

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
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**SUBJECT:** Interior Dust Samples  
Nitro, WV Community Center and Schools

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In May 2005, several interior dust samples were collected from the Community Center, the elementary school and the high school in Nitro, West Virginia. This task was conducted by a private contractor hired by a law firm representing some residents in the community. The analytical findings of this effort were then provided to U.S. EPA for evaluation. The request to formally evaluate these data was made by the School Board in Nitro, West Virginia on 4 August 2005.

The purpose of this memo is to summarize the results of the dust sampling conducted in May 2005, to project the potential risks associated with exposure to the levels of dioxin measured in the Nitro Community Center and schools, and to identify the uncertainties related to this evaluation. Additionally, this memo provides generic background information on dioxin.

## I. UNCERTAINTIES

As with all projections of potential risk, uncertainties exist that can impact conclusions to varying degrees. In this particular case, in addition to the generic unknowns associated with most risk evaluations (exposure and toxicity assumptions), significant uncertainties pertaining to data quality and representativeness merit mentioning. These are discussed below in more detail, and must be considered when determining the need for further action (or not).

### **I.A. Sample Characterization**

The precise method and locations of sample collection are not known. These factors can have a profound effect on assumptions related to contact with contaminated media and, therefore, projections of risk. Samples collected from generally inaccessible areas are of less concern, for example, than samples collected from desk or table tops. During a conference call on 4 August 2005, U.S. EPA was told by School Board representatives that the interior dust samples evaluated for this memo were collected primarily from ceiling rafters. From an exposure perspective, contaminated dust in areas of infrequent contact (such as ceiling rafters) pose much less of an exposure threat (and, consequently, less risk) than projected in this memo.



### **I.B. Quality Assurance**

U.S. EPA employs very strict protocols for sample collection and analysis, as well as for the intermediate steps between these two tasks. This Quality Assurance/Quality Control process, which includes data validation, allows the Agency to make statements about the quality and level of confidence in results. This information was not provided to U.S. EPA for the data set evaluated in this memo. A gap of this sort is reflected in the analytical findings for the Community Center dust sample – which happens to have the highest observed levels of contamination. The analytical summary sheet indicates that most of the contaminant concentrations in this sample are “greater than” some reported value. This is not a typical observation or reporting method. No explanation is given for why the data are reported in this manner, casting doubt on the validity of these findings.

### **I.C. Risk Considerations**

Of the exposures evaluated, assumptions regarding contact with observed contamination were generally very conservative (protective) and, in this regard, likely overestimate actual or potential risks.

Conversely, other sources of exposure – such as through the food chain or through contact with other areas of contamination – could contribute to an individual’s overall risk. These potential contributions are not reflected in the risk estimates provided in this memo.

## **II. SUMMARY OF NITRO DATA**

In May 2005, the contractor hired by attorneys representing plaintiffs in a lawsuit collected interior dust samples from the Community Center (four grab samples), the elementary school (one composite sample) and the high school (four grab samples) in Nitro, West Virginia. Additionally, a single sample labeled “Filter Composite” from all three locations was analyzed for dioxin. The maximum levels reported by the lab (in terms of 2,3,7,8-TCDD equivalents) for the Community Center, the high school and the elementary school, respectively, were greater than 865 ppt, 496 ppt and 173 ppt.

## **III. POTENTIAL RISKS**

### **III.A. Receptors**

Upon consideration of the sampling locations, several exposure scenarios were evaluated for risk. At the Community Center, the receptors with the greatest potential for exposure were determined to be young children in day care and full-time workers. At the elementary school, the potential risk to students was assessed. At the high school (where observed dioxin concentrations were greater than at the elementary school), risks to students and teachers were estimated.

### **III.B. Exposure Routes**

Inadvertent ingestion and dermal contact with dust on surfaces were considered to be the most significant exposure routes under these scenarios. Inhalation of airborne particles was not evaluated quantitatively because, in addition to being highly subjective (due to the modeling that

would be necessary to estimate air concentrations in the breathing zone), this route is unlikely to contribute significantly to overall risk.

### III.C. Exposure Inputs

In general, to the extent available, default exposure parameters were used in the dose equations to project potential risks. These assumptions tend to be upperbound estimates and, therefore, are typically conservative (protective), representing conditions of maximum exposure. Under circumstances where default parameters were not available, explanations are provided below. Details regarding the risk calculations can be found in the attached tables.

Exposure Point Concentration (EPC) - For each sample, the total dioxin concentration (in terms of 2,3,7,8- TCDD equivalents) was calculated by U.S. EPA by applying TEQs developed by the World Health Organization (1998). These TEQ values currently represent best science. The maximum TEQ concentration measured at each location – the Community Center (756 ppt), the high school (358 ppt), and the elementary school (161 ppt) – was conservatively assumed to represent the relevant EPC for each receptor. This assumption assumes that the highest detected level of contamination is uniformly present on all surfaces, and that exposure to this concentration is constant throughout the duration of exposure.

Note that the total dioxin concentrations reported by the lab differed from those calculated by U.S. EPA. The maximum results given by the lab tended to be slightly higher than those estimated by U.S. EPA for the Community Center (greater than 865 ppt vs. 756 ppt), the high school (496 ppt vs. 358 ppt), and the elementary school (173 ppt vs. 161 ppt). The likely explanation is that the lab used different (older) TEQ values than U.S. EPA.

Contact Rate (CR) - For ingestion of contaminated dust, default values for inadvertent soil consumption under either a residential or worker scenario (as appropriate for each receptor), was assumed. For children in day care, a CR of 200 mg/day (residential) was used. For elementary and high school students, 100 mg/day (residential) was assumed. The default CR for workers (at the Community Center and for teachers) was 50 mg/day.

Note that the use of residential soil CRs for non-residential scenarios – for children in day care and for students (elementary and high school) – is very conservative, due to the difference in medium (dust vs. soil), the limited number of hours spent each day at these locations, and the difference in activities (school vs. home).

Fraction Ingested (FI) - This parameter is related to CR. The FI was assumed to be 1. That is, in risk calculations, 100 percent of the dust ingested was considered to be from the contaminated source.

Surface Area (SA) - A component of the dermal route of exposure is the skin SA available for contact with contaminated media. The values used in this risk evaluation were derived from U.S. EPA's Risk Assessment Guidance for Superfund - Part E (2004). For children in day care, this input is based on the SA of the head, hands, forearms and lower legs in children between zero and six years old (2800cm<sup>2</sup>). For high school students, this value represents the SA of the head, hands, forearms and lower legs of adults (5700 cm<sup>2</sup>). For elementary school students, the arithmetic average of young children and adults was applied (4250 cm<sup>2</sup>). For workers, the SA of the head, hands and forearms of adults (3300 cm<sup>2</sup>) was assumed.

Exposure Frequency (EF) - Default EF assumptions were not available for children in day care, for elementary or high school students, or for teachers. For these receptors, best-professional judgement was used to estimate appropriate EF values. For children in day care, an EF of 250 days per year was assumed; this is the default value for full-time employees, and was also used for Community Center workers. For elementary and high school students, 180 days per year was considered to be the relevant EF. For teachers, 180 days per year plus 14 days (to represent preparation time when school is not in session), for a total of 194 days per year, was assumed to be the appropriate EF.

Exposure Duration (ED) - Default ED assumptions were not available for children in day care, elementary school students, or high school students. For these receptors, best-professional judgement was used to estimate appropriate ED values. For children in day care and elementary school students, an ED of six years was assumed. For high school students, four years was considered to be the relevant ED. A default ED for full-time workers (both at the Community Center and for school teachers) was available (25 years) and used to project potential risks to these receptors.

Body Weight (BW) - For children between the ages of zero and six years and for adults, default BW values of 15 kg and 70 kg, respectively, were used. However, for elementary and high school students, respective mean BWs of 25 kg and 60 kg were calculated based on recommendations given by U.S. EPA's Exposure Factors Handbook (1997) for these age ranges.

### **III.D. Risk Projections**

Estimates of potential cancer risks for each of the receptors considered in this memo are provided below:

Day Care Child - Of the receptors evaluated in this memo, the greatest potential risk is to young children in day care. The excess cancer risk associated with exposure under the described conditions is  $9.1 \times 10^{-5}$ , representing an increased cancer risk of 91 in one million. (Please refer to Table 1 for details.) This falls within U.S. EPA's generally acceptable risk range of  $10^{-6}$  to  $10^{-4}$ . The need for action is generally triggered when risks exceed  $10^{-4}$ .

Community Center Worker - The incremental cancer risk to full-time workers in the Community Center was estimated to be  $2.3 \times 10^{-5}$ , or 23 in one million. (Please refer to Table 2 for details.) This falls within U.S. EPA's generally acceptable risk range of  $10^{-6}$  to  $10^{-4}$ .

High School Student - The excess cancer risk projected for high school students is  $2.8 \times 10^{-6}$ , representing an increased cancer risk of 3 in one million. (Please refer to Table 3 for details.) This falls within U.S. EPA's generally acceptable risk range of  $10^{-6}$  to  $10^{-4}$ .

Teacher - Using the maximum concentration detected at either school, the potential incremental cancer risk to teachers is  $8.3 \times 10^{-6}$ , or 8 in one million. (Please refer to Table 4 for details.) This falls within U.S. EPA's generally acceptable risk range of  $10^{-6}$  to  $10^{-4}$ .

Elementary School Student - The excess cancer risk projected for elementary school students is  $4.4 \times 10^{-6}$ , representing an increased cancer risk of 4 in one million. (Please refer to Table 5 for details.) This falls within U.S. EPA's generally acceptable risk range of  $10^{-6}$  to  $10^{-4}$ .

#### IV. CONCLUSIONS

Under the given conditions and assumptions, none of the scenarios evaluated in this assessment demonstrated an unacceptable risk from exposure to dioxin.

If you have questions or comments regarding the content of this memo, please let me know.  
Thanks.

## APPENDIX A DIOXIN BACKGROUND INFORMATION

### Definition

"Dioxin" refers to a group of compounds sharing certain similar chemical structures and mode-of-action (toxicological) characteristics. The group is comprised of many compounds in three closely-related families: chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans, and certain polychlorinated biphenyls. Dioxins have varying degrees of toxicity, related to the number and positions of chlorine atoms on the core molecule. The most studied – and most toxic – form is 2,3,7,8-TCDD. In general, compounds with chlorine atoms located in the 2,3,7,8 positions of the molecule are most threatening.

### Formation and Release

Dioxin is an unintended byproduct created during combustion of certain types of organic materials (halogenated compounds), during the bleaching of paper, and in certain types of chemical manufacturing and processing. Natural environmental processes, such as forest fires, also produce dioxin. There has been an 80 percent decrease in dioxin releases between 1987 and 1995. As a result, the average body burden of dioxin has declined from 55 parts per trillion (ppt) in the late 1980s to 25 ppt in the late 1990s. The half-life of dioxin in the body is 10 years.

### Exposure

Dioxins are highly persistent and accumulate in the tissues of animals. Exposure to dioxin occurs primarily through the food chain; in fact, 95 percent of dioxin exposure for a typical person comes from dietary intake of animal fat. Additionally, breast milk is a significant source of dioxin for nursing infants. Other sources include inadvertent ingestion of contaminated soil, dermal absorption from contaminated soil, water and air, and inhalation of airborne particles.

### Risks

To assess risk, toxicity equivalents (TEQs) are used to rank the carcinogenic potential of dioxin compounds relative to 2,3,7,8-TCDD. Carcinogens cause cancer by damaging DNA, either directly or indirectly. Dioxin does not damage DNA directly, but can switch on genes responsible for cell growth and proliferation; if DNA has been damaged by other carcinogens, dioxin promotes cancer by triggering these abnormal cells to rapidly divide. In lab animals, dioxin exposure has been associated with an increased tumor incidence at multiple sites. In rats, hepatocellular carcinoma (liver cancer) appears to predominate. Epidemiologic studies involving occupationally-exposed males in Sweden and the U.S. imply suggestive evidence of a biological association between phenoxy herbicides (of which 2,3,7,8-TCDD is a contaminant) and soft tissue sarcomas; it is unclear, however, whether increased tumor incidence is related to the herbicides or to the unavoidable contaminants in phenoxy herbicides (such as 2,3,7,8-TCDD).

Regarding non-cancer impacts, the toxicity of dioxin varies dramatically within mammalian species. Guinea pigs, for example, are profoundly sensitive to dioxin exposure, compared to rats. This extreme variation in responses in similar species creates great toxicological uncertainty, making difficult the task of quantifying dioxin risks by simply extrapolating from lab animals to humans. Accidental exposure in human populations has, however, indicated that dioxin produces a broad spectrum of adverse systemic effects. Dioxin can alter the fundamental growth and development of cells, impacting reproduction (hormones) and fetal development (birth defects), suppressing the immune system and causing chloracne, liver damage, neuropathies and psychiatric disturbances.