Indoor Dust Investigation/Interpretation Plan
Stephen Foster Neighborhood
Gainesville, Florida

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Prepared by the Indoor Dust Dioxin Workgroup

U.S. Environmental Protection Agency
Kevin Koporec

U.S. Agency for Toxic Substances and Disease Registry
Lynn Wilder

Florida Department of Environmental Protection
Kelsey Helton
Nancy Murchinson

Florida Department of Health
Randy Merchant, Chair

Alachua County Health Department
Anthony Dennis

Alachua County Environmental Protection Department
John Mousa
Robin Hallbourg

Alachua County Environmental Protection Advisory Committee
Bob Palmer

Protect Gainesville's Citizens, Inc. Technical Advisor
Pat Cline

University of Florida, Center for Environmental & Human Toxicology
Steve Roberts
Leah Stuchal

ARCADIS-US
Paul Anderson

Introduction

The Stephen Foster neighborhood is adjacent to the western boundary of the Koppers portion of the Cabot Carbon-Koppers hazardous waste site in Gainesville, Florida. The pattern of dioxin concentrations in the Stephen Foster neighborhood surface soil suggests wind-blown dust deposition from the Koppers site. In 2010, representatives of some residents reported the presence of dioxin-like compounds in area house dust using the Chemical-Activated Luciferase Expression bioassay test (CALUX®). Residents want to know if the levels of dioxins in their homes are elevated, what the health risks related to dioxins are, and what actions they can take to reduce these risks.

In November 2010, the Florida Department of Health (DOH) formed an indoor dioxin dust workgroup of county, state, and federal agency representatives. The purpose of this workgroup is to develop an indoor dust investigation/interpretation plan and present it to U.S. Environmental Protection Agency (EPA). In March 2011, the workgroup added representatives from the community and the responsible party. The workgroup formulated this plan during several conference calls.

One challenge in interpreting the CALUX® screening test is that it responds to dioxin-like compounds that may not be associated with contamination identified on the Koppers site. Another challenge is that there are many sources of dioxins in indoor dust.

The objectives of this plan, in order of priority, are:

1. To determine the levels of chlorinated dioxins and furans (dioxins) expressed as 2,3,7,8-tetrachlorodibenzo dioxin toxicity equivalents or TCDD-TEQ in the dust from living spaces of homes near the Koppers site using EPA Method 8290 (high resolution gas chromatography/mass spectrometry or HRGC/MS);
2. To compare the levels of dioxins (TCDD-TEQ) in dust from living spaces of homes near the Koppers site to background levels in Gainesville;
3. To provide guidance on assessing the health risk from dioxins (TCDD-TEQ) in dust from living spaces;
4. To investigate the relationship between the levels of dioxins (expressed as TCDD-TEQ) measured in indoor dust using standard EPA method 8290 and the TCDD-Bio TEQ[1] levels determined using EPA screening method 4435 (CALUX®). This is desirable to put the residents' CALUX® data collected in 2010 into perspective, and
5. To identify and quantify specific brominated dioxin-like compounds common in house dust (polybrominated dioxins and furans (PBDD/PBDF) and polybrominated diphenyl ethers (PBDEs)) that could contribute to the reported TCDD-Bio TEQ concentrations of dioxin like compounds in EPA method 4435 (CALUX®).

[1] TCDD-Bio TEQ is the estimate of dioxins and dioxin-like compounds measured by the Chemical-Activated Luciferase Expression bioassay test (CALUX®), EPA method 4435.

This plan assumes children and adult residents accidentally swallow very small amounts of indoor dust (incidental ingestion) due to normal hand to mouth activities such as eating and smoking.

Both indoor and outdoor sources contribute to indoor dust. This plan recommends testing for dioxins in indoor dust samples from Stephen Foster houses as well as "background" houses distant from the Koppers site. Due to other sources of dioxins, dust in "background" houses will likely contain low levels of dioxins.

There are no enforceable federal or state standards for dioxins or dioxin-like compounds in indoor dust. This plan does not propose cleanup levels or provide guidance on how to clean up indoor dust if it is determined an unacceptable health risk exists. Clean up and other risk management decisions are the responsibility of EPA in consultation with the Florida Department of Environmental Protection (DEP).

Background

Koppers Site History - Chemical treatment of wood to prevent rot and decay occurred on the Koppers portion of the Cabot Carbon-Koppers NPL site between 1916 and 2010. Soil on the 90-acre Koppers site is contaminated with dioxins and other chemicals. In 2009, the highest concentration of dioxins (as expressed as 2,3,7,8-tetrachlorodibenzo dioxin toxicity equivalents or TCDD-TEQ) was 170,635 parts per trillion (ppt) in surface soil in the northeastern portion of the site (SS104AA). The highest TCDD-TEQ concentration on the site along the western boundary near the Stephen Foster neighborhood was 907 ppt [AMEC 2007]. In the past, winds likely carried dioxin-contaminated soil (dust) offsite.

Since 2009, consultants for the party responsible for the Koppers site have tested over 90 surface soil samples (0-6 inches deep) in the Stephen Foster neighborhood. They found TCDD-TEQ concentrations from a high of 1,302 ppt in the City of Gainesville easement next to the western Koppers site boundary to a low of 1 ppt northwest of the site (Figure 1) [ARCADIS 2010]. The pattern of decreasing dioxin concentration with distance from the Koppers site suggests that wind-blown dust deposition from the Koppers site is a major source of dioxins in Stephen Foster neighborhood surface soil. Further testing of Stephen Foster neighborhood soils is ongoing to complete the delineation of the extent of dioxin contamination. The selected remedy requires the responsible party cleanup dioxin-contaminated soil in the Stephen Foster neighborhood.

Indoor Dust - Many sources contribute to dust inside homes. Sources of dust from inside the home include:

1. The breakdown of plant and animal materials including food debris, animal hairs/dander, feathers, insect parts from cockroaches and dust mites, human skin scales, and molds/mildew;

2. Cotton and wool from the disintegration of clothing, carpets, and furniture as well as stuffing in mattresses, pillows, quilts, and upholstered furniture;
3. Materials deliberately released indoors including tobacco/fireplace smoke, cosmetic/baby powders, powdered laundry detergents, cooking/food particulates, and various aerosols.

Indoor sources of contaminants include dioxin-like PCBs found in fluorescent light capacitors, paints, caulks, and plasticizers, as well as dioxin-contaminated pesticides and home furnishings that incorporate dioxin-like chemicals [O'Conner 2005, UM 2006].

Indoor dust also comes from sources outside the home. Dust from outside the home can enter directly through open windows and doors and/or from tracking in soil from outdoors. Estimates of the contribution of outdoor soil to indoor dust range between 30 and 70% [Trowbridge 1997, EPA 1998, Layton 2009]. Outdoor sources of dioxins include industrial facilities such as pulp/paper mills and wood treating plants, exhaust from automobiles, lawnmowers, and other internal combustion engines and smoke from grills, fireplaces, and debris/trash fires. Studies of dust from living spaces in homes near dioxin sources found average dioxin TCDD-TEQ levels between 50 and 300 ppt [ATSDR 2007a, 2007b, 2009, EPA 2005, 2008, 2010].

<u>Previous Stephen Foster Neighborhood Indoor Dust Tests</u> – Representatives for some residents provided data on dust samples collected in 2010 inside 116 homes within approximately 2 miles of the Koppers site. They reported that a screening test for dioxin and dioxin-like compounds (EPA method 4435, CALUX®) found between 20 and 1,150 ppt TCDD-BioTEQ in these dust samples [Calwell 2011]. Much of the community concern is based on these results.

In addition to dioxins, CALUX® also detects other chemicals <u>not</u> identified as being related to the Koppers site. This workgroup did not, however, have access to documentation such as method of sample collection, contaminant surface loading (nanograms per square meter), composite vs. discrete sample, and correlation of the screening CALUX® test with standard analytical methods. Without this information, it is not possible to judge the validity of these tests, estimate the health threat, or answer the concerns of nearby residents. Additional information is needed to more accurately interpret these data.

Two aspects of this investigation/interpretation plan will aid in interpretation of existing data:

1. Comparison of the results of the standard EPA method 8290 (HRGC/MS) to EPA screening method 4435 (CALUX®) will help clarify the contribution of dioxins to the TCDD Bio-TEQ concentrations reported by representatives of some residents in some homes.
2. Additional testing of dust samples for brominated compounds that contribute to the response of EPA screening method 4435 (CALUX®) will help identify other sources of dioxin-like compounds. This will allow for a better understanding of

all the chemicals included in TCDD-Bio TEQ. This will help residents better gauge the effectiveness of various risk reduction measures including actions they can take to reduce brominated compounds in indoor dust.

Indoor Dust Studies at Other Sites – Studies at a few other sites have investigated dioxins in indoor dust (Tables 1 - 3). These studies used standard EPA methods 8290 and 1613 to measure specific dioxin isomers and calculate TCDD-TEQ concentrations.

Studies of U.S. homes in background, "unpolluted" areas found average TCDD-TEQ concentrations in indoor dust between 10 and 20 ppt [UM 2006, O'Conner 2005]. Possible sources of dioxins in these background homes were discussed above.

A test of dust from inaccessible or seldom accessed surfaces (top of light fixtures, top of ceiling tiles, top of lockers, etc.) in two schools and a community center in industrial Nitro, WV found elevated dioxin levels (100 to 1,000 ppt TCDD-TEQ). Because there was little exposure, no cleanup was recommended [ATSDR 2007b]. The median concentrations of dioxin in floor dust of 18 homes in an industrial area of Mossville, Calcasieu Parish, LA was 9 ppt TCDD-TEQ (range 0.3 to 83 ppt). These levels did not result in a recommendation for cleanup [ATSDR 2006]. The median concentrations of dioxins in carpet dust of 12 homes near a wood treatment plant and railroad facility in Somerville, TX was 8 ppt TCDD-TEQ (range 3 to 32 ppt). A cleanup was not recommended [CTEH 2008].

A test of dust in nine homes in the flood plain of Michigan's dioxin-contaminated Tittabawassee River, found a median dioxin TCDD-TEQ concentration of 120 ppt (range 55 to 3,100 ppt). Based on this and outdoor soil contamination, EPA declared a public health threat and proposed a cleanup. The responsible party scraped up outdoor soil and cleaned up inside homes by replacing carpets and cleaning upholstery, mattresses, and ductwork [EPA 2008, ATSDR 2007a, ATSDR 2009].

A test of floor dust in 10 Cass Lake, MN homes adjacent to a wood treatment facility found a median dioxin TCDD-TEQ concentration of 61 ppt (range 0.2 to 240 ppt). EPA determined these levels to be a health threat and ordered the responsible party to clean all 40 neighborhood homes by replacing carpeting and cleaning of furniture, drapes, and rugs [EPA 2005, 2010].

Following the collapse of the World Trade Center, a working group of city, state, and federal officials recommended a cleanup goal of 2 nanograms per cubic meter for dioxins (TCDD-TEQ) in indoor dust. This recommendation was based on a cancer slope factor of 1×10^6 $(mg/kg/day)^{-1}$ and a target cancer risk of 1 in 10,000, and assumed no ongoing source of dioxin contaminated dust [WTCIEA 2003].

Analytical Methods - EPA method 8290 (HRGC/MS) is the standard for detection and quantitative measurement of polychlorinated dibenzo-p-dioxins (tetra- through octachlorinated homologues; PCDDs), and polychlorinated dibenzofurans (tetra- through octachlorinated homologues; PCDFs) in a variety of environmental matrices at part-per-trillion (ppt) to part-per-quadrillion (ppq) concentrations. This long-established method is the definitive standard for determining dioxin concentrations in soil, sediment, fly ash, water, sludge (including paper pulp), still bottom, fuel oil, chemical reactor residue, fish tissue, and human adipose tissue.

EPA method 4435 (CALUX®) is a relatively new bio-analytical screening procedure for dioxin-like compounds in soils/sediments. EPA has not validated this method for dust samples. This method is based on the ability of dioxin and related chemicals to activate the aryl hydrocarbon receptor (AhR), a chemical-responsive DNA binding protein that mediates the toxic and biological effects of these chemicals. The CALUX® method compares the bioluminescence response from dioxin-like chemicals in a sample extract to a standard response from different concentrations of 2,3,7,8-TCDD to report a CALUX® TCDD Bio-TEQ concentration in a sample. This method has been compared to the EPA 8290 (HR/GCMS) method for soil samples and there is some correlation.

The TCDD Bio-TEQ concentrations reported by the CALUX® method, however, tend to be higher than the TCDD-TEQ concentrations reported by the HRGC/MS method. To varying degrees, the CALUX® method responds to other compounds including brominated and fluorinated dioxins/furans, biphenyls, and naphthalenes. These compounds can contribute to the reported CALUX® TCDD Bio-TEQ concentration but are not quantified by the standard EPA method 8290 (HRGC/MS).

Specifically, the CALUX® test is responsive to polybrominated diphenyl ethers (PBDEs) which are used as flame retardant in fabrics, electronic plastics (TVs and PCs), and other household products. The CALUX® test is also sensitive to polybrominated dibenzo dioxins (PBDDs), polybrominated dibenzofurans (PBDFs), and polybrominated biphenyls (PBBs) which are all breakdown products of PBDEs and are likely found in indoor dust. Thus CALUX® responds to many brominated compounds found in house dust potentially leading to higher estimates of dioxin concentrations than identified by EPA method 8290.

<u>Attic Dust</u> - Attics accumulate ambient airborne dust. In contrast to living spaces that people routinely clean, attics are rarely cleaned and may accumulate dust for many years. Contaminant levels in attic dust are often higher than in living spaces [Ilacqua 2003]. Because most people access their attics infrequently, exposure to attic dust is limited compared to exposure to dust in living spaces. This is especially true in the Stephen Foster neighborhood where most houses have roofs with low slopes that restrict attic access. At their highest point, most attics in the Stephen Foster neighborhood are less than 5 feet tall.

Therefore, the most important exposure and first priority for testing should be dust from living spaces. Because exposure is limited, ATSDR recommends attic dust not be used to estimate exposure or predict potential health effects [ATSDR 2001]. Therefore, this plan does not recommend attic dust testing at this time. If testing of dust in living spaces finds a significant health threat, EPA should consider testing attic dust in future investigations.

Indoor Dust Investigation/Interpretation Plan

Dust Collection – This plan recommends collection of dust from living spaces inside 10-15 Stephen Foster neighborhood houses primarily in an area west of the Koppers site. Selection of these houses should consider the following:

1. Initially, sampling should focus on homes east of NW 6th Street, where dust deposition from the site is likely highest.
2. Indoor dust samples should be collected from a few homes near the site with the highest soil dioxin concentrations. Because dioxin concentrations in soil and indoor dust levels may not be well-correlated, indoor dust should also be collected from houses at varying distances from the Koppers site and at homes with a range of dioxin soil concentrations.
3. If possible, an indoor dust sample should be collected from some of the nine homes in the Stephen Foster neighborhood east of NW 6th Street previously sampled in 2010 by representatives of some residents using the CALUX® method. Note: the workgroup does not have addresses of these homes.

This plan recommends the collection of dust samples using standard EPA operating procedure 2040 [EPA 2002]. Collection should include one composite dust sample per house. The composite sample should compile dust from high traffic areas: inside the main entrance, the main living area, and a bedroom, preferably a child's. Dust samples should be collected from carpets or rugs using a vacuum. Vacuuming from hard floors is permissible but requires a much larger surface area to obtain the necessary weight of dust. Tape should be used to mark a one square meter sample location on the carpet or floor of each room. If necessary to obtain the required sample weight, a larger sample location should be marked and noted. Vacuuming from a known area allows expression of results in both weight per surface area (nanograms per square meter: ng/m^2) and concentration (ppt).

This plan recommends collection of at least 40 grams of dust for this composite sample from each house, which will provide enough for EPA methods 8290, 4435, 1614, and a special method for PBDDs/PBDFs. Each of these four methods requires approximately 10 grams of dust. Collect enough dust to have 40 grams after the laboratory screens the sample to remove hair, insect parts, food debris, and other large objects. Before any analysis, this plan recommends weighing the entire collected sample in order to calculate the surface loading (in nanograms per square meter).

Also, collect indoor dust samples as described above from 10-15 houses sufficiently distant from the Koppers site to establish Gainesville-specific background levels. Given community concern that dust from the Koppers site is widespread, selection of background houses is a critical element of the sampling program. This workgroup, however, was unable to define a particular distance to be considered background.

Background homes should be far enough away to be unaffected by the Koppers site and other industrial dioxin sources but close enough to be similar in age and other characteristics to those in the Stephen Foster neighborhood. Avoid proximity of samples to known industrial sources of dioxins when possible and note if samples are collected in those areas. These homes should also be distant from areas of frequent outdoor burning. Although previous testing established that soil dioxin levels more than one mile from Koppers are at background levels, selection of at least some background homes for indoor dust testing more than two miles from the Koppers site may help assure some nearby residents who believe contaminated dust from Koppers has spread more than a mile from the site.

When collecting indoor dust samples, the collection team should use a questionnaire. The purpose of the questionnaire is to identify potential sources of dioxins and dioxin-like compounds inside and near the homes. This questionnaire should ask about the age of the house, smokers in the house, recent fires in the house (e.g. appliances that started smoking, stove/grease fires, plastic or paper catching fire, use of candles, etc.), recent remodeling, new appliances/carpets/furniture, frequency of outdoor fires, and any other sources (in addition to the Koppers site) that may contribute to dioxins in indoor dust.

<u>Laboratory Analysis</u> - Priorities for laboratory analysis of indoor dust samples are:

1. Determine the dioxin TCDD-TEQ concentrations in dust from all Stephen Foster and background homes using the standard EPA method 8290 (HRGC/MS). Analytical costs are approximately $1,000 per sample.
2. If resources permit, determine the CALUX® Bio TCDD-TEQ concentration in all Stephen Foster and background homes using EPA screening method 4435 (CALUX®). Analytical costs for EPA method 4435 are approximately $500 per sample.
3. If resources permit, analyze all indoor dust samples for polybrominated dibenzo dioxins and furans (PBDDs and PBDFs) and polybrominated diphenyl ethers (PBDEs) using a method similar to EPA methods 8290 and 1614. If, however, resources are a limiting factor, test for PBDDs, PBDFs and PBDEs in eight to ten samples with the greatest difference in concentration between EPA methods 8290 and 4435. If possible, these samples should represent both Stephen Foster and background homes. (Because of the special/extensive set up and calibration, the laboratory requires at least eight samples.) Waiting for the method 8290 and 4435 results before determining which samples to test for polybrominated compounds will, however, take 8 to 10 weeks longer than analyzing all the samples for polybrominated compounds. On the other hand, it will focus resources on those samples where the polybrominated compounds are most likely to explain the difference between TCDD-TEQ (EPA method 8290) and TCDD Bio-TEQ (EPA method 4435) concentrations.

Only a few laboratories are capable of analyzing for these brominated compounds. Analysis of PBDDs, PBDFs, and PBDEs is not routine and requires special method set-up and calibration by an experienced laboratory. Analytical costs for the polybrominated dioxins and furans are approximately $1,000 per sample. Analytical costs for the polybrominated diphenyl ethers are also approximately $1,000 per sample. This plan recommends consulting with the laboratory for exact costs.

Data Interpretation – Depending on the dust test results, data interpretation may involve multiple steps. This section summarizes some possible data interpretation procedures.

Compare dioxin dust concentrations (as determined by EPA method 8290) in Stephen Foster neighborhood homes to those in background homes. This will help determine if there are elevated dioxin levels in Stephen Foster homes. To be consistent with Florida DEP guidelines, consider using the Wilcoxon Rank Sum test as one of the statistical tests [DEP 2008].

For all homes tested (background and Stephen Foster neighborhood), data interpretation should include a comparison of TCDD-TEQ, TCDD-Bio TEQ and PBDD, PBDF and PBDE concentrations to identify the presence and magnitude of various sources of dioxins and dioxin-like compounds in homes. Comparison of these different measures of dioxins and dioxin-like compounds will shed light on the magnitude of different sources. Data interpretation should include a discussion of all of the sources of dioxins in indoor dust, risk from other chemicals common in indoor dust, and other sources of exposure to dioxins such as diet, and lifestyle factors (smoking, grilling food, fireplaces, etc.).

To identify the source of dioxins in indoor dust, EPA should consider comparing dioxin congener ratios in indoor dust to those in on-site soil. In theory, comparing these ratios or "fingerprints" could establish if Koppers was the source. In practice, however, different indoor/outdoor degradation rates and low concentrations/non-detects in indoor dust make this comparison extremely difficult.

Health Risk Assessment – Because there are no enforceable, environmental standards for dioxins in indoor dust, this plan suggests a health risk assessment to assess the public health risk. Many factors go into a health risk assessment. Some factors such as average body weight are well known. Values for other factors such as the potency of dioxins to cause cancer (slope factor) and the amount of dust ingestion per day are less certain. When estimating a value for less certain factors, health risk assessments err on the side of safety and overestimating the risk. Although unlikely, selecting values that may overestimate the risk is protective of public health.

This plan recommends assessing the health risk from accidentally swallowing very small amounts of indoor surface dust (incidental ingestion) due to normal hand to mouth activities such as eating and smoking. Young children have a higher exposure to indoor surface dust than adults do because they crawl on the floor and they put their hands, toys, and other objects in their mouth. Multiplying the dust dioxin concentration times a dust ingestion rate and dividing by the body weight produces a dose estimate in milligrams per kilogram per day (mg/kg/day). Comparing this dose estimate to doses from animal tests and human epidemiological studies determines the risk of non-cancer illnesses. The dose estimate multiplied by the cancer potency (slope factor) determines the theoretical increased cancer risk.

In addition to concentration, a health risk assessment should consider the weight of dust per surface area in a house. Because the rate of dust generation and frequency of cleaning varies from one house to another, the amount of dust in each house will vary. In general, dusty houses tend to have larger dust particles (the larger particles have a lower surface area to contaminant ratio) and therefore lower contaminant concentrations. On the other hand, less dusty houses tend to have smaller dust particles (smaller particles have a higher surface area to contaminant ratio) and thus higher contaminant concentrations. Therefore, the amount of contaminant available for ingestion by surface area is important.

Non-Cancer Risk - To evaluate the risk of non-cancer illness, consider the range of dust concentrations, the mean, the 95% upper confidence level, and the maximum. Calculate a child dose using an indoor dust ingestion rate of 60 mg/day [Stuchal & Roberts 2011], and a body weight of 16 kilograms. Unlike soil and water, there is no widely used, standard indoor dust ingestion rate. Stuchal and Roberts based their dust ingestion rate on a recent review of the literature. Before evaluating the non-cancer risk, this plan recommends checking for any EPA updates on child dust ingestion rates.

To evaluate the risk of non-cancer illness, compare the estimated maximum dose to the ATSDR oral minimal risk levels (MRLs) [ATSDR 1998]. There are no EPA reference doses (RfDs) for dioxins.

ATSDR acute MRL (< 14 days) = 2×10^{-4} ug/kg/day
ATSDR intermediate MRL (14-365 days) = 2×10^{-5} ug/kg/day
ATSDR chronic MRL (>365 days) = 1×10^{-6} ug/kg/day

For doses above the corresponding ATSDR MRL, this plan recommends determining the human health risk using reproductive and developmental studies of Rhesus monkeys (studies #219, 220, 221, 225, 226, and 227 on page 114-115 of the ATSDR toxicological profile) [ATSDR 1998].

Cancer Risk - To evaluate the risk of cancer, this plan recommends calculating an age-adjusted dose using equation # 3 on page 23 of the EPA Risk Assessment Guidelines (RAGS) Part B [EPA 1991]. Child and adult dust ingestion rates should be substituted for child and adult soil ingestion rates. When deciding on the dust concentration to use, consider the range of values, the mean, the 95% upper confidence level, and the maximum value. To be consistent with assessments in the EPA Record of Decision for this site, use an oral cancer slope factor of 150 $\mu g/kg/day^{-1}$.

This plan recommends using an adult indoor dust ingestion rate of 11 mg/day [Stuchal & Roberts 2011]. Before evaluating the cancer risk, this plan recommends checking for any EPA updates on adult dust ingestion rates.

Additional Considerations - The results from EPA method 4435 (CALUX®) should not be used to assess potential health risks. The results from method 4435 should, however, be compared to those obtained using EPA method 8290. Use the difference in concentrations to determine the relative difference of response between the two methods. This will help provide perspective for the CALUX® indoor dust data previously reported by representatives of some residents.

If the dioxin dust concentrations in Stephen Foster homes are statistically higher than background and are a significant health risk, this plan recommends testing additional houses to delineate the extent of houses with elevated dioxin levels. Depending on the health risk level, state and federal regulatory agencies should consider remediation of these houses. The appropriate agencies should also work with homeowners to reduce those exposures not related to the Koppers site.

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Figure 1. 2009 and 2010 Dioxin Concentrations (2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence, TCDD-TEQ) in Stephen Foster Surface Soil (0-6 inches deep)

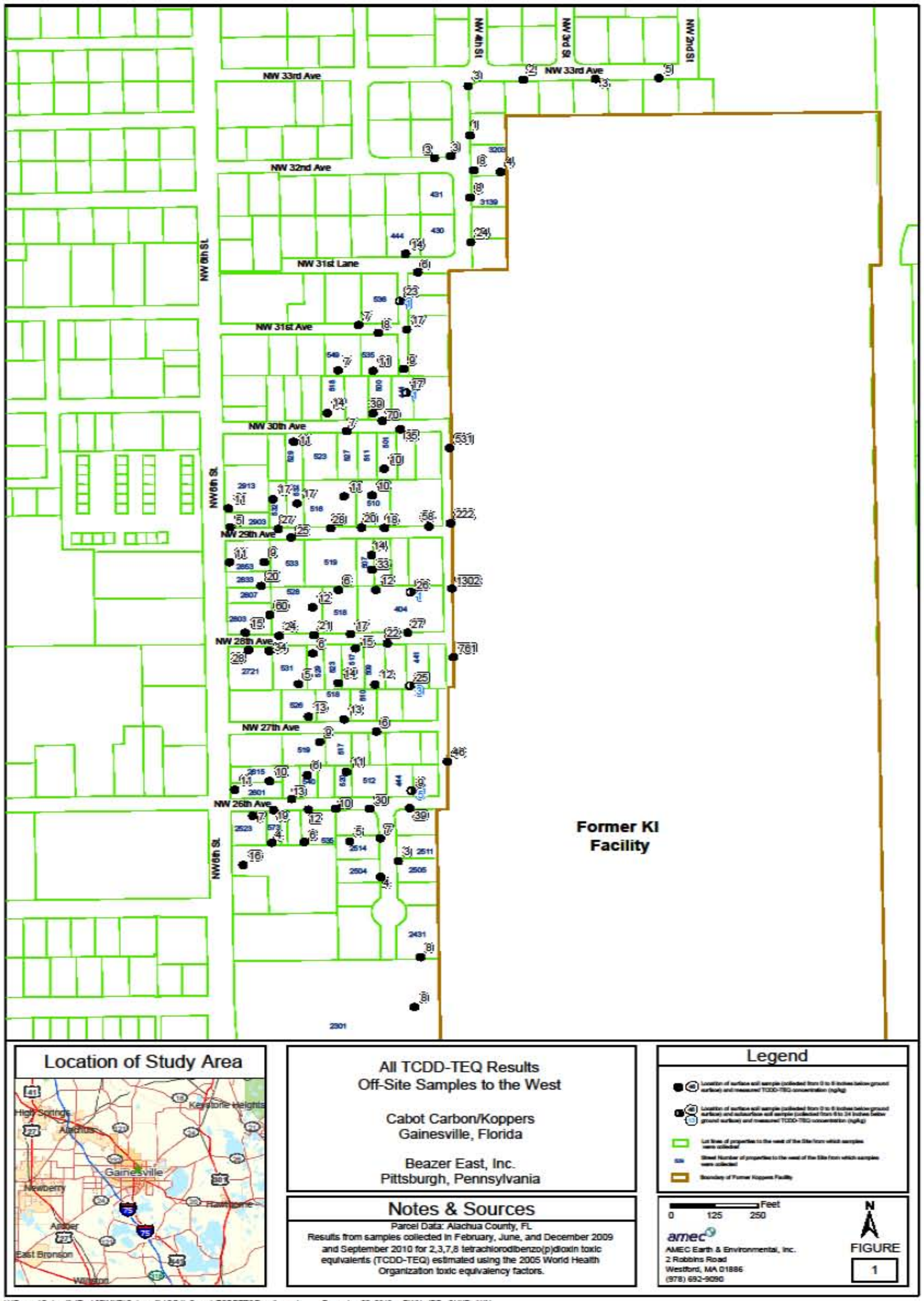

Table 1. Background Indoor Dust Dioxin Concentrations[1]

Site Location	Nearby Industry	Reference	Test Date	Sample Location	Sample Method	n	Analytical Method	Dioxin TEQ Loading (ng/m^2)	Dioxin TEQ Concen. (ng/kg)	Study Conclusions/Remediation	Web Link
Jackson/Calhoun Counties, MI	none (unpolluted)	U of M 2006	2005?	living room and hallway floors	vacuum HVS-3	198	EPA 8290	unspecified	2 to 1,092 med = 11	houses in an area with no known industrial source of dioxins	J
Columbia, MS	none (unpolluted)	O'Conner 2005	2004?	interior carpets	vacuum	6	EPA 8290	unspecified	1.3 to 23 med = ?	average of all samples ~ 20 ng/kg	I
				inaccessible surfaces		8			2.8 to 54 med = ?		
Cameron, Caldwell, and Clay, TX	none (unpolluted)	CTEH 2008	2007	carpets	vacuum	3	EPA8290	0.004 to 0.012 med = 0.01	unspecified	background location	H

Table 2. Indoor Dust Dioxin Concentrations Near Industrial Facilities[1]

Site Location	Nearby Industry	Reference	Test Date	Sample Location	Sample Method	n	Analytical Method	Dioxin TEQ Loading (ng/m^2)	Dioxin TEQ Concen. (ng/kg)	Study Conclusions/Remediation	Web Link
Columbus, MS	wood treat (Kerr McGee)	Dahlgren 2003	1999-2001	kitchen countertops and baseboards	wipe	11	EPA 8290 ?	unspecified	bdl to 0.4 med = ?	wood treatment plants need regulation	G
Somerville, TX	railroad (BNSF) wood treatment (Koppers)	CTEH 2008	2007	home carpet	vacuum	12	EPA 8290	0.003 to 0.240 med = 0.02	3 to 32 med = 7.7	1) homes/schools are unaffected by industry 2) dioxin dust levels are similar to other communities 3) dioxin levels are below health guidelines	H
				schools carpet		3		0.060 to 0.150 med = 0.09	6 to 26 med = 9.8		
Mossville, LA (Calcasieu Parish)	numerous	ATSDR 2006	2005	entryway & TV room	vacuum w/HEPA filter	18	EPA 8290	Unspecified	0.3 to 83 med = 8.9	Dioxin levels in living area dust are not a health concern	A
Midland, MI (Tittabawassee River)	Dow Chemical	ATSDR 2007a	2003	entryway	vacuum w/HEPA filter	11	EPA 1613	0.0002 to 0.06 med = 0.03	7.5 to 120 med = 47	no state or federal guidelines for indoor dust; health effects are unknown.	D
				living area		11		0.001 to 0.02 med = 0.04	11 to 267 med = 57		
Midland, MI (Tittabawassee River)	Dow Chemical	ATSDR 2009 & EPA 2008	2008	indoor (unspecified)	vacuum?	9	EPA 8290?	unspecified	55 to 3,100 med = 120	public health hazard: PRP replaced carpets & cleaned ducts, mattresses, and upholstery	E, K
					wipe	5		0.06 to 0.21 med = unspcfed.	unspecified		
Cass Lake, MN	wood treatment (St. Regis)	EPA 2005, 2010	2004	entryway & main living area floors	vacuum	10	EPA 8290	0.005 to 33 med = 4.3	0.2 to 240 med = 61	interim measure: replace carpets/air filters. Clean ducts, drapes, rugs & upholstery in all 40 homes ($212K)	B
Nitro, WV	Monsanto	ATSDR 2007b	2006	inaccessible surfaces in school & center	vacuum HVS-3	9	unspecified	unspecified	100 to 1,003 med = 323	no health hazard because little exposure to inaccessible surfaces	C

Table 3. Attic Dust Dioxin Concentrations Near Industrial Facilities[1]

Site Location	Nearby Industry	Reference	Test Date	Sample Location	Sample Method	n	Analytical Method	Dioxin TEQ Loading (ng/m^2)	Dioxin TEQ Concen. (ng/kg)	Study Conclusions/Remediation	Web Link
Alexandria, LA	wood treatment	Feng 2010	2009?	attic	vacuum HVS-4	21	EPA 8290	unspecified	32 to 3,936 med = 165	contaminants from wood treatment facility	F
Florala, AL	wood treatment	Feng 2010	2009	attic	vacuum HVS-4	11	EPA 8290	unspecified	8 to 641 med = 78	contaminants from wood treatment facility	F
Grenada, MS	wood treatment	Feng 2010	2009	attic	vacuum HVS-4	14	EPA 8290	unspecified	13 to 383 med = 112	contaminants from wood treatment facility	F
Pineville, LA	wood treatment	Feng 2010	2009	attic	vacuum HVS-4	14	EPA 8290	unspecified	11 to 3,437 med = 298	contaminants from wood treatment facility	F
Mossville, LA (Calcasieu Parish)	numerous	ATSDR 2006	2005	attic	vacuum w/ HEPA filter	16	EPA 8290	unspecified	0.3 to 923 med = 17		A

[1] = There are no state or federal standards for concentrations of dioxin in indoor dust. ng/m^2 = nanograms per square meter. ng/kg = nanograms per kilogram. bdl = below detection limit. med = median

Table References

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ATSDR 2007a. Agency for Toxic Substances and Disease Registry. Health Consultation. Exposure Investigation Report. A Pilot Exposure Investigation: Dioxin Exposure in Adults Living in the Tittabawassee River Floodplain, Saginaw County Michigan. November 1, 2007.

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O'Connor 2005. Rod O'Connor and Justin Sabrsula. Background Dioxins in House Dust. Environmental Forensics, 6:283-287, 2005. Taylor & Francis, Inc.
U of M 2006. University of Michigan. Measuring People's Exposure to Dioxin Contamination Along the Tittabawassee River and Surrounding Areas: Finding from the University of Michigan Dioxin Exposure Study. Ann Arbor, MI: University of Michigan. August 2006.

Table Web Links

A = http://www.atsdr.cdc.gov/HAC/pha/CalcasieuEstuary/CalcasieuEstuaryHC031306.pdf
B = http://www.epa.gov/region5/cleanup/stregis/
C = http://www.atsdr.cdc.gov/HAC/pha/NitroSchoolDioxinSite/NitroSchoolDioxinHC041807.pdf
D = http://www.atsdr.cdc.gov/HAC/pha/TittabawasseeRiver/TittabawasseeRiverHC110107.pdf
E = http://www.atsdr.cdc.gov/HAC/pha/Dow-ResidentialSoilsResPropTRiver/DioxinContaminationonResidentialPropertyintheTittabawasseeRiverFloodplain8-19-2009.pdf
F = http://findarticles.com/p/articles/mi_hb6679/is_6_73/ai_n56541508/
G = http://www.ncbi.nlm.nih.gov/pubmed/12854689
H = http://www.somervillefacts.com/img/assets/docs/Goad_somerville-environmental-assessment.pdf
I = http://www.informaworld.com/smpp/content~db=all~content=a725780694
J = http://www.sph.umich.edu/dioxin/PDF/BDS_new_region_forwebsite/BDS_2005_17/Dust_2005_17.pdf
K = http://www.epa.gov/region5/cleanup/dowchemical/pdfs/dowchemical_aoc_20080715.pdf

Special Notes on this Report from Individual Workgroup Members

Additional Comments by Bob Palmer

This dust/dioxin sampling plan was developed carefully and thoughtfully and I endorse it. During the course of its development, I suggested (but the Task Force did not agree) that the first round of tests should include dust samples from a few local schools. Earlier this year, soil samples taken outside three local schools showed safe dioxin levels, so in all likelihood dust samples from inside the schools will also be safe. However, in light of community concerns about dioxins in schools as well as the heightened vulnerability of children to these chemicals, it seemed sensible to include schools in the first round of dust sampling. Although this will not be the case, I would recommend that school testing be included in any future rounds of dust analysis.

Additional Comments by Alachua County Environmental Protection Department (ACEPD)

This workplan limits the initial focus area for house dust testing to homes east of NW 6th Street near the former Koppers site. If the validated data from the HRGC/MS Method 8290 testing indicate levels of dioxins in the preliminary neighborhood test area are above background levels and pose an elevated heath risk, ACEPD recommends the expansion of the indoor dust testing for dioxins to the adjacent areas of the Stephen Foster Neighborhood and to nearby schools in future rounds of sampling.

While addressed in this workplan, ACEPD wants to reinforce the need for FDOH and USEPA to provide practical guidance to homeowners on how to reduce the potential impacts to their homes from brominated and other dioxin-like chemicals that may be contained in house dust regardless of whether these chemicals are linked to discharges from the Koppers site.

A carefully considered Communication Plan should be developed prior to the start of any dust sampling to inform the owners and residents of homes to be sampled and other neighborhood residents of the implementation details of any indoor dust sampling, including the anticipated time schedule for completion and receipt of results, how these results will be communicated and regular progress updates. The Communication Plan should include distinct points of contact for answering questions from the residents and the public about the plan and include written materials with explanations and answers to frequently asked questions.

Additional comments by Pat Cline

Members of the community continue to be very concerned about potential exposures to contamination in their homes from historical wood treating operations at the Koppers Site, and it is strongly recommended that EPA move forward to collect data that will help citizens understand and respond to this issue. The Workgroup's plan provides EPA with background information and recommendations for sampling and analysis that will be defensible and provide considerable data to help us understand exposures to dioxins/dioxin-like compounds in our homes. This is a complex issue, and I hope that the experience of CDC/DOH and EPA will help guide the interpretation of these results and provide the community with a basis to understand their potential exposures to these compounds. However, premature recommendations on intakes and statistical approaches may not sufficiently capture the complexity of the issues at this time (e.g. concentrations and ingestion rates vary with the amount of dust collected over a given area). I encourage EPA to further consider these factors when evaluating the data so the community may be fully and accurately informed on this issue.

Florida Department of
Environmental Protection
Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Jennifer Carroll
Lt. Governor

Herschel T. Vinyard Jr.
Secretary

July 20, 2011

Mr. Randy Merchant
Florida Department of Health
Bureau of Environmental Public Health Medicine
4052 Bald Cypress Way Bin #A-08
Tallahassee. FL 32399-1712

RE: Indoor Dust Investigation/Interpretation Plan, Stephen Foster Neighborhood, Gainesville, Florida

Dear Randy:

Thank you for the opportunity for DEP to participate in the development of the Indoor Dust Investigation/Interpretation Plan for the Stephen Foster neighborhood. As the Chair of the work group, you did an excellent job in facilitating discussion, identifying issues and priorities, and helping the diverse work group participants navigate through this complex and sensitive area of citizen concern.

DEP looks forward to working with EPA and DOH in the future assessment of indoor dust in the neighborhood.

Sincerely,

Kelsey A. Helton

Kelsey A. Helton
Bureau of Waste Cleanup

MEMO

To: Randy Merchant Florida Department of Health

Copies: None

From:
Paul D. Anderson
Vice President/Principal Scientist

ARCADIS U.S., Inc.

2 Executive Drive Suite 303 Chelmsford Massachusetts 01824

Tel 978 937 9999

Fax 978 937 7555

Date: ARCADIS Project No.:
July 19, 2011 B0039235.0000

Subject:
Indoor Dust Investigation/Interpretation Plan for the Stephen Foster Neighborhood in Gainesville Florida dated July 2011 (Workplan)

This memorandum, limited to one page as requested, contains a necessarily brief summary of my primary concerns related to the information and approaches contained in the Indoor Dust Investigation/ Interpretation Plan for the Stephen Foster Neighborhood in Gainesville, Florida, dated July 2011 (Workplan), prepared by the Indoor Dust Dioxin Workgroup (Workgroup). I have provided more detailed commentary on the Workplan over the many emails provided to you and the Workgroup over the course of this project.

General comment. I agree that implementation of the Workplan as written should achieve Objectives 1 and 2 listed in the introduction and also, if fully implemented, Objectives 4 and 5. However, I do not believe the Workplan meets the objective of providing appropriate guidance to USEPA (Objective 3), or any other agency, on assessing the potential health risks from dioxins in dust from living spaces. As described in the Workplan, interpretation of indoor dust data may include many types of evaluations. While listing and briefly describing those is appropriate, I believe it is inappropriate for the Workplan to have an extended discussion of, and provide specific recommendations regarding, one type of evaluation (i.e. human health risk assessment) and not provide similar discussion and examples for the other equally, if not more important, types of evaluations. By doing so, the Workplan may inappropriately lead people to believe that the most important evaluation to be conducted is the human health risk assessment, even though other evaluations may be equally or more important, such as comparing near-Site to background concentrations. Thus, I do not believe that many of the specific recommendations contained in the data interpretation section of the Workplan are appropriate and I cannot support them.

Specific comment 1. The Workplan (page 3) briefly discusses the indoor dust testing conducted within an approximate two-mile radius of the Site in 2010. I appreciate and share the Workgroup's reservations about that lack of documentation regarding how those data were collected. However, if one assumes the data were collected following USEPA protocols and are representative of indoor dust concentrations, they can be used in regression analyses of concentration versus distance to investigate whether the Site is influencing the concentrations of BioTEQ reported in those houses. Such regression analyses (as described in my emails of April 7 and 8, 2011 to you and the Workgroup) provide no evidence that BioTEQ concentrations (of which dioxins and furans are a component) in indoor dust from houses near the Site are higher than in dust from houses distant from the Site or that the Site is influencing concentrations of BioTEQ in indoor dust. Given their potential significance, more extensive discussion of these data should have been presented in the Workplan.

Specific comment 2. The Workplan (page 10) presents recommended dust ingestion rates for children and adults. A review of the literature indicates that variation exists in reported dust ingestion rates and the methods used to derive them. Selection of a single value is necessarily both a scientific and a subjective process. For example, on one of the Workgroup calls Dr. Stuchal referred to the recommended 60 mg/day for a child as a central tendency estimate. Recent data developed by USEPA (Ozkaynak et al. 2011, as cited by Drs. Stuchal and Roberts) indicate that the median and mean dust ingestion rates for children (11 and 27 mg/day, respectively) are substantially lower than 60 mg/day. Thus, several equally valid ingestion rates are available and selecting 60 mg/day represents, in part, a subjective judgment. Given that the information presented in this Workplan may be used by agencies and entities other than the USEPA (contrary to my understanding of the initial charge of the Workgroup), each with their own set of guiding public health protection principles, it would have been more appropriate for the Workplan to summarize the available literature on indoor dust ingestion rates and not recommend specific ingestion rates for children and adults.

Specific comment 3. The Workplan recommends use of USEPA's current cancer slope factor of 150,000 $mg/kg/day^{-1}$. As I noted in my April 29, 2011 e-mail, many other alternative cancer slope factors and methods to evaluate potential cancer risk associated with dioxins and furans are available. Use of those would lead to more representative estimates of potential cancer risk than estimated using USEPA's current cancer slope factor. I believe the Workplan should have included additional discussion regarding the availability of alternative cancer slope factors and how use of those would change estimates of potential cancer risk associated with dioxins and furans in indoor dust.