Final Report

"Investigation of Household Dust for Dioxins and Dioxin-Like Chemicals in Akwesasne"

The Winds: Owera' shon: a

Let us give thanks to the winds of the earth. From the four directions they come, carrying the rains upon their back, and bringing change to the weather and the seasons. They deliver our words, and can be gentle as a whisper, or have the power of a hurricane. The winds fill us, and connect us to all life, and are the breath of the ancestors of life. The winds are the sacred breath of the Creator. Let us acknowledge the winds. So be it in your mind. Now our minds are as one.

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Ska'tne ionkwaio'te ón:wa wenhniserá:te ne sén:ha aioianerénhake ne enióhrhen'ne
WORKING TOGETHER TODAY TO BUILD A BETTER TOMORROW

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Glossary

Acronym	Definition
ALCOA	Aluminum Company of America
ASTM	American Society for Testing and Materials
CR	Cook Rd
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
FT	Frogtown
HRGC/HRMS	High-resolution gas chromatography/high-resolution mass spectrometry
HVS3	High Volume Small Surface Sampler
IAQ	Indoor Air Quality
JEFCA	Joint Expert Committee on Food Additives
KG	Kilogram
NHAPS	National Human Activity Pattern Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PG	Picogram
PPB	Parts per billion
RPT	Raquette Point
SR37	State Route 37
SRMT	Saint Regis Mohawk Tribe
STR	St. Regis
TEF/TEQ	Toxicity Equivalency Factor/Toxic Equivalent
US/USA	United states/United States of America
WHO	World Health Organization

Introduction

Over the past forty years, General Motors, Reynolds Metals Company, and the Aluminum Company of America (ALCOA), on the American banks, have economically thrived from the low-cost electricity produced by the hydro-electric project. In the process, Akwesasne, the first community down-river from them, has born a disproportionate share of environmental, socio-cultural and economic impacts resulting from pollution from these industries.

Many toxic substances including PAHs, PCBs, dioxins, dibenzofurans, metals, cyanide and styrene have been discharged into the air, land or water in and around Akwesasne. All three companies used polychlorinated biphenyls (PCBs), human-made chemicals that were ideal for industrial purposes, in their plants. PCBs would eventually be banned by the EPA in 1978 as the chemical was found to be toxic to both human health and the environment. The PCBs at these three plants eventually ended up in the environment through industrial wastewater discharges, spills, and illegal dumping into the Raquette, Grasse, and St. Lawrence Rivers. In addition, emissions of pollutants such as fluoride, PAHs and other toxic substances from ALCOA and Reynolds contaminated the air in and around Akwesasne. Mercury and mirex were discharged by Domtar, a pulp and paper mill located on the Canadian side of the river.

The Akwesasne community (US portion) consists of approximately 14,600 acres, primarily unused agricultural land and wetlands. There has been a decline in agricultural activities over the years partially due to the negative influence of industrial emissions and pollution. The rivers had also previously provided a means of income through guide fishing, and fish marketing. Since then, industrial pollution has been responsible for the contamination of the fish, to the point that government warnings have been limiting the consumption of fish.

PCBs are not dioxins, but 12 of the congeners have dioxin-like properties. PCB's are one of the primary contaminants of concern in the St. Lawrence River watershed and have been measured in high concentrations in numerous environmental samples in the area, including soil (US EPA 2007).

PCBs are a group of 209 chlorinated hydrocarbon chemicals (individually known as PCB congeners). These chemicals were produced from the 1930s until their production was banned in the United States by the U.S. Environmental Protection Agency in 1979, and were ultimately phased out of use by 1985, except in cases where they were totally enclosed (US EPA 1979). Because of their chemical stability at high temperatures, PCBs were used primarily as insulating materials for electrical transformers and capacitors, but were also used in such diverse products as paints and carbon copy paper. Their chemical stability has also contributed to their persistence in the environment.

PCBs are relatively mobile in the environment in that they can be volatilized and transported in the atmosphere, resulting in their presence in animal tissues and environmental media around the world (Eisler 2000[1]). Although a previous study of the soil in Akwesasne didn't show high values, indoor air PCB concentrations in the early 1980s, were typically at least ten times higher than in the surrounding outdoor air. On average people spend about 68% of their time in their homes, 5%

at their jobs and the rest of time in various places-indoor and outdoor[2]. Because so much time is spent indoors it is important to have clean indoor air.

The mean atmospheric concentration of PCBs in urban areas in the USA was 5 ng/m^3(range 1–10 ng/m^3) (Eisenreich et al., 1992[3]). The mean atmospheric concentrations of PCBs in two rural areas (rural Ontario, Canada, and Adirondack, New York, USA) were 0.2 and 0.95 ng/m^3, respectively (Knap & Binkley, 1991; Hoff et al., 1992[4]).

Purpose

It is the policy of the St. Regis Mohawk Tribe to maintain a reasonable degree of purity of Tribal Air resources, which shall be consistent with the public health and welfare and the public enjoyment. The industrial development of the reservation while protecting the flora and fauna, physical property and other natural resources, require the use of all available practical and reasonable methods to prevent and manage air pollution on the reservation. It is further declared that this can be done most effectively by focusing on goals to be achieved by a maximum of cooperation among all parties concerned and that the findings of the grant should be clearly premised upon scientific knowledge of causes as well as of the facts.

In animals and fish, studies have shown dioxin exposure to cause cancer, birth defects, liver damage, endocrine damage, and immune system suppression. Studies have shown that exposure to dioxin increases the ratio of female births to male births among a population[5]. Concentrations of dioxins are found in all humans today, with higher levels found in persons living in more industrialized countries. The estimated elimination half-life for dioxins in humans ranges from 7.8 to 132 years. Dioxin enters the general population almost exclusively from ingestion of food, specifically through the consumption of fish, meat, and dairy products since dioxins are fat-soluble and readily climb the food chain. But because Dioxins are found in particulate matter their occurrence in household dust may be an important key potential health risk.

Methods

The Air Quality Program of the Saint Regis Mohawk Tribe measured the concentration of dioxins and dioxin-like chemicals in household dust in the Akwesasne Community through funding from the US Environmental Protection Agency. The Tribe's Air Quality Program was responsible for quality assurance project plans, recruitment of individuals to participate, sampling homes and processing/implementing contracts for the analytical laboratory and environmental consultant following the SRMT Procurement policy 2011[6] as well as quarterly progress reports, an interim final report, final report, and budget for the grant.

The project goals and objectives
The overall goal of the study was to determine the concentrations of Dioxin and Dioxin-like chemicals in the dust of homes in Akwesasne.
1. To collect samples of household dust of 25 homes in the Akwesasne population:
2. To collect the following data from each participant by personal interview/questionnaire:
   - Proximity and duration of residence to adjacent industries

- Past occupations of household members
- Other factors (age, sex, diet, etc.)

3. To compare the house dust concentrations to the soil study: PCBs in Garden soils of Akwesasne (SRMT 2007[7]) and other studies done at Akwesasne such as the *Fish consumption and breast milk PCB concentrations among Mohawk women at Akwesasne (1998)* or *Environmental and Occupational Exposures and serum PCB concentrations and patterns among Mohawk Men at Akwesasne (2006)*[8].

4. To better understand how household dust contributes to sources of probable human exposure to dioxins and dioxin-like chemicals.

This study was not intended to address potential adverse health effects of exposures to dioxin like chemicals. We believe that studies of health effects should not be done unless there is evidence of excessive exposure that has resulted in elevated tissue burdens in the exposed population. This study is also not intended to provide information on the geographic distribution of dioxins, furans and PCBs in Akwesasne or address potential economic consequences of dioxin exposures.

Recruitment and Participation

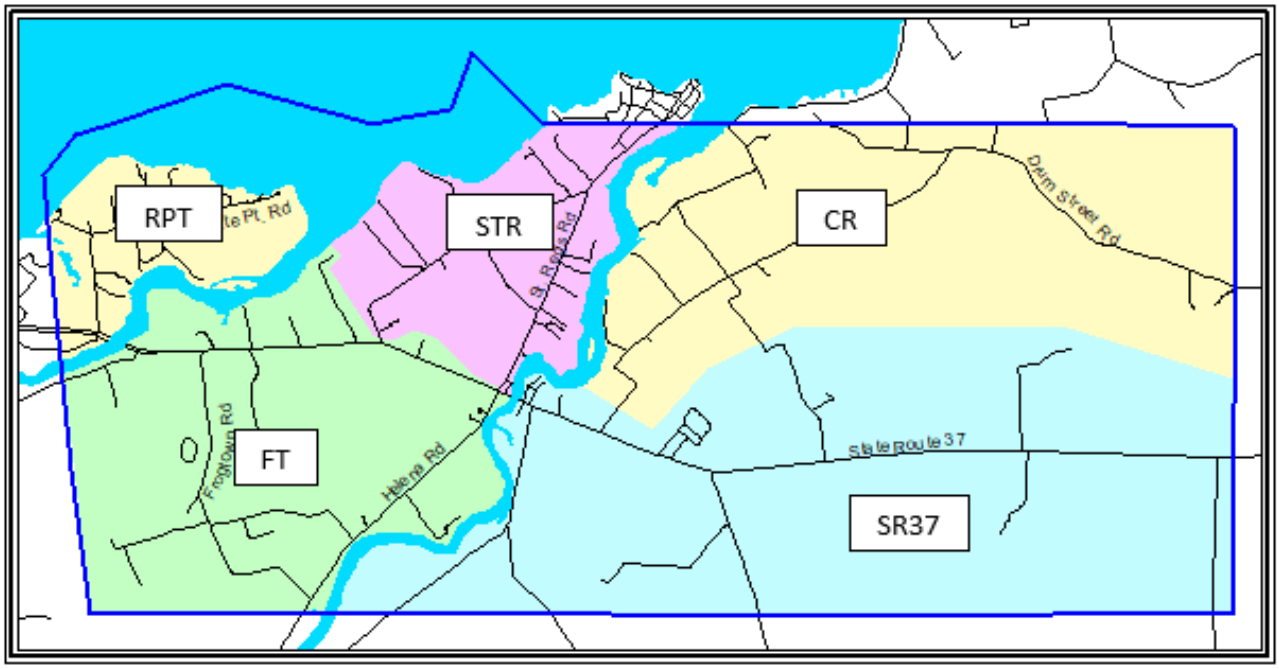
Recruitment occurred via press release and newspaper advertising as well as events held by the Environment Division such as seed and tree giveaway, Earth day Activities and personal contacts with community coordinators with whom we have worked in the past. We specifically targeted families in the area closest to the industries but encouraged anyone to participate. For the project, participants will be given a non-identifying code number and the SRMT will maintain confidentiality for all participants. Each participant received gifts (less than $100) related to dust control as an incentive, including some or all of the following:

- Swiffer Steam Boost Mop with refills;
- Swiffer Duster 360° Starter Kit with refills
- Swiffer Sweeper Starter Kit with dry and wet refills.

Table 1. Project activities, outputs and outcome

Activities	Programmatic/ Environmentally Related Outputs	Short-term and Intermediate Action Outcomes	Long-term Environmental Health Outcomes
Conduct household dust sampling (vacuum and surface wipe) in 25 Akwesasne homes	Quantify the concentration of dioxin and dioxin-like chemicals in household dust. Quantify the exposure to the occupants and their distance from sources.	Measurable exposure to dioxin and dioxin-like chemicals in household dust. Increase awareness to community about indoor exposure to ambient air toxics.	Reduction in occupant exposure to dioxin and dioxin-like chemicals. Increase in occupant performance and productivity attributable to IAQ best practices.

Figure 1. Map of sampling areas of Akwesasne



The project was done throughout Akwesasne focusing on the western portion because of the proximity to the neighboring industries. Throughout the community 25 homes were recruited to take part in the collection of household dust. Akwesasne was divided into 5 different sections, sampling 5 homes in each section. Figure 1 shows the map of the sections that were used.

Sampling

Vacuum sampling was conducted in the home of each respondent, following consent of the respondent, if the respondent is an owner of the residence. The sampling protocol was based on the American Society for Testing and Materials (ASTM) method "Standard Practice for Collection of Floor Dust for Chemical Analysis" (ASTM, 2000[9]). The household vacuum dust sample was taken from two sampling locations that present the highest potential for human contact with household dust and dirt. The locations were frequently occupied living space (e.g., living or family room) and a high traffic hallway or pathway. Samples were taken from both hard and soft surfaces and were not be taken of undisturbed dust in generally inaccessible areas.

The sample was obtained from designated sampling areas within each sampling location. Two measuring tapes were placed and taped down so that they were parallel to each other and on either side of each sampling area. A High Volume Small Surface Sampler (HVS3) was used to collect the sample. The HVS3 is a vacuum cleaner equipped with a cyclone and a fine-particle filter capable of capturing 99.95% of particles above 0.3 µm aerodynamic mean diameter. The dust sampling technicians collected a minimum of 10 grams of total dust. If the amount of dust collected from the initial sampling area within each location was not sufficient, a secondary areas was marked and sampled. The total surface area of all of the sampling areas that make up each sampling location was recorded on a pre-printed field data sheet, as well as the surface types from which the

sample was taken. Samples were transported back to the Environment Office and stored until shipped to the analytical Laboratory for analysis. Analyses of the vacuum samples was performed by the chosen Laboratory for the 29 dioxin congeners using US EPA methods 8290 (US EPA, 1994)[10] and 1668 (US EPA, 1999)[11].

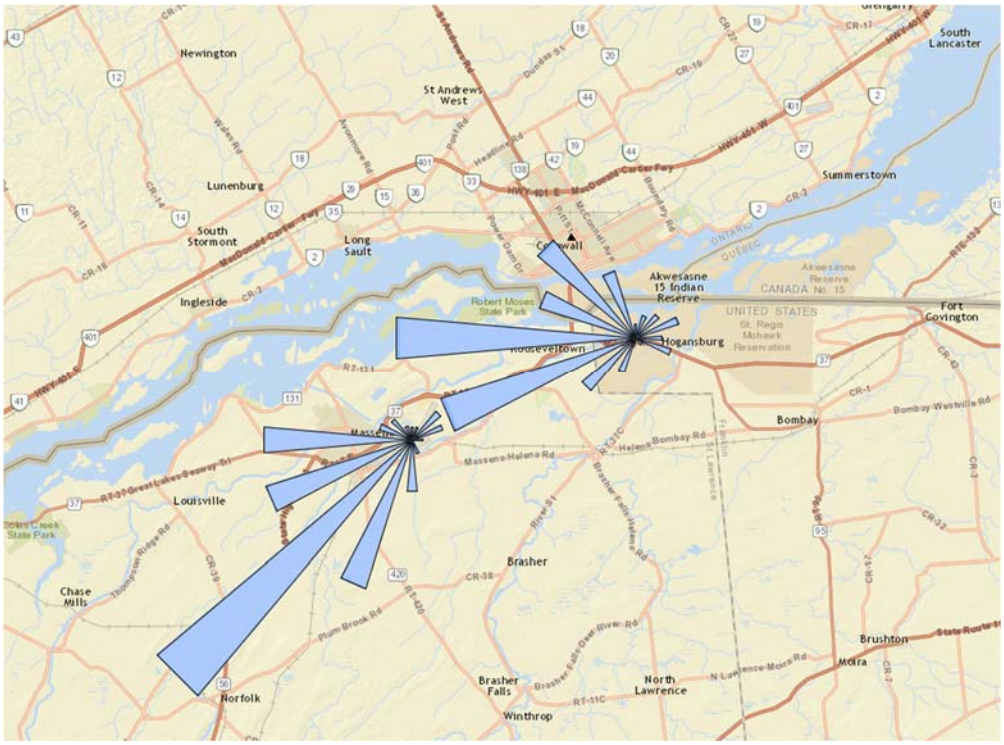
Wipe sampling was done according to the ASTM E 1728-03[12]. Standard practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Lead Determination. Hard, smooth, reusable templates made of aluminum or reusable plastic or disposable cardboard or disposable plastic. Templates were 1 ft x 1 ft (1 ft^2) or of otherwise accurately known dimensions, between 0.1 ft2 and 2 ft2. Reusable templates were wiped with a clean disposable cloth before and after each use.

Wipe sampling procedure: Place the wipe at one corner of the wipe surface with wipe fully opened and flat. First wipe pass (side-to-side): With the fingers together, grasp thumb and the palm. Wipe using the pressure and length of the fingers and the palm of the hand. Press down firmly, but not excessively. Do not touch the surface with the thumb. If the wipe area is a square, wipe side-to-side with as many "S" or “Z” like motions as are necessary to completely cover the entire wipe area. Exerting excessive pressure on the wipe will cause it to curl. Exerting too little pressure will result in poor dust col lection. Always press the front edge of the wipe forward. Attempt to remove all visible dust from the wipe area. Second wipe pass (facing inward. The wipe can be straightened out by laying it on the wipe area, contaminated side up, and folding it over. Do not touch the contaminated side of the wipe with the hand or fingers. Do not shake the wipe in an attempt to straighten it out, as dust may be lost during shaking. Once folded, place wipe in the top corner of the wipe area and press down firmly with the fingers and the palm. Repeat wiping the area with "S" or “Z” –like motions, but in a top-to-bottom direction for the second pass. Attempt to remove all visible dust. top-to-bottom): Fold the wipe in half with the contaminated side facing inward. Once folded, place wipe in the top corner of the wipe area and press down firmly with the fingers. Wipe around the perimeter of the area, staying inside the border, and focusing on collecting dust from the corners. The wipe samples were also transported back to the environment offices and stored until shipped to the laboratory for analysis.

Data

Figure 2 shows a sampling of air flow between Ohiarihko:wa/July and Seskehko:wa/September 2015. This wind rose shows that the predominant winds come from the west-southwest.

Figure 2. Wind Rose



The following are charts of the data from all the homes. All data is shown in picograms (pg) which is a lot smaller than milligrams (mg). 1 pg = 0.000000001 mg. Since all the data are represented in pictograms, the data from the samples show that the concentrations of pollutants in the dust in the homes are not really significant.

World Health Organization (WHO) dioxin guidelines Provisional tolerable monthly intake In 2002, the Joint Food and Agriculture Organization of the United Nations (FAO)/WHO Expert Committee on Food Additives (JECFA) established a provisional tolerable intake of 70 pg/kg body weight per month for PCDDs, PCDFs and coplanar PCBs expressed as TEFs, based on reproductive end-points. The value is expressed "per month" to reflect that exposure is cumulative and chronic rather than acute. Drinking-water No water quality guidelines have been set for these substances because of their low water solubility. Air An air quality guideline for PCBs was not established, because direct inhalation exposures constitute only a small proportion of the total exposure, in the order of 1–2% of the daily intake from food. Although this air concentration is only a minor contributor to direct human exposure, it is a major contributor to contamination of the food-chain[13].

Below **Chart 1** is the percentage of dioxin and PCB's in each area to the total area. The data shows that the dioxins and PCB's were found in more homes north of state route 37 than in the homes south of it. Even though the predominant winds come from the west-southwest (as shown by the

wind rose) of Akwesasne, it cannot be concluded where the dioxins and PCBs are coming from. The rest of the charts/graphs are the rest of data broken down by area as well as the homes in each section.

Chart 1

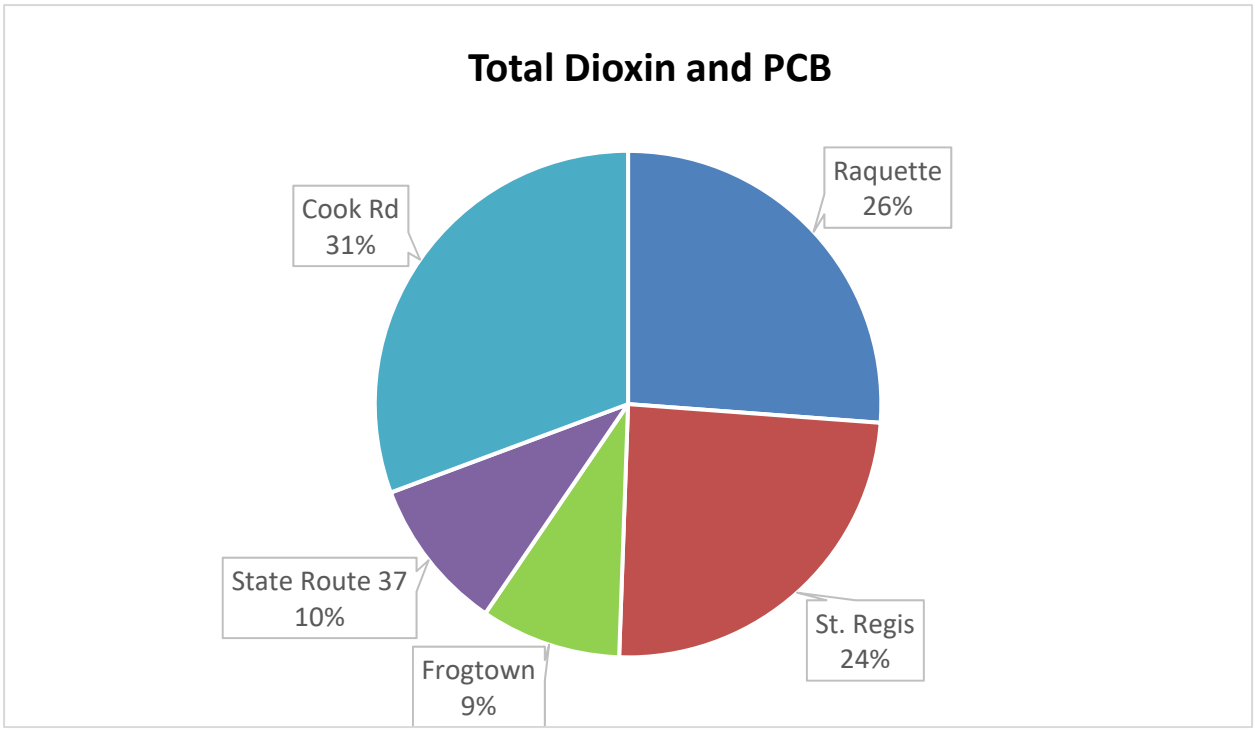
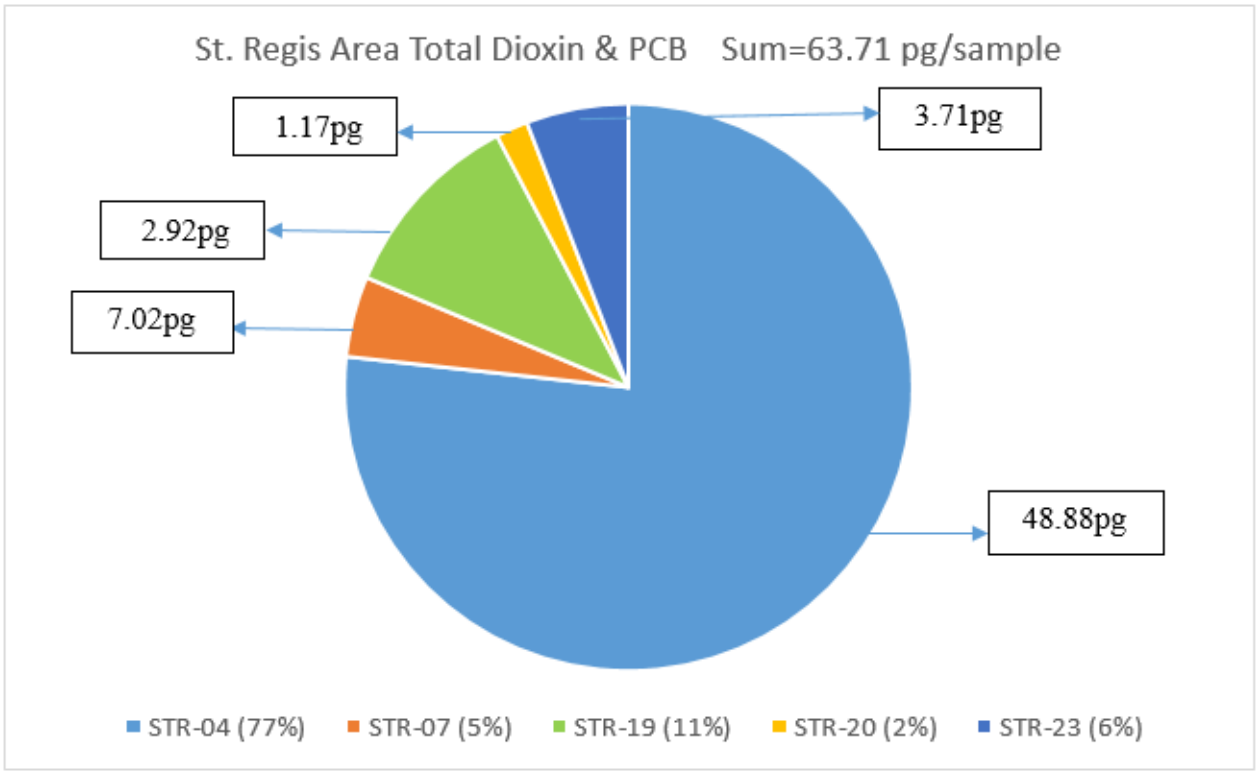
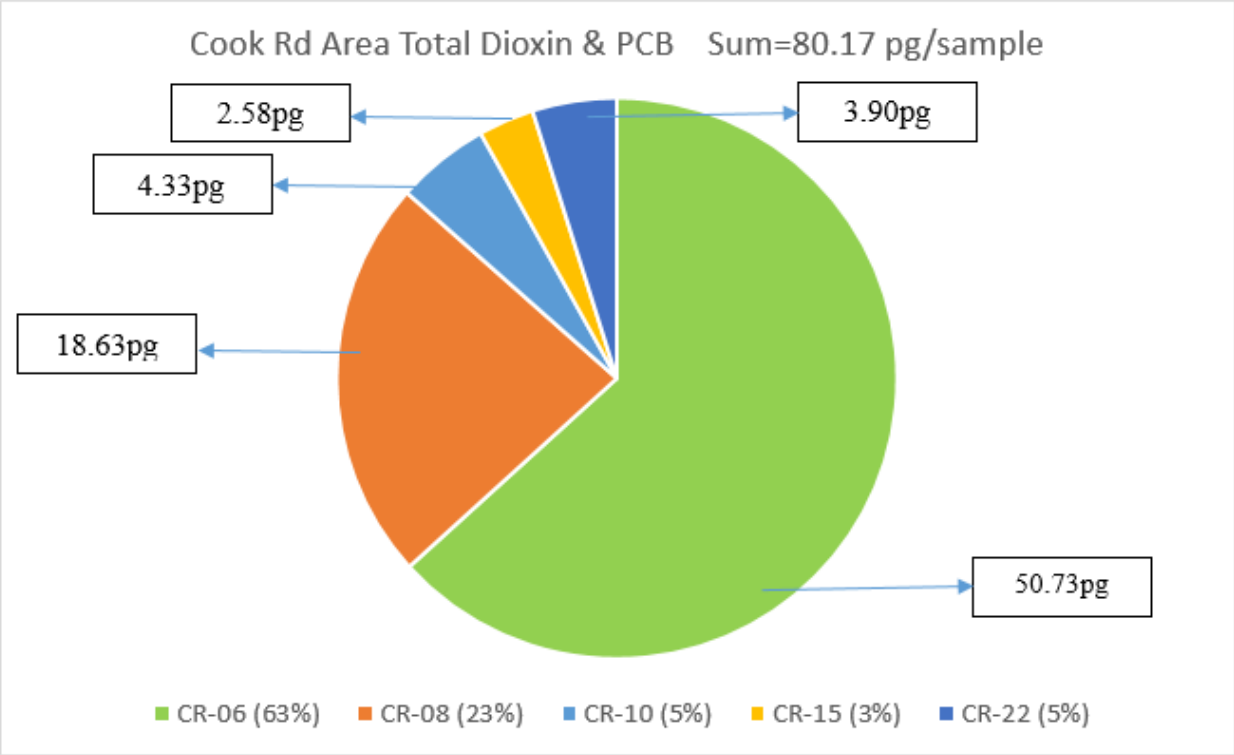


Chart 2




Cook Rd Area Total Dioxin & PCB Sum=80.17 pg/sample
2.58pg
3.90pg
4.33pg
18.63pg
50.73pg
CR-06 (63%)
CR-08 (23%)
CR-10 (5%)
CR-15 (3%)
CR-22 (5%)

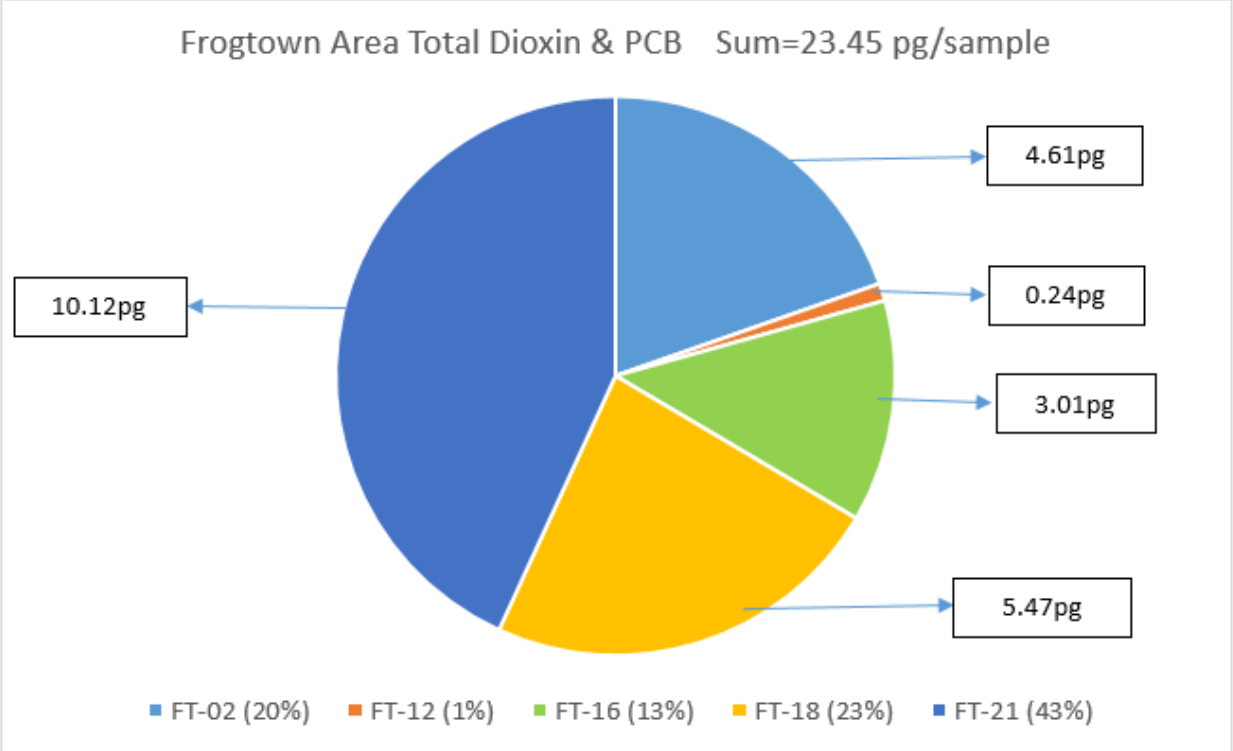

Frogtown Area Total Dioxin & PCB Sum=23.45 pg/sample
4.61pg
0.24pg
10.12pg
3.01pg
5.47pg
FT-02 (20%)
FT-12 (1%)
FT-16 (13%)
FT-18 (23%)
FT-21 (43%)

Chart 5

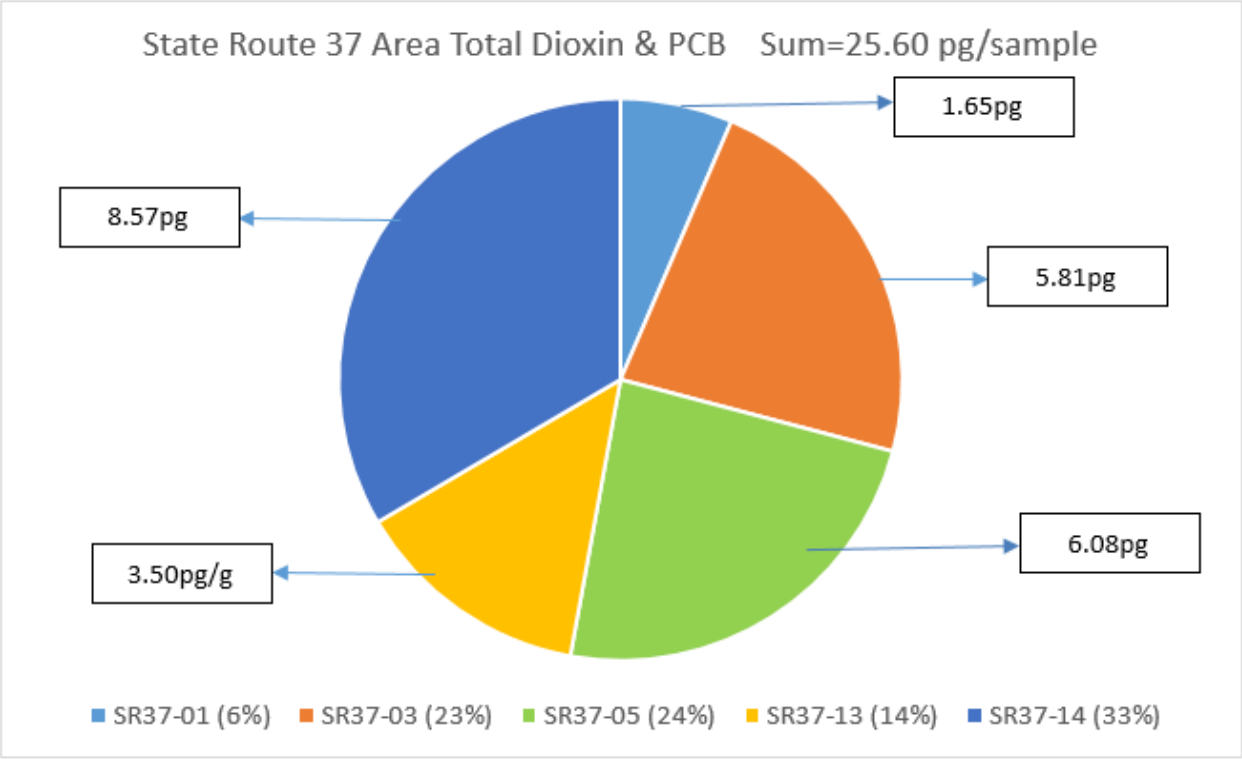


Chart 6

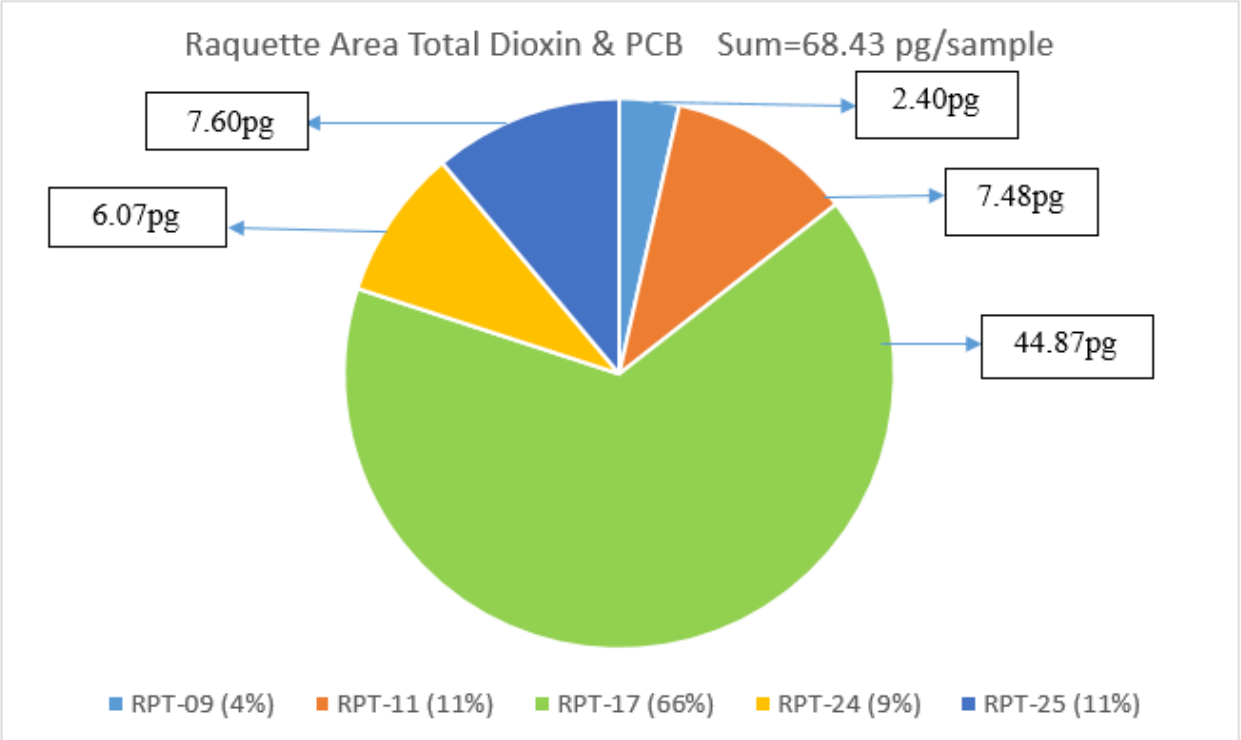


Chart 7

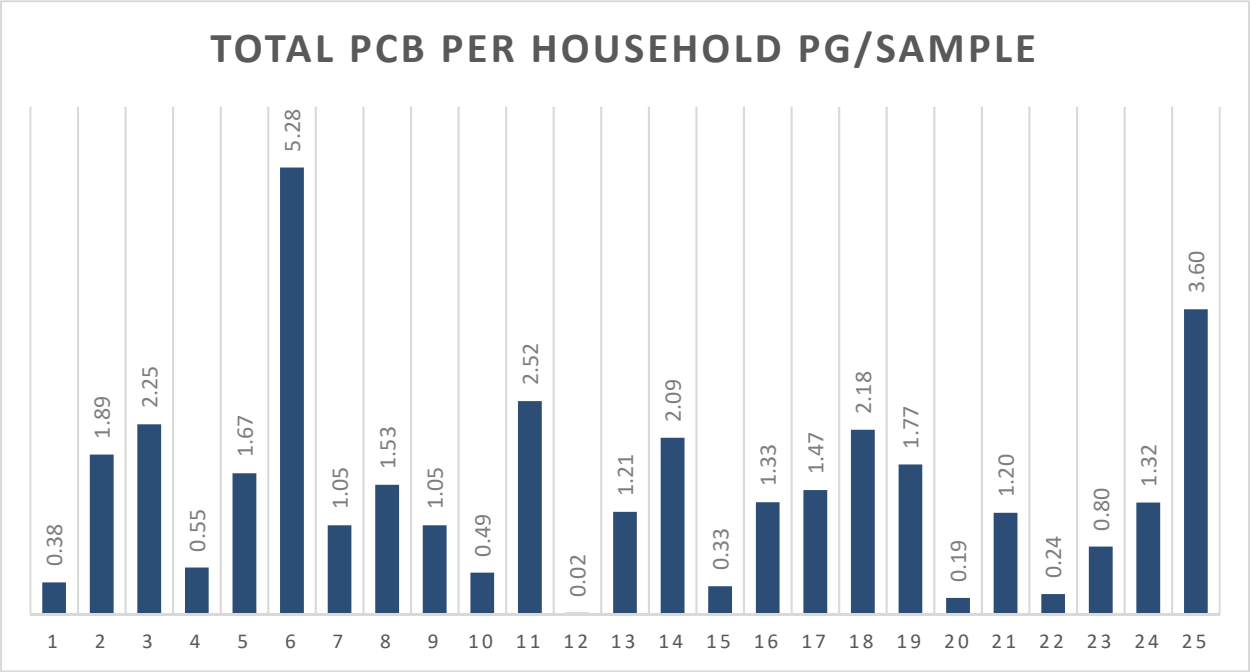


Chart 8

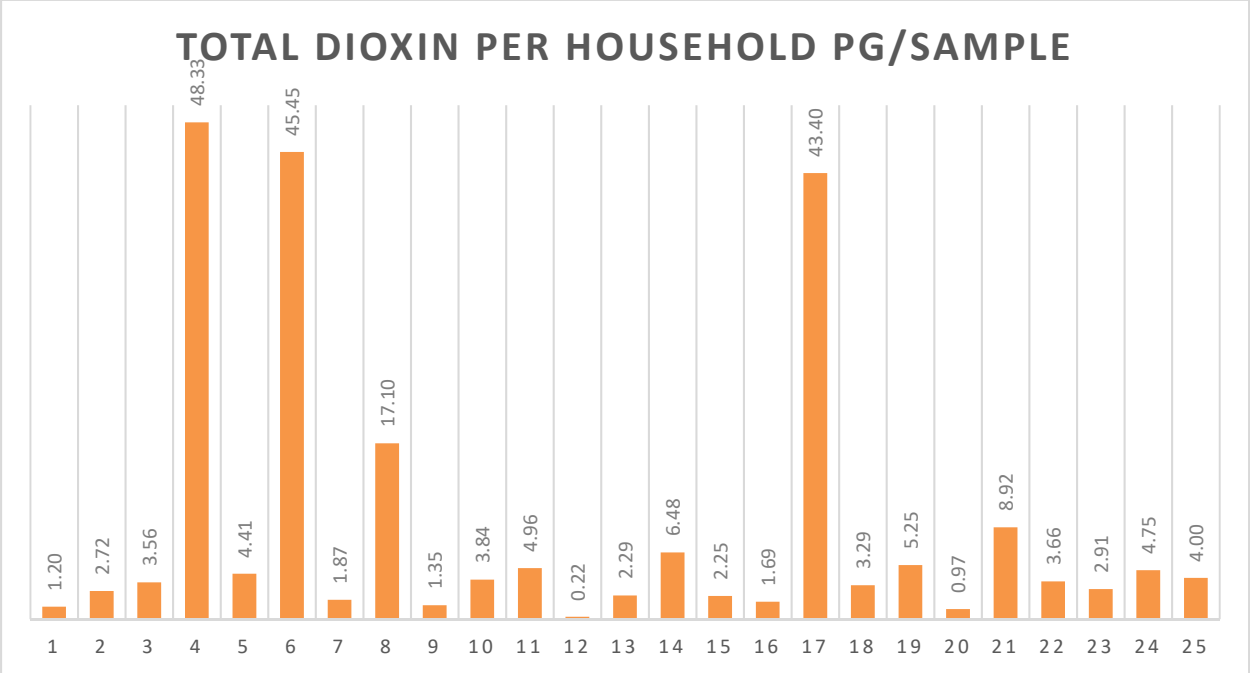


Chart 9 Occupant Questionnaires

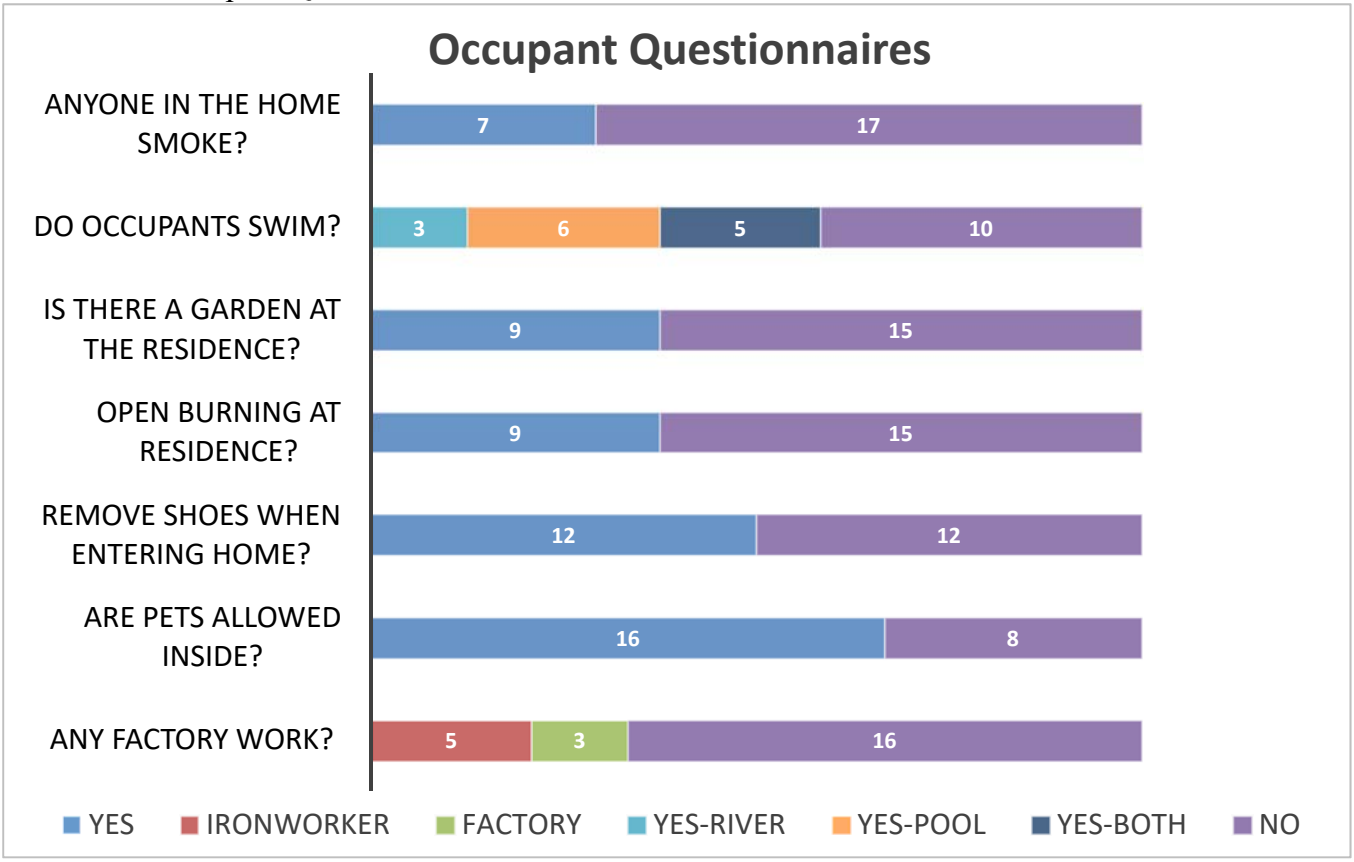


Chart 9 shows the responses to the questionnaires of the occupants of the homes sampled. Of the 25 homes 24 filled out the questionnaires.
Besides the questions above the following were also asked:
How many people live in the home? Average of all homes was 3.5
When was the house built? Answers between 1900 & 2010 most between 1980 & 2006
Square footage of home? Answers between 900 & 2400 most between 1000-1500
Years lived in home? Answers between 10 month & 58 years; average of all homes 17.5 years

The reasoning for the questionnaires was to get a snapshot of what may go on in the home that may affect the concentration of PCB's and Dioxins. The older the home there might be impact from older materials or depending on the work an occupant does there may be impact from clothes worn into the home after work. Pets are also a good carrier of particulates into a home if they go outside they carry whatever they get in their fur back into the home. Open burning also allows particulates into the air that can get into homes. Sometimes when non-organic items are burnt things like dioxins, furans, benzene, mercury and arsenic[14] can find its way into homes by air or on clothes, shoes or your body.

Closing Remarks

This report presents the results of a screening study of the dust in Akwesasne homes. The sampling regime was comprehensive, and resulted in a very robust estimation of average concentrations of

PCBs and dioxins in the dust studied. Although not all of the data quality objectives outlined by the Environment Division in the Dioxin in Dust Quality Assurance Project Plan were met, this may be due in part to the fact that PCB concentrations in the dust samples were very low. For this reason, because the dataset was small, and because this study was undertaken for screening purposes, no data were excluded from analysis.

Results indicate that there are Dioxins and PCB's in dust from the homes located in Akwesasne, but concentrations are insignificant. In addition, none of the samples had dioxin or PCB concentrations greater than one ppm, which would have triggered additional, external analysis. In fact, none of the samples had concentrations higher than 10 ppb, and were all over one hundred times less than the action level. Although no quantitative spatial analyses were performed, a visual inspection of the data suggests that there are no clear spatial patterns in the concentrations of PCBs in the dust from homes across the Akwesasne community.

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