

Letter Health Consultation

Indoor Air Sampling Results and Health Risk Evaluation for Vapor Intrusion
Investigation at Oak Ridge Apartments, Oxford, North Carolina

OXFORD, GRANVILLE COUNTY, NORTH CAROLINA

EPA FACILITY ID: NCD122263825

Prepared by the

North Carolina Department of Health and Human Services

January 4, 2016

This report was supported in part by funds provided through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. The findings and conclusions in these reports are those of the author(s) and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to agency standards.

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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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LETTER HEALTH CONSULTATION

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Division of Public Health

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January 4, 2016

Lisa M. Harrison
Health Director
Granville-Vance District Health Department
101 Hunt Drive
Oxford, NC 27565

Dear Ms. Harrison,

The U.S. Environmental Protection Agency (U.S. EPA) requested a vapor intrusion study to be conducted at Oak Ridge Apartments in Oxford, NC. The Oak Ridge Apartment complex is located east of the JFD Electronics/Channel Master National Priorities List (NPL) site (U.S. EPA ID: NCD122263825) and northeast of the Cristex Drum NPL site (U.S. EPA ID: NC0001606250) in Oxford, NC. A plume of contaminated groundwater from these sites extends east/northeast towards Oak Ridge Apartments. Contaminants from these NPL sites include the volatile organic compounds tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1, 2-dichloroethene (cis-1,2-DCE). The N.C. Department of Health and Human Services, Division of Public Health (DPH) evaluated the results from groundwater, sub-slab vapor, indoor air, and outdoor air samples collected from the eastern portion of the apartment complex in 2013. This letter health consultation summarizes these results and discusses the public health implications of exposure to volatile organic compounds (VOCs) at the site.

In brief, the DPH concludes that chemicals associated with the nearby NPL sites (TCE, PCE, and cis-1,2-DCE) were not present in indoor air samples at levels that will harm people's health. Four other chemicals were detected in apartment indoor air samples that would indicate a potential for adverse health effects for long-term apartment residents. These chemicals (1,4-dichlorobenzene, benzene, chloroform, and naphthalene) likely originate from an indoor source and not via the vapor intrusion pathway. In 2014, both the U.S. EPA and DPH sent letters to individual residents informing them of the results of the indoor air tests, as well as recommendations for reducing the levels of indoor air contaminants by eliminating common household sources (Attachment C). The remainder of this letter will describe our assessment process and how we arrived at our conclusions and recommendations.

Background and Statement of Issues

The JFD Electronics/Channel Master National Priority List (NPL) site¹ (U.S. EPA ID: NCD122263825) is located at 629 West Industry Drive in Oxford in Granville County, North Carolina. The Cristex Drum NPL site² (U.S. EPA ID: NC0001606250) is located at 500 West Industry Drive in Oxford in Granville County, North Carolina. A plume of contaminated groundwater extends east/northeast from the two sites towards Oak Ridge Apartments.

¹ <http://www.epa.gov/region04/superfund/sites/npl/northcarolina/jfdchmasnc.html>

² <http://www.epa.gov/superfund/sites/npl/nar1879.htm>

Contaminants from these sites include tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1,2-dichloroethylene (cis-1,2-DCE). Volatile organic compounds (VOCs), such as PCE, TCE, and cis-1,2-DCE, are known to volatilize from groundwater, migrate through the soil, and potentially enter structures and contaminate the indoor air, a pathway known as vapor intrusion. Since the groundwater plume extends below some of the buildings in the Oak Ridge Apartment complex, the U.S. EPA requested a vapor intrusion study to assess if residents were being exposed to site-related contaminants via indoor air contamination. Groundwater, sub-slab vapor, indoor air, and outdoor air samples were collected by U.S. EPA's contractor AECOM Environment in April 2013 and analyzed for VOCs using EPA-approved protocols (AECOM 2013). The Division of Public Health (DPH) used the data to evaluate potential public health effects for Oak Ridge Apartments' residents exposed to the air on a daily basis.

Discussion

Environmental Analytical Data

Samples collected include indoor air (10 apartments), sub-slab vapor (12 apartments), outdoor air (2 samples), and groundwater (1 monitoring well).

TCE was detected in groundwater at concentrations exceeding the N.C. Department of Environment and Natural Resources (DENR) Inactive Hazardous Sites Branch Residential Vapor Intrusion Screening Table (IHSB VI SL) value of 1.1 $\mu\text{g/L}$ ³. However, TCE was only detected in one sub-slab vapor sample, and the concentration was approximately 3 times lower than the screening level. TCE was detected in one of two outdoor air samples at concentrations below indoor air screening levels. No indoor air samples had detectable levels of TCE, but it is important to note that the reporting limits for some indoor air samples exceed the screening level (ATSDR CREG⁴ = 0.24 $\mu\text{g/m}^3$)⁵. This means that TCE may be present in these samples at levels high enough to be a concern for health effects, but was not detected because the analytical methods were not sensitive enough to detect the TCE.

PCE was detected in groundwater at concentrations exceeding the IHSB VI SL value of 12 $\mu\text{g/L}$. PCE was detected in three sub-slab vapor samples at concentrations 6-46 times lower than vapor intrusion screening levels. PCE was not detected in outdoor air samples. One indoor air sample had detectable PCE levels (1.5 $\mu\text{g/m}^3$), but this level is lower than the screening level (ATSDR CREG = 3.8 $\mu\text{g/m}^3$) by a factor of 2.5. It should be noted that the PCE reporting limit for one indoor air sample was six times higher than the screening level, resulting in insufficient data to effectively assess health risk from PCE exposure at this apartment.

The site-associated contaminant cis-1,2-DCE was not detected in any indoor air, outdoor air, or sub-slab vapor samples. Cis-1,2-DCE was measured in groundwater collected from a monitoring

³ $\mu\text{g/L}$ = microgram of substance per liter of water

⁴ ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide

⁵ $\mu\text{g/m}^3$ = microgram of substance per cubic meter of air

well on the Oak Ridge Apartments property at levels that exceed the North Carolina 2L standard⁶ of 70 µg/L. However, there is no vapor intrusion screening level for cis-1,2-DCE in groundwater. Residents of Oak Ridge Apartments do not rely on groundwater for a drinking water source and are connected to the city’s public water supply.

Other chemicals not associated with the groundwater plume from the nearby sites were detected in indoor air and sub-slab vapor samples at Oak Ridge Apartments. Chemicals detected in indoor air at concentrations greater than health-protective screening levels are 1,4-dichlorobenzene, benzene, chloroform, and naphthalene (Table 1).

Table 1. Indoor air data summary and screening values for VOCs detected at concentrations greater than screening level values in indoor air samples collected from Oak Ridge Apartments in April 2013. These VOCs are not related to the site.

Chemical	Number of Detections	Number of Detections >SL	Range of Detections (µg/m ³)	Screening Level (µg/m ³)	Screening Level Type
1,4-Dichlorobenzene	7	3	1.2 - 3600	60	ATSDR Chronic EMEG/MRL
Benzene	7	7	0.35 - 2.7	0.13	ATSDR CREG
Chloroform	6	6	1.6 - 26	0.043	ATSDR CREG
Naphthalene	1	1	87	3.7	ATSDR Chronic EMEG/MRL

Notes: µg/m³ = microgram of substance per cubed meter of air
 ATSDR Chronic EMEG/MRL = Agency for Toxic Substances and Disease Registry Environmental Media Guideline / Minimal Risk Level, health-based screening level
 ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide, health-based screening level
 SL = Screening Level
 > = greater than
 VOC = Volatile Organic Compounds

Health Effect Evaluation

Non-Cancer Adverse Health Effects

The ATSDR health effects evaluation process involves screening environmental analytical data from the site by comparing site contaminant concentrations to comparison values. Comparison values (CVs) are screening levels developed by ATSDR as chemical concentrations in environmental media such as air and are set at levels that are highly health protective, well below concentrations known or anticipated to result in adverse health effects. Contaminant

⁶ N.C. 2L groundwater quality standards are the maximum allowable concentrations of contaminants in groundwater which may be tolerated without creating a threat to human health or which would otherwise render the groundwater unsuitable for use as a drinking water source

concentrations at or below the CV may reasonably be considered safe and require no additional evaluation. When chemicals are found on a site at concentrations greater than the CV, it does not mean that adverse health effects would be expected, but it does identify that a more in-depth evaluation is warranted, such as comparing exposure concentrations to levels studied in human health effect and animal laboratory studies for the chemicals of concern.

Levels of 1,4-dichlorobenzene measured in the indoor air of three apartments exceeded the ATSDR Chronic Environmental Media Guideline (EMEG). Additionally, concentrations of this compound measured in two apartments exceeded the ATSDR Intermediate EMEG of 1200 $\mu\text{g}/\text{m}^3$, which is the screening level for intermediate exposure durations (2 weeks to 1 year). Inhalation of 1,4-dichlorobenzene at very high concentrations can irritate the eyes and nose and cause coughing, dizziness, headaches, and liver problems. Laboratory studies with animals show that inhalation of this chemical can adversely affect the liver, kidneys, and blood (DCB ToxFAQs 2006). Adverse health effects in animal studies generally are observed at exposure concentrations approximately 100 times greater than the highest observed indoor air concentration during this sampling event (DCB ToxProfile 2006), but data on adverse health effects from long-term human exposure is lacking. There may be a small risk for nasal effects, such as irritation of the nasal passages or nasal lesions, for residents of Oak Ridge apartments exposed to 1,4-dichlorobenzene at the highest observed concentrations.

Benzene and chloroform were detected in seven and six apartments, respectively, at levels greater than the screening levels, which are based on a cancer endpoint (see discussion below). The screening levels for non-cancer effects of benzene (ATSDR Chronic EMEG/MRL = 9.6 $\mu\text{g}/\text{m}^3$) and chloroform (ATSDR Chronic EMEG/MRL = 98 $\mu\text{g}/\text{m}^3$) were not exceeded in any indoor air sample, and non-cancer adverse health effects associated with benzene and chloroform exposure are not expected at this site.

Naphthalene was detected in one apartment at levels exceeding the screening level by a factor of 24 times. Exposure to large amounts of naphthalene may damage red blood cells, or cause nausea, vomiting, and diarrhea (Naphthalene ToxFAQs 2005). Adverse health effects in animal studies generally are observed at exposure concentrations more than 100 times greater than the highest observed indoor air concentration during this sampling event (Naphthalene ToxProfile 2005), but data on adverse health effects from long-term human exposure is lacking. Therefore, there may be a small risk for adverse health effects associated with lesions of the nasal and respiratory epithelium for residents of Oak Ridge apartments exposed to naphthalene at the observed concentration for long periods of time.

Cancer Risk

The National Toxicology Program (NTP) of the U.S. Department of Health and Human Services (U.S. DHHS) has determined that there is no direct evidence that 1,4-dichlorobenzene can cause cancer in humans, but it may reasonably be anticipated to be a carcinogen. The International Agency for Research on Cancer (IARC) classifies 1,4-dichlorobenzene as “possibly carcinogenic

to humans.” Benzene is classified by NTP and IARC as a known human carcinogen. Chloroform and naphthalene are both classified by NTP as “reasonably anticipated to be a carcinogen” and by IARC as “possibly carcinogenic to humans”. For this reason, DPH estimated an increased cancer risk from exposure to these compounds at the concentrations measured in the indoor air samples. For a detailed explanation of the cancer risk evaluation process, see Attachment B. Briefly, when estimating an increased cancer risk, DPH calculates what is likely an overestimation of increased cancer incidence over a lifetime for a specified exposure period, compared to expected cancer incidence (referred to as the background cancer level). The background cancer level in North Carolina is considered to be 40% in that, on average, 4 out of 10 North Carolina residents will be diagnosed with cancer during their lifetime (North Carolina Central Cancer Registry). The expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the probability of additional cancers, and merely suggests that there is a possibility. For example, a 1 in a million cancer risk means that if one million people were exposed to a given level of a chemical, one excess cancer case may be expected over the background cancer incident rate of 40%, or 400,000 in one million. The actual risk may be much lower. For this assessment, two exposure periods were considered: 12 years and 33 years, which are the average and 95th percentile⁷ residence times (EPA 2011).

Assuming a 12 year residence time out of a 78 year lifetime, the estimated increased cancer risk from exposure to 1,4-dichlorobenzene is high ($>1 \times 10^{-3}$ increased cancers) in three apartments, moderate ($>1 \times 10^{-4}$ increased cancers) in one apartment, low ($>1 \times 10^{-5}$ increased cancers) in two apartments, and very low ($>1 \times 10^{-6}$ increased cancers) in two apartments (Table 2). Given a 33 year residence time, the estimated increased cancer risk from exposure to 1,4-dichlorobenzene is very high ($>1 \times 10^{-2}$ increased cancers) in three apartments, moderate in two apartments, low in one apartment, and very low in two apartments (Table 3). Residents of the apartments with very high and moderate cancer risk levels may be at risk of adverse health effects after long-term exposure to this compound at the concentrations measured in the indoor air.

Exposure to benzene at the measured concentrations for a 12 year residence time resulted in very low cancer risk for three apartments and no increased cancer risk ($<1 \times 10^{-6}$ increased cancers) in four apartments (Table 2). Considering a 33 year residence time, the cancer risk was very low for all seven apartments where benzene was detected (Table 3). This range of increased cancer risk is within the U.S. EPA acceptable level of cancer risk ($<1 \times 10^{-4}$).

Exposure to chloroform for 12 years at levels detected in the indoor air results in a low cancer risk for three apartments and a very low cancer risk for three apartments (Table 2). Given a 33 year residence time, cancer risk ranges from low (five apartments) to moderate (one apartment) (Table 3).

Naphthalene was only detected in one indoor air sample. Long-term inhalation of air containing the measured level of naphthalene would result in a moderate cancer risk in a 12 year residence

⁷ 95th percentile means that 95% of the population has residence times shorter than this value.

scenario (Table 2), or a high cancer risk for a 33 year residence scenario (Table 3). Long-term exposure to naphthalene at the measured concentration may pose risk for adverse health effects.

Cumulative cancer risk was calculated for each apartment where indoor air samples were collected by summing the individual cancer risk for all chemicals detected in a particular apartment. In the 12 year residence exposure scenario, cumulative cancer risk ranged from 6 in 1,000,000 to 6 in 1,000 excess cancers (Table 2). For a 33 year residence scenario, cumulative cancer risk ranged from 2 in 100,000 to 2 in 100 (Table 3).

Table 2. Theoretical increased cancer risk for residents exposed to measured contaminant concentrations in indoor air over a 12 year residence time. “--” denotes that that compound was not detected in that apartment.

Apartment ^a	Cancer risk (1,4-Dichlorobenzene)	Cancer Risk (Benzene)	Cancer Risk (Chloroform)	Cancer Risk (Naphthalene)	Cumulative cancer risk ^b
1	--	6 x 10 ⁻⁷	6 x 10 ⁻⁶	--	6 x 10 ⁻⁶
2	3 x 10 ⁻⁶	2 x 10 ⁻⁶	2 x 10 ⁻⁵	--	2 x 10 ⁻⁵
3	6 x 10 ⁻³	--	--	--	6 x 10 ⁻³
4	2 x 10 ⁻⁶	6 x 10 ⁻⁷	6 x 10 ⁻⁶	--	8 x 10 ⁻⁶
5	1 x 10 ⁻⁴	--	--	--	1 x 10 ⁻⁴
6	--	4 x 10 ⁻⁷	9 x 10 ⁻⁵	--	9 x 10 ⁻⁵
7	5 x 10 ⁻⁵	6 x 10 ⁻⁷	2 x 10 ⁻⁵	--	6 x 10 ⁻⁵
8 ^c	4 x 10 ⁻³	--	--	--	4 x 10 ⁻³
9	1 x 10 ⁻⁵	1 x 10 ⁻⁶	9 x 10 ⁻⁶	--	2 x 10 ⁻⁵
10	--	3 x 10 ⁻⁶	--	5 x 10 ⁻⁴	5 x 10 ⁻⁴

- a. Apartment numbers have been changed for privacy
- b. 1 x 10⁻⁶ = one in 1,000,000; 1 x 10⁻⁵ = one in 100,000; 1 x 10⁻⁴ = one in 10,000; 1 x 10⁻³ = one in 1,000; 1 x 10⁻² = 1 in 100
- c. Duplicate samples were taken at this apartment. Results presented are an average of the two samples.

Table 3. Theoretical increased cancer risk for residents exposed to measured contaminant concentrations in indoor air over a 33 year residence time. “--” denotes that that compound was not detected in that apartment.

Apartment ^a	Cancer risk (1,4-Dichlorobenzene)	Cancer Risk (Benzene)	Cancer Risk (Chloroform)	Cancer Risk (Naphthalene)	Cumulative cancer risk ^b
1	--	2 x 10 ⁻⁶	2 x 10 ⁻⁵	--	2 x 10 ⁻⁵
2	9 x 10 ⁻⁶	6 x 10 ⁻⁶	5 x 10 ⁻⁵	--	6 x 10 ⁻⁵
3	2 x 10 ⁻²	--	--	--	2 x 10 ⁻²
4	6 x 10 ⁻⁶	2 x 10 ⁻⁶	2 x 10 ⁻⁵	--	2 x 10 ⁻⁵
5	3 x 10 ⁻⁴	--	--	--	3 x 10 ⁻⁴
6	--	1 x 10 ⁻⁶	3 x 10 ⁻⁴	--	3 x 10 ⁻⁴
7	1 x 10 ⁻⁴	2 x 10 ⁻⁶	4 x 10 ⁻⁵	--	2 x 10 ⁻⁴
8 ^c	1 x 10 ⁻²	--	--	--	1 x 10 ⁻²
9	3 x 10 ⁻⁵	3 x 10 ⁻⁶	3 x 10 ⁻⁵	--	6 x 10 ⁻⁵
10	--	9 x 10 ⁻⁶	--	1 x 10 ⁻³	1 x 10 ⁻³

- a. Apartment numbers have been changed for privacy
- b. 1 x 10⁻⁶ = one in 1,000,000; 1 x 10⁻⁵ = one in 100,000; 1 x 10⁻⁴ = one in 10,000; 1 x 10⁻³ = one in 1,000; 1 x 10⁻² = 1 in 100
- c. Duplicate samples were taken at this apartment. Results presented are an average of the two samples.

We also calculated the number of years of residence that would be required to reach an increased cancer risk of 1 in 10,000 (1×10^{-4}), the highest level of cancer risk within the targeted risk range. The range of times to reach this level of cancer risk is 0.2 to 190 years (Table 4). It is important to note that excess cancer risk was calculated for continuous exposure to these compounds, and residents are unlikely to spend all of their time in the same apartment, and we do not know if the measured indoor air concentration is consistent over time. The chemicals that had the largest effect on increased cancer risk were 1, 4-dichlorobenzene and naphthalene. Residents of the apartments were informed of common sources of all four chemicals (Attachment A) in order that they may remove the sources and decrease their exposure, thereby reducing risk of adverse health effects.

Table 4. Number of years of residence required to reach a cancer risk level of 1 in 10,000 assuming continuous exposure to contaminant levels measured in this sampling event.

Apartment ^a	Number of years
1	190
2	52
3	0.2
4	144
5	10
6	13
7	19
8 ^b	0.3
9	55
10	2.6

a. Apartment numbers have been changed for privacy

b. Duplicate samples were taken at this apartment. Results presented are an average of the two samples.

Sources of uncertainties

In the health assessment process there are inherent sources of uncertainty. For instance, when considering the likelihood of adverse health effects from exposure to contaminants, many substances are lacking in data of adverse human health effects, and DPH must rely on animal laboratory studies. To account for this discrepancy, large margins of safety, or uncertainty factors, are used to extrapolate from animal data to human exposures.

Other sources of uncertainty are a result of the sampling or laboratory analysis. In the case of this vapor intrusion study, one factor to consider is the lack of long-term or temporal monitoring of indoor air or soil vapor levels. The likelihood and extent of vapor intrusion can vary widely depending on weather, temperature, and other environmental factors that change over time. It is important to note that we do not know the source of these chemicals, but the results suggest that the detected chemicals are not site-associated and do not occur via the vapor intrusion pathway. The assessment presented in this Letter Health Consultation considers samples taken at one specific point in time with the assumption that these concentrations are representative of average

conditions. Risk of adverse health effects will increase or decrease if the actual long term chemical concentrations are greater or lesser than those measured in April 2013. The exposure period can also impact the likelihood of adverse health effects, and in this assessment, exact exposure periods were unavailable, leading to the use of estimated periods of 12 and 33 years. Additionally, for many of the chemicals discussed here the sample reporting limits were greater than the screening levels. Some chemicals of concern may be present in the indoor air samples at concentrations that may pose a health risk, but were not detected because the analytical methods were not sensitive enough to detect them.

Conclusions

The N.C. DPH reviewed the environmental data collected for the vapor intrusion study at Oak Ridge Apartments in April 2013 and concluded:

1. N.C. DPH agrees with U.S. EPA that the concentrations of TCE, PCE, and cis-1, 2-DCE measured in sub-slab vapor samples and indoor air samples do not indicate a complete exposure pathway originating from the JFD Electronics/Channel Master or Cristex Drum NPL sites via vapor intrusion at the Oak Ridge Apartments. There is no indication that residents are exposed to site-related chemicals in indoor air at levels that can cause adverse health effects at this time.
2. 1,4-dichlorobenzene, benzene, chloroform, and naphthalene concentrations in indoor air pose a possible health hazard for residents, particularly for cancer. These substances are not associated with the JFD Electronics/Channel Master or Cristex Drum NPL sites.
3. Sources of 1,4-dichlorobenzene, chloroform, and naphthalene are likely indoor, as the indoor air concentrations were greater than the sub-slab vapor levels. The source of benzene was likely to be indoor or outdoor, due to the detection of benzene in outdoor air samples. For a list of potential residential sources and uses of these compounds, see Attachment A.

Recommendations:

Based on the conclusions of our evaluation, N.C. DPH recommends:

1. U.S. EPA continues to monitor the contaminated groundwater plume in the vicinity of the apartment complex, with follow-up vapor intrusion studies if the groundwater contaminant concentrations increase.
2. U.S. EPA samples soil vapor near the apartment complex on yearly or twice a year basis to monitor changes in contaminant levels over time, as the vapor intrusion pathway can vary under different environmental conditions and time of year.
3. U.S. EPA makes every effort to select sample collection and analytical methods to achieve analyte reporting limits equal to or less than health-based screening levels to provide the best available information for health risk evaluations.

4. Residents make efforts to reduce their risk to the detected chemicals if the chemicals are associated with household products used by the residents. Residents can use replacement products that do not contain the compounds of concern or adopt certain lifestyle changes, such as smoking cessation.

Please do not hesitate to contact me at (919) 707-5900 if you have any questions regarding this letter.

Sincerely,

Beth Dittman, M.S.

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REPORT PREPARATION

This Letter Health Consultation for Oak Ridge Apartments was prepared by the North Carolina Division of Public Health (N.C. DHHS) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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Attachment A – List of potential residential sources of compounds detected in the indoor air samples

Chemical Name	Chemical sources or uses that may be occurring at the site *
1, 4-Dichlorobenzene	Fumigant insecticide – moth repellent; lice and tick control near birdcages Insecticide – fruit borers and ants Space deodorant (“air fresheners”) Control mildew and mold on leather and fabrics
Benzene	Gasoline additive Used for printing and lithography, paint, rubber, dry cleaning, adhesives and coatings Paint thinner Degreasing agent Cigarette smoke
Chloroform	Manufacture of hydrochlorofluorocarbon-22 which is used in refrigerants and fluoropolymers (some plastics) such as polytetrafluoro-ethylene (PTFE) Fire extinguishers Insecticidal fumigant on stored barley, corn, oats, popcorn, rice, rye, sorghum, and wheat Dry cleaning agent
Naphthalene	Insecticide and repellent Moth repellent; squirrel and bat repellent Ingredient of some toilet bowl deodorants Cigarette smoke

*Not an exhaustive list; focus is on uses that might reasonably occur in an apartment complex or residence.

Source: *TOXNET*, National Institutes of Health, U.S. National Library of Medicine. Online search April 2015.

Attachment B – Cancer Risk Evaluation Process

Estimates of increased numbers of cancers are calculated for known or suspected cancer-causing contaminants using the measured air concentration and the Inhalation Unit Risk (IUR) provided in ATSDR health guideline documents. N.C. DPH evaluates cancer health effects in terms of estimates of possible increased cancer risk over background levels. In North Carolina, approximately 30% of women and 50% of men (about 40% combined), will be diagnosed with cancer in their life-time from a variety of causes (North Carolina Central Cancer Registry). This is referred to as the “background cancer risk”. The term “excess” or “increased cancer risk” represents the risk on top of the background cancer risk. A “one-in-a-million” excess cancer risk (1/1,000,000 or 10^{-6} cancer risk) means that if 1,000,000 people are exposed to the cancer-causing substance at a certain level every day of their life-time (considered 78 years), then one cancer above the background number of cancers may develop in those 1 million people. In numerical terms, the background number of cancers expected in 1 million people over their life-time is 400,000. If they are all exposed to the cancer-causing substance daily throughout their life-time, then 400,001 people may get cancer, instead of the expected 400,000. The expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the statistical probability of additional cancers, and merely suggests that there is a possibility. The actual risk may be much lower, or even no risk.

The estimated increased cancer risk calculation is:

$$\text{Estimated Increased Cancer Risk} = \text{Concentration} \times \text{IUR}$$

Where:

Estimated Increased Cancer Risk = Expression of the cancer risk (unitless)

Concentration = Measured contaminant concentration in air sample (mg/m^3)

IUR = Inhalation Unit Risk [$(\text{mg}/\text{m}^3)^{-1}$]

This calculation is based on the assumption that there is no safe level of exposure to a chemical that causes cancer, which is a health-protective assumption that may not apply to all chemicals. In order to be health-protective the calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. This increased cancer risk estimate does not equal the increased number of cancer cases that will actually occur in the exposed population, but estimates an increased cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime or other selected period of exposure. Qualitative assessment of the predicted increased numbers of cancers is also used.

For specific exposure situations N.C. DPH may use exposure periods of less than a life-time to provide a more realistic estimation of the risks that are known or predicted to have occurred for a particular area. If information on the specifics of the exposure situations at a particular site is not known, then N.C. DPH will always use health protective values to estimate the maximum level of risk that we believe to be realistic. In this assessment, exposure periods of 12 years and 33

years were considered, as these represent the average and 95th percentile residence times for residential exposure (EPA 2011).

Attachment C – Sample Letter to Residents of Oak Ridge Apartments

Both the U.S. EPA and N.C. DHHS sent letters to individual residents informing them of the results of the indoor air tests, as well as recommendations for reducing the levels of detected indoor air contaminants by eliminating common household sources. Below is the text of a sample letter sent to residents on behalf of N.C. DHHS.

“May 2, 2014

We are writing to give you additional health information as a follow-up to a letter from the U.S. Environmental Protection Agency (September 17, 2013). The letter summarized the results from air tests done in your apartment.

Testing found *CHEMICAL X, Y and Z* at levels that could cause health problems in the future. Some people may be more sensitive to these chemicals than others, such as very young children or persons with breathing difficulties. The chemicals found do not appear to be coming from the groundwater. More likely, these chemicals are coming from tobacco smoke, household air fresheners, household cleaners, personal care products, pesticides (bug spray), cars, or evaporation of chemical by-products used to disinfect tap water at the drinking water plant.

The kind of testing done in your apartment was extremely sensitive. This type of testing is also very uncommon. It is likely that many homes today have similar levels of these chemicals. We recommend, when possible, to reduce the use of chemicals that could affect your health. This is even more important if you have children because they may be more sensitive to the effects of some of these chemicals.

There are things you can do to lower the levels of harmful chemicals in your home. One way is to quit smoking or smoke only outdoors. The other way is to limit the use of air fresheners or other household products that contain harmful chemicals. We have included information about smoking cessation programs and about alternatives to air fresheners.

Staff from our office are available to do an indoor-air quality evaluation and provide recommendations. Please feel free to call us at 919-707-5952 with any health related questions or to schedule an indoor-air quality evaluation.

Sincerely,

Health Assessment, Consultation and Education Program Staff”