendix B

Formula and assumptions used to calculate cancer risk from air inhalation:

$$\text{Chronic Daily Intake (mg/kg/day)} = \frac{\text{AC} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

$$\text{Cancer Risk} = \text{Chronic Daily Intake} \times \text{SF}$$

Variable			Dieldrin		Toxaphene	
			Students	Staff	Students	Staff
AC	Chemical concentration in air	mg/m^3	0.0000052	0.0000052	0.000256	0.000256
IR	Inhalation rate	m^3/day	12[a]	20	12	20
EF	Exposure frequency	days/year	40[b]	40	40	40
ED	Exposure duration	years	7[c]	30	7	30
BW	Body weight	kg	27[d]	70	27	70
AT	Averaging time	days	25,550	25,550	25,550	25,550
SF	Slope Factor	$(mg/kg/day)^{-1}$	16.1	16.1	1.1	1.1

a. Adapted from "Investigating Human Exposure to Contaminants in the Environment: A Handbook for Exposure Calculation. Health Canada (1995)"
b. 40 days = 238 days/year (days attending school per year) × 4 hours/day (the amount of time spend outdoor while at school)
c. From age 5 to 12
d. Adapted from "Investigating Human Exposure to Contaminants in the Environment: A Handbook for Exposure Calculation. Health Canada (1995)"

Appendix C

Qualitative Descriptors for Excess Lifetime Cancer Risk

Cancer Risk	Qualitative Descriptor
Equal to or less than one per million (Cancer Risk $\leq 10^{-6}$)	Very Low
Greater than one per million to less than one per ten thousand (10^{-6} < Cancer Risk $\leq 10^{-5}$)	Low
Greater than one per ten thousand to less than one per thousand (10^{-5} < Cancer Risk $\leq 10^{-4}$)	Moderate
Greater than one per thousand to less than one per ten (10^{-4} < Cancer Risk < 10^{-1})	High
Equal to or greater than one per ten (Cancer Risk $\geq 10^{-1}$)	Very High

An estimated increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is a plausible upper-bound estimate of the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant.

There is insufficient knowledge of cancer mechanisms to decide if there exists a level of exposure to a cancer-causing agent below which there is no risk of getting cancer, namely, a threshold level. Therefore, every exposure, no matter how low, to a cancer-causing compound is assumed to be associated with some increased risk. As the dose of a carcinogen decreases, the chance of developing cancer decreases, but each exposure is accompanied by some increased risk.

There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. The EPA considers an acceptable cancer risk range from 10^{-6} to10^{-4}.