Health Consultation

INDOOR AIR QUALITY

RAYTHEON AREA

ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EPA FACILITY ID: FLD004100152

Prepared by the
Florida Department of Health

JULY 28, 2009

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

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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Foreword

In this health consultation report, the Florida Department of Health (DOH) addresses the public health threat of possible vapor intrusion from contaminated ground water into buildings above the highest ground water contamination near the Raytheon hazardous waste site in St. Petersburg, Florida.

***Evaluating exposure**:* Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how people might be exposed to it. Usually, Florida DOH does not collect its own environmental sampling data. We rely on information provided by the Florida Department of Environmental Protection (DEP), the U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the public.

***Evaluating health effects**:* If evidence is found that people are being exposed—or could be exposed—to hazardous substances, Florida DOH scientists will take steps to determine whether that exposure could be harmful to human health. Their assessment focuses on public health; that is, the health impact on the community as a whole, and is based on existing scientific information.

***Developing recommendations**:* In an evaluation report—such as this health consultation report—Florida DOH outlines its conclusions regarding any potential health threat posed by a site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason the evaluation report will typically recommend actions to be taken by other agencies—including the EPA and Florida DEP. If, however, the health threat is immediate, Florida DOH will issue a public health advisory warning people of the danger and will work to resolve the problem.

***Soliciting community input**:* The evaluation process is interactive. Florida DOH solicits and evaluates information from various government agencies, the organizations or individuals responsible for cleaning up the site, and from community members who live near the site. Any conclusions are shared with the organizations and individuals who provided information. Once an evaluation report has been prepared, Florida DOH seeks feedback from the public. If you have questions or comments about this exposure investigation report, we encourage you to contact us.

***Please write to**:* Susan Skye / Health Assessment Team
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Summary and Statement of Issues

This report addresses the public health threat of possible vapor intrusion from contaminated ground water into buildings above the highest ground water contamination near the Raytheon hazardous waste site in St. Petersburg, Florida.

The Florida Department of Health (DOH) reviewed ground water monitoring data and developed an indoor air test plan for nearby buildings. In August and October 2008 Florida DOH and the Pinellas County Health Department collected 12- and 24-hour air samples in 10 nearby condominiums, apartments, and other buildings near the site and one background sampling location away from the ground water contamination.

None of the main ground water contaminants (trichloroethylene (TCE), 1,2-dichloroethene (DCE) or vinyl chloride (VC)) were found in indoor air of nearby buildings. Therefore, the chemicals found in the air of the 10 buildings near the site are not likely from ground water vapor intrusion. The tested buildings did, however, have chemicals commonly found in indoor air. Many of these chemicals found in these buildings were also found in the background sampling location. These chemicals are not at levels expected to harm people's health.

If for 70 years someone breathes the highest concentrations of six chemicals found in the air of buildings near Raytheon (benzene, bromoform, carbon tetrachloride, chloroform, 1,2-dichloroethane (1,2-DCA), and methylene chloride) there is a theoretical increased cancer risk. Because of uncertainties, the actual cancer risk may be as low as zero. None of these chemicals are likely to cause non-cancer illness at the levels detected, nor do they pose an imminent health threat. Short-term exposures (less than year) are not likely to cause illness. Air quality in the buildings tested is categorized as no apparent public health hazard.

Residents should follow label directions when using cleaning products, glues, air fresheners and other chemicals indoors. Residents should periodically open their windows for fresh air. Residents with elevated levels of chloroform or bromoform should use a bathroom exhaust fan when showering.

If additional chemicals are found in the ground water or ground water contaminant levels increase significantly, the Florida DOH will consider recommending additional indoor air tests.

Background

Site Description

The Raytheon facility is at 1501, 72nd Street North near the intersection of 22nd Avenue North in St. Petersburg, Pinellas County, Florida (Figures 1 and 2). The 32-acre Raytheon site has three main buildings, paved parking, and a large field on the north side of the site. A chain-link fence controls site access (Photograph 5). A linear, man-made storm-water retention pond is along the west central side of the site. Raytheon is selling the site for commercial re-use or redevelopment

with appropriate mitigation measures and/or institutional controls.

Ground Water Contamination

Since October 1957, the facility's primary activity has been the manufacture of electronics and communication hardware. Site activities included electronics assembly, soldering, vapor degreasing, painting, electroplating, metal finishing, photo-imaging, machining, and laboratory functions. From the 1950s to the 1990s, the facility released chlorinated solvents that contaminated soil and ground water. In 1991 Pinellas County discovered ground water contamination during construction of the Rails to Trails project. A drum storage area and a wastewater equalization tank were likely sources. Soil and groundwater was contaminated with volatile organic compounds (VOCs); predominantly trichloroethylene TCE, its breakdown products, and 1,4-dioxane (DEP 2008).

From 1992 to 1994, the facility owner E-systems removed contaminated soil and began ground water testing. In 1995 Raytheon purchased the facility. Between 2005 and 2008, the Florida Department of Environmental Protection (DEP) required Raytheon to install a series of monitoring wells to determine the extent of groundwater contamination (DEP 2008). Raytheon found shallow ground water contaminated with TCE, 1,2-dichloroethene (DCE), vinyl chloride (VC) and 1,4-dioxane had spread beneath nearby condominiums, apartments, and other buildings. The depth to ground water is between 2 and 12 feet (Table 1). The top 12 feet of soil is mostly sand. It is important to note that 1,2-dichloroethane (1,2-DCA) was found under the Brandywine apartments in the deeper ground water (45-55 feet deep) but not in the shallow ground water. From here on in this document, all ground water references will be to shallow groundwater.

In 2007, the highest concentrations in both on- and off-site ground water were TCE 59,000 ug/L, vinyl chloride 1900 ug/L, *cis*-1,2-DCE 6700 ug/L, and *trans*-1,2-DCE 4.4 ug/L. In 2008, the highest ground water concentrations were TCE 37,000 ug/L, vinyl chloride 7600 ug/L, *cis*-1,2-DCE 5100 ug/L, and *trans*-1,2-DCE 110 ug/L (Table 2) (Environ 2008). The City of St. Petersburg supplies all area homes and businesses with drinking water from distant, unaffected wells. These wells are routinely tested and are safe to use.

In May 2008, the Pinellas County Health Department requested assistance from Florida DOH. Also in May 2008, Florida DEP notified Florida DOH of off-site ground water contamination. In July, Florida DOH held an open house to answer health questions. Nearby residents were concerned about use of their private irrigation wells. Florida DOH found lawn watering or filling swimming pools from private irrigation wells near the Raytheon site is not a public health threat (ATSDR 2008d). In July 2008, Raytheon tested homegrown fruits and vegetables for TCE, 1,4-dioxane, and other chemicals. Florida DOH is reviewing these results and will have a report available soon (http://hazwastework.doh.state.fl.us/).

Volatile organic chemicals such as TCE, 1,2-DCE, and VC can evaporate from ground water, diffuse through overlying soils, and enter the atmosphere or indoor air. Florida DOH was concerned that vapors from the contaminated ground water around Raytheon could come up into nearby buildings; therefore, indoor air testing was completed with the Pinellas County Health Department in August and October 2008.

Hydrology and Hydrogeology

In Pinellas County, aquifers are recharged primarily by precipitation, which is typically 53 inches per year. In the vicinity of the site, the surficial sediments are used as a source of water for irrigation but not as a source of drinking water. Across the county, the depth to the water table ranges from ground surface to approximately 10 feet deep. The water-table elevation fluctuates seasonally as much as four feet, with a minimum elevation at the end of the dry season and a maximum elevation at the end of the rainy season (Arcadis 2008).

Near the Raytheon site, the hydrogeology consists of several layers: upper sand, interbedded, lower sand, and the Hawthorn layer. The Surficial Aquifer System (SAS) at the site is unconfined and composed of post-Miocene age sediments. The SAS is approximately 50 to 60 feet thick and consists of fine sand with varying amounts of silt, shell hash, and clay-sand mixtures. The SAS near the site is not a source of drinking water. The underlying Floridan Aquifer System is the primary drinking water source. The only permitted use of the SAS is for irrigation. Hydraulic conductivities span several orders of magnitude; typical of sediments ranging from sand to clay (Arcadis 2008).

Table 1 lists all wells sampled on and near the site. Table 2 includes the ground water test data.

Other Air Testing near Raytheon

Since 1978, the Pinellas County Department of Environmental Management, Air Quality Division has operated an air toxics monitoring station across the street from Raytheon. This Azalea Park station (EPA AIRS # 12-103-0026) is at 7200 22nd Ave. N. near 72nd Street. It is an official EPA ambient (outdoor) air monitoring station for numerous criteria pollutants as well as other toxic compounds. It operates under an EPA approved quality assurance project plan which includes standard operating procedures for air toxics sample collection and laboratory analysis. It has monitored volatile organic compounds since 1996. Motor vehicle exhaust is a major contributor to air toxics at this station.

Between 2006 and 2008, the average annual outdoor air levels of TCE, 1,2-DCE, and VC at this station were at or below the laboratory's detection limit (Table 5). On August 28, 2008, this station collected a 24-hour ambient air sample. The levels of TCE, 1,2-DCE and VC were below detection limits.

In January and February 2008, consultants for Raytheon tested ambient air around Raytheon. They detected low levels of benzene, chloromethane, toluene, m,p-xylene (Arcadis 2008). These levels were below ATSDR's air comparison guidelines and are not likely to cause illness.

In August 2008, consultants for the Pinellas County School Board and consultants for Raytheon tested indoor air quality at the Azalea Elementary School, one block west of Raytheon. They collected six 8-hour samples in summa canisters and analyzed for volatile organic chemicals using EPA method TO-15. They found common indoor air contaminants including low levels of chloromethane, toluene, xylenes, benzene, ethylbenzene, and 1,2,4-trimethylbenzene. They also found 1,2-dichlorethane in a classroom (Bldg. 6, sample AE-14) at a concentration of 2.7 $\mu g/m^3$. 1,2-dichloroethane has not been detected in groundwater near the school, suggesting a source

unrelated to Raytheon (Environ 2008).

Demographics and Land Use

The Raytheon site is in a high population density area with residential, commercial, and industrial land use (Photographs 1 thru 4), (DEM 2008). Land use to the north is primarily commercial (Tyrone Mall). Land use to the west is a public park area (Azalea Park). Land use to the south is primarily residential. East (beyond the Pinellas Trail) are the Stone's Throw Condominium and Brandywine Apartment complexes (Arcadis 2008). Within 1/2 mile of the site to the east and northeast, there are 300 single family homes, 18 condo units, and 35 apartment buildings; to the west 300 single family homes; and to the south 225 single family homes (Figures 1 and 2). Some residents live within 200 feet of the facility. A retention pond exists on the west side of the Stone's Throw Condominiums. Approximately 1,000 feet west-southwest of the site is a drainage ditch that flows southwesterly into Boca Ciega Bay. Small ponds exist 1,500 feet east and 1,000 feet southeast of the site. Major land-use changes in the area are not anticipated (Arcadis 2008).

Community Health Concerns

Nearby residents were concerned about exposure to contaminants in their irrigation well water. Florida DOH evaluates the public health risk from use of irrigation wells in a separate report. The Florida DOH initiated this investigation as a precautionary measure, thus, until initiation of indoor air testing, Florida DOH was unaware of any residents' concern about vapor intrusion. After the start of indoor air testing, three residents expressed health concerns about indoor air quality.

Discussion

Indoor Air Sampling Methods

As a precautionary measure, Florida DOH initiated indoor air testing based on the pattern and concentrations of ground water contamination and ATSDR/EPA vapor intrusion guidance (ATSDR 2008b). Florida DOH requested permission to test residences above the highest ground water concentrations. Some residents chose not to participate in the testing. Florida DOH tested those residences where residents agreed to participate. All agreed to keep all windows shut prior to and during testing.

Even though other chemicals were found in the ground water, Florida DOH focused on the three most widespread contaminants with the highest concentrations: TCE, 1,2-DCE, and vinyl chloride. DOH did not test for 1,4-dioxane because its high water solubility makes it unlikely to evaporate from ground water (ATSDR 2007a).

Based on a review of the ground water data, in August and October 2008, Florida DOH collected air samples from a total of 11 buildings. In August, Florida DOH collected indoor air samples in ground floor rooms in one Azalea Park building, eight homes/apartments east of Raytheon, and one distant background home northeast of Raytheon (Figure 3). In October 2008, DOH re-tested some of these buildings and added a non-smoking residence.

The Florida DOH used the highest levels of VOCs detected in the ground water monitoring wells for selecting houses for indoor air testing. Since the Brandywine Apartment Complex had the highest level of VOCs underneath their buildings, the Florida DOH selected four first floor units closest to or above the contaminated ground water.

On August 26 and 27, 2008, Florida DOH and Pinellas CHD staff collected two sequential 12-hour samples in stainless steel Summa© canisters from nine buildings near the site and one background home distant from the site. They began testing at 7:16 a.m. and finished at 8:21 a.m. the next day. Before starting, staff checked the seal between regulator and canister. They placed each canister approximately 3 feet off the floor in a room that each resident used the most. They checked that all windows and doors were shut and asked residents to keep them shut. They also reminded each resident not to use household products containing VOCs. On the morning of the testing, staff discovered that residents in location #4 were heavy smokers. They noted strong, heavy cigarette smoke in their apartment. Because there was not enough time to find another participant, they decided to test the indoor air despite the thick cigarette smoke. Staff also noted an unidentified odor at location #3.

After sample collection, Florida DOH packaged the regulators and canisters and shipped them overnight to Data Chem Laboratories in Utah. They included chain-of-custody forms, laboratory analytical request forms, canister serial numbers, collection times, and pressure readings. Unfortunately, Data Chem Laboratories received only 16 of 20 canisters. The shipping company lost one box containing canisters #1A, 2A, 3A and 4A (Table 3). The shipping company was unable to find the canisters before the holding time deadline expired on September 25th and claimed responsibility for the lost canisters. Also while preparing the canisters for shipment, one of the canisters from the Azalea Park concession stand (7A) was inadvertently mislabeled as an empty canister. The laboratory recycled the sample canister before Florida DOH discovered the mistake. Florida DOH decided to re-test the concession stand and the four buildings where the shipping company lost the sample containers to obtain 24 hour data rather than just 12 hour.

On October 20 and 21, the Florida DOH and Pinellas CHD retested one location in Stones Throw Condos (1C, 1D), one location in Brandywine Apartments (3C and 3D) and the concession stand (7C and 7D). They also tested one new location in Brandywine apartments without smokers (11C and 11D)(Table 3). They followed the same procedures as before. Because one of the Brandywine apartments (location #4 in building # 6946) had thick cigarette smoke, Florida DOH chose an alternate apartment without smokers (location #11 in building #6947). Therefore, they tested a total 11 buildings in August and October (Table 3).

Brandywine apartment staff initially reported that residents in location #3 smoked. Florida DOH spoke through a Spanish interpreter with a resident and learned, however, that no one at this location smokes.

Laboratory Analytic Procedures

In August 2008, DataChem Laboratories analyzed fifteen air samples (1B, 2B, 3B, 4B, 5A, 5B, 6A, 6B, 7B, 8A, 8B, 9A, 9B, 10A and 10B) using EPA Method Total Organic 15 (http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-15r.pdf). They also tested one method blank and one duplicate for each canister sampled. The quality assurance/control data were acceptable except for hexachlorobutadiene in the duplicate sample which had a lower percent

recovery (66-76%). For all other volatiles, the percent recovery was in the acceptable range from 80%-124%. All VOCs were non-detected in the laboratory blank sample.

In October 2008, DataChem analyzed eight additional air samples (1C,1D, 3C, 3D, 7C, 7D, 11C and 11D) using EPA method TO-15. The quality assurance/control data were acceptable except for tetrachloroethene in the duplicate sample which had a lower percent recovery (72%). For all other volatiles, the percent recovery was in the acceptable range from 81-106%. For the laboratory blank sample, all VOCs were non-detect.

The laboratory reported the concentrations of 35 chemicals included in EPA method TO-15 for which ATSDR has health comparison values. 19 of these chemicals were found in ground water near Raytheon. However, DOH tested for all 35 to educate residents on other chemicals in their homes. Chemicals found in indoor air but not in ground water are most likely from other sources such as household products.

Exposure Pathways

Florida DOH determines exposure to environmental contamination by identifying exposure pathways. An exposure pathway consists of five elements:

1. A source of contamination (e.g., a landfill),
2. An environmental medium such as water, soil, or air that can contain or move the contamination,
3. A point or area where people can come into contact with a contaminated medium (e.g., soil in a backyard),
4. An exposure route (e.g., inhalation, ingestion, or dermal contact), and
5. A population who could come into contact with the contaminants.

An exposure pathway is eliminated if at least one of the five elements is missing and will not occur in the future. For a completed pathway, all five components must exist and exposure to a contaminant must have occurred, is occurring, or will occur. A potential pathway exists when some, but not all, of the five elements are present and the potential exists that the missing element(s) have been present, are present, or will be present in the future (ATSDR 2005a). It should be noted that the identification of a completed or potential exposure pathway does not necessarily result in human health effects.

Florida DOH reviewed the site's history, community concerns, and available environmental sampling data. Based on this review, we determined one potential exposure pathway to be evaluated for this report: inhalation to VOCs in indoor air from ground water vapors under buildings.

In the area surrounding the Raytheon site, the ground water is close to the surface, making it possible for volatile organic chemicals (VOCs) in ground water to migrate up through the soil and into homes (vapor intrusion). Vapor intrusion, however, is a complex problem with multiple factors and often too few measurements. Determining the environmental health hazards from air contaminants in homes and commercial buildings is often difficult because of the dynamic nature of the media and the need to assess the entire period of time people are inhaling the contaminants (ATSDR 2008b).

Results

Table 3 lists the indoor air test results. None of the main ground water contaminants (TCE, 1,2-DCE, or VC) were found in the indoor air.

In August, 18 chemicals were found: acetone, benzene, bromoform, 2-butanone, carbon disulfide, carbon tetrachloride, chloroform, chloromethane, 1,2-dichloroethane, ethylbenzene, hexane, methylene chloride, styrene, tetrachloroethylene, toluene, 1,1,1-trichloroethane, xylenes, 1,4-dichlorobenzene. These chemicals are commonly found in indoor air. The background samples had nine chemicals: 2-butanone, acetone, benzene, chloromethane, ethylbenzene, hexane, tetrachloroethylene, toluene and xylenes (total). Locations 1, 2, 3, 4 and 7 were evaluated using one 12-hour sample and the other locations (5, 6, 8, 9 and 10) were evaluated using a 24 hour average.

In October, 13 chemicals were found: acetone, benzene, 2-butanone, carbon disulfide, chloroform, chloromethane, 1,2-dichloroethane, ethylbenzene, hexane, styrene, toluene, xylenes, 1,4-dichlorobenzene.

In September and November 2008 the Florida DOH talked with residents and mailed letters to the residents explaining their results. The letter also included a list of chemicals and common household uses.

Evaluation Process

The Florida DOH compared measured air concentrations to ATSDR and EPA screening values (Table 4). If the measured air concentration exceeded a screening value, Florida DOH evaluated the finding in more detail. Air concentration less than the screening value are not likely to cause illness and were not evaluated further.

After determining how people may be exposed to a contaminant through completed and potential exposure pathways, Florida DOH next examines contaminant types and concentrations. Florida DOH uses ATSDR comparison values and other established agencies' reference values to screen chemical and exposure levels that may warrant further evaluation. Comparison values are substance concentrations or doses that are well below levels known or anticipated to cause adverse health effects. These values are not thresholds of toxicity, and should not be used to predict adverse health effects. They only provide an initial screening of the contaminant data (ATSDR 2005a).

To identify contaminants of concern, Florida DOH determines the maximum concentration of each chemical for the various exposure scenarios and compares the concentrations to guidelines developed by ATSDR. If a comparison value is not available from ATSDR, we may compare the chemical concentration to a screening value established by another agency. A chemical having a concentration that exceeds the screening value is considered a contaminant of concern.

For each identified contaminant of concern, Florida DOH calculates a dose. The dose is the

estimated amount of contaminant to which a person may have been exposed. Florida DOH compares this calculated dose to ATSDR's health guidelines as well as studies presented in ATSDR's chemical-specific toxicological profiles. This in-depth toxicological evaluation determines the likelihood of illness.

Florida DOH uses two methods to evaluate indoor air data. First we compare the levels to ATSDR comparison values for non-cancer illnesses. Secondly, we look at the cancer risk. Not all chemicals cause cancer. We look at the theoretical increased cancer risk from life-time (70-year) exposure.

None of the chemicals found in any of the 11 buildings (except toluene in the apartment with smokers) were above these guidelines. Therefore, these chemicals (except toluene in smoker's apartment) are not likely to cause non-cancer illness.

The chemicals of concern identified were: benzene, bromoform, carbon tetrachoride, chloroform, 1,2-dichloroethane (1,2-DCA), methylene chloride for exceeding cancer screening values, and toluene for exceeding non-cancer screening values. These chemicals of concern are discussed below.

Benzene

There are many sources of benzene. Benzene is found in certain plastics, glues, paints, furniture wax, resins, nylon and synthetic fibers. It is used to make some types of rubbers, lubricants, dyes, detergents, drugs and pesticides. It is a natural part of crude oil, gasoline, and cigarette smoke. Benzene reacts with other chemicals in the air and breaks down within a few days (ATSDR 2008a). It is commonly found in indoor at about 5 micrograms per cubic meter ($\mu g/m^3$)(EPA 1998).

For this investigation, the benzene levels from all locations except that of the smokers (location #4) were below typical values. In August and October, the levels of benzene at locations #1, #3, #5, #6 and #8 were slightly above the Environmental Protection Agency's cancer risk screening levels. Florida DOH calculated the cancer risk for lifetime (70 years) inhalation and concluded there was a very low theoretical increased risk. In August, the benzene levels at location #4 (smoking household) were slightly higher, but still present a low theoretical increased cancer risk. For location #10 in August and location #11 in October, the benzene levels, although detected, were very low, and therefore present a very low theoretical increased cancer risk (see Appendix B for calculations).

Regardless of the source of benzene, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

Bromoform

Bromoform is somewhat soluble in water and readily evaporates into the air. Most bromoform

that enters the environment is formed as a byproduct when chlorine is added to kill bacteria in drinking water. The fate of this chemical in air has not been investigated, but it is likely stable with a half-life of 1-2 months. Most levels measured in air are quite low (<10 parts per trillion)(ATSDR 2008a). The bromoform levels measured at one location (#8) were estimated to be 3.3 ug/m^3 and present a very low theoretical increased cancer risk based on a lifetime exposure of 70 years (see Appendix B for calculations).

Regardless of the source of bromoform, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

Carbon Tetrachloride

Carbon tetrachloride was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid/degreasing agent, in fire extinguishers, and in spot removers. Because of its harmful effects, these uses are now banned and it is only used in some industrial applications.

Carbon tetrachloride moves very quickly into the air upon release. Carbon tetrachloride is very stable in air (lifetime 30-100 years). Because carbon tetrachloride evaporates at normal temperatures, most in the environment is in the air. Typical levels in rural areas are about 1 micorgram per cubic meter (ug/m^3). Levels in urban areas and near industrial sources are somewhat higher (ATSDR 2008a).

In August, the levels of carbon tetrachloride at location #8 were slightly above the Environmental Protection Agency's cancer risk screening levels. Florida DOH calculated the cancer risk for lifetime (70 years) inhalation and concluded there was only a very low theoretical increased cancer risk (see Appendix B for calculations).

Regardless of the source of carbon tetrachloride, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

Chloroform

Chloroform is used to make other chemicals and can be formed in small amounts when chlorine is added to water. Chloroform breaks down in air, but only slowly (ATSDR 2008a).

Chloroform enters the environment from chemical companies, paper mills and other sources. Chloroform can enter the air directly from factories that make or use it and by evaporating from contaminated water and soil. It evaporates easily into the air. Chloroform enters indoor air from hot showers and other vaporization of chlorinated municipal water. Typical indoor levels are 1 µg/m^3 (EPA 1998). The chloroform levels found in the indoor air of all locations ranged from non-detect up to 6.4 µg/m^3 (location #9).

In August and October, the levels of chloroform at locations #2, #3, and #8 were slightly above the Environmental Protection Agency's cancer risk screening levels. Florida DOH calculated the

cancer risk for lifetime exposure (70 years) and concluded there is only a very low theoretical increased cancer risk.

In August at locations #4 and #9, the levels of chloroform were slightly higher and but still only present a low theoretical increased cancer risk (see Appendix B for calculations). The chloroform may be from the water supply released during showering. DOH recommends a bathroom exhaust fan to reduce these levels.

Regardless of the source of chloroform, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

1,2-Dichloroethane (DCA)

1,2-Dichloroethane (1,2-DCA) is a common indoor contaminant coming from adhesives (glues), cleaning products, paint/varnish/ finish removers, and other indoor sources (EPA 1988, ATSDR 2001). 1,2-DCA is most commonly used in the production of vinyl chloride which is used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. It is also used as a solvent and was added to leaded gasoline to remove lead (ATSDR 2008a). Old cleaning solutions, pesticides, wallpaper/ carpeting glue, and some paint/varnish/ finish removers also contain 1,2-DCA. The National Institute of Health's web site lists chemicals in common house hold products (http://hpd.nlm.nih.gov/). Because old household cleaning and chemical products may still be in use, people should follow label directions about ventilation.

In 2002 the New York State Department of Health found an indoor air concentration of 52.4 ug/m^3 of 1,2-DCA in the indoor air of a Hempstead day care center due to cleaning products (ATSDR 2005b). In 2008 Florida DOH found 55 to 61 ug/m^3 of 1,2-DCA in the air of a DeLand flower shop and 65 ug/m^3 in the home of a smoker during a different site investigation (ATSDR 2009).

Breathing the highest measured indoor air concentrations of 1,2-DCA in buildings near Raytheon is not likely to cause any non-cancer illness. It is not known if 1,2-DCA causes cancer in humans. In laboratory animals, drinking large amounts of 1,2-DCA does cause cancer. Therefore, the US Department of Health and Human Services has determined that 1,2-DCA may reasonably be expected to cause cancer in humans (ATSDR 2001).

Using EPA's inhalation unit risk factor, Florida DOH estimates the theoretical increased cancer risk from lifetime (70 year) inhalation of the highest indoor air concentration of 1,2-DCA (52 ug/m^3 at location #3) is about 1 in 1,000 or a moderate increased cancer risk. This is an upper-bound risk estimate. The actual risk may be lower and may be as low as zero. To put this into context, the American Cancer Society estimates that one out of every three Americans (or 333 in 1,000) will be diagnosed with some form of cancer in their lifetime. Adding the upperbound estimate of the theoretical increased cancer risk from lifetime exposure to 52 ug/m^3 1,2-DCA near Raytheon would increase the cancer incidence from 333 in 1,000 to 334 in 1,000. The levels

of 1,2-DCA at other locations resulted in a theoretical increased cancer risk of very low to low (see Appendix B for calculations).

1,2-DCA in ground water under the Brandywine apartment is in the deeper ground water (45-55 feet deep) but not in the shallow ground water. Regardless of the source of 1,2-DCA, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

Methylene chloride

Methylene chloride is used as an industrial solvent and paint stripper. It may also be found in some aerosol and pesticide products and is used in the manufacture of photographic film. Methylene chloride is mainly released to the environment in air. About half of the methylene chloride in air disappears in 53 to 127 days (ATSDR 2008a).

Average daily intake of methylene chloride from urban air ranges from approximately 33 to 309 micrograms per cubic meter. Occupational and consumer exposure to methylene chloride in indoor air may be much higher, especially from spray painting or other aerosol uses (ATSDR 2008a).

In August, the levels of methylene chloride at locations # 1, #4, and #10 presented a very low theoretical increased cancer risk (see Appendix B for calculations).

Regardless of the source of methylene chloride, short term exposures to the measured levels are not likely to cause illness. However, if someone breathes these levels chronically, that may cause a theoretical increased cancer risk. Cancer risk levels are based on a lifetime (70 year) exposure.

Toluene

Toluene is a clear, colorless liquid with a distinctive smell. It is a good solvent (a substance that can dissolve other substances). It is added to gasoline along with benzene and xylene. Toluene occurs naturally in crude oil and in the tolu tree. It is produced in the process of making gasoline and other fuels from crude oil, in making coke from coal, and as a by-product in the manufacture of styrene. Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. It is disposed of at hazardous waste sites as used solvent or at landfills where it is present in discarded paints, paint thinners, and fingernail polish. You can begin to smell toluene in the air at a concentration of 8 parts of toluene per million parts of air (ppm)(ATSDR 2000).

The toluene level in the air outside your home is usually less than 1 ppm in cities and suburbs that are not close to industry. The toluene inside your house is also likely to be less than 1 ppm.

Unless you smoke cigarettes or work with toluene-containing products, you are probably exposed to only about 300 micrograms (μg) of toluene a day. A microgram is one millionth of a gram. If you smoke a pack of cigarettes per day, you add another 1,000 μg to your exposure.

People who work in places where toluene-containing products are used can be exposed to 1,000 milligrams of toluene a day when the average air concentration is 50 ppm and they breathe at a normal rate and volume. A milligram is one-thousandth of a gram.

People are exposed to toluene when you breathe air containing toluene. When this occurs the toluene is taken directly into their blood from their lungs. Where they live, work, and travel and what they eat affects someone's daily exposure to toluene. Factors such as age, sex, body composition, and health status affect what happens to toluene once it is in someone's body. After being taken into the body, more than 75% of the toluene is removed within 12 hours. It may leave the body unchanged in the air you breathe out or in your urine after some of it has been changed to other chemicals. Generally, your body turns toluene into less harmful chemicals such as hippuric acid.

In August, toluene was found at 390 ug/m^3 (or 104 ppb) at location #4 (Brandywine Apartment with smokers). This level is 1.3 times ATSDR's chronic exposure comparison value of 300 ug/m^3. The ATSDR minimal risk level (MRL) for tolune is 0.3 mg/m3 or 0.08 parts per million (ppm). Toluene inhalation of 35 ppm for 17 yrs increases odor confusion, and this amount is 350 times higher than the maximum level of toluene found in the apartment near Raytheon Therefore, although toluene was slightly above ATSDR's comparison value of 300 ug/m^3,it is unlikely to cause non-cancer illness.

Limitations

At least three factors limit this investigation. First, samples were collected on only two occasions. Indoor air quality likely varies from day-to-day and season-to-season. Second, although samples were collected from homes above the highest ground water contamination, air quality in other homes may be different. Differences in building foundations, buried utilities, and air conditioning system operation can all affect vapor intrusion. Thus air quality in tested homes may not be representative of other nearby homes. Third, the lack of sub slab vapor testing makes the contribution, if any, from vapor intrusion less certain.

Child Health Considerations

Children may be more sensitive to the effects of VOCs than are adults. Little information exists on how VOCs differ in their effects between children and adults (ATSDR 2007). Children drink more fluids, eat more food, and breathe more air per kilogram of body weight than do adults. Children have a larger skin surface in proportion to their body volume.

Florida DOH reviewed the air test results in terms of sensitive populations such as pregnant women, nursing mothers and children, and found that VOCs in the indoor air are not likely to cause illness for these populations.

Conclusions

The highest levels of chemicals in the air of these 10 buildings during sampling in August and October 2008 are not likely to harm people's health. If for 70 years someone breathes the highest concentrations of six chemicals found in the air of buildings near Raytheon (benzene, bromoform, carbon tetrachloride, chloroform, 1,2-dichloroethane, and methylene chloride) there is a theoretical increased cancer risk ranging from very low for most of the chemicals to

moderate for 1,2-dichloroethane (1,2-DCA). Because of uncertainties, however, the actual cancer risk may be as low as zero.

The chemicals found in the buildings tested over contaminated ground water from Raytheon are common in indoor air. For most chemicals, the levels were similar to those in a distant, unaffected background home. None of the three most widespread ground water contaminants (TCE, 1,2-DCE, and VC) from the Raytheon site were detected in the indoor air of these 10 buildings. Therefore, the chemicals found in the air of these 10 buildings are not likely from ground water vapor intrusion. The chemicals found are commonly found in indoor air and the likely source for most is household products.

Recommendations

FDOH has no recommendations regarding the air testing. For best public health practice, and to reduce indoor air chemicals if residents are concerned:

- Residents should follow label directions when using cleaning products, glues, air fresheners and other chemicals indoors.
- Residents should periodically open their windows for fresh air.
- Residents with elevated levels of chloroform or bromoform should use a bathroom exhaust fan when showering.
- Residents should not smoke inside their homes.

Public Health Action Plan

Past Actions

In May 2008, the Pinellas County Health Department requested assistance from Florida DOH. Also in May 2008, Florida DEP notified Florida DOH of off-site ground water contamination. In July, Florida DOH held an open house to answer health questions. Nearby residents were concerned about use of their private irrigation wells. Florida DOH found lawn watering or filling swimming pools from private irrigation wells near the Raytheon site is not a public health threat (ATSDR 2008c). In July 2008, Raytheon tested homegrown fruits and vegetables for TCE, 1,4-dioxane, and other chemicals. Florida DOH is reviewing these results and will have a report available soon (http://hazwastework.doh.state.fl.us/).

Future Actions

If additional chemicals are found in the ground water or ground water contaminant levels increase significantly, the Florida DOH will consider recommending additional indoor air tests.

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Figure 1. Aerial View of Raytheon Area

Figure 2. Raytheon Area Map

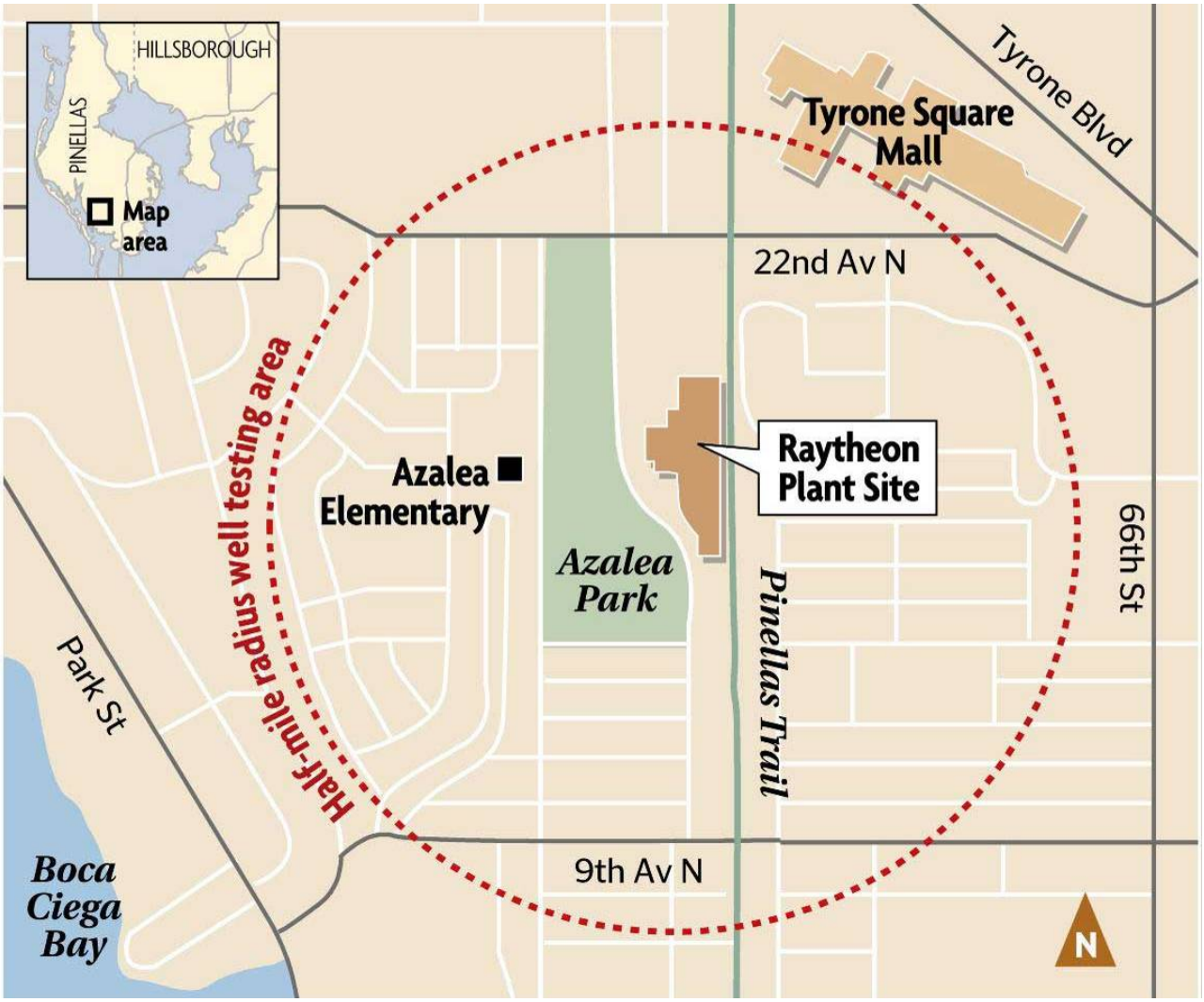
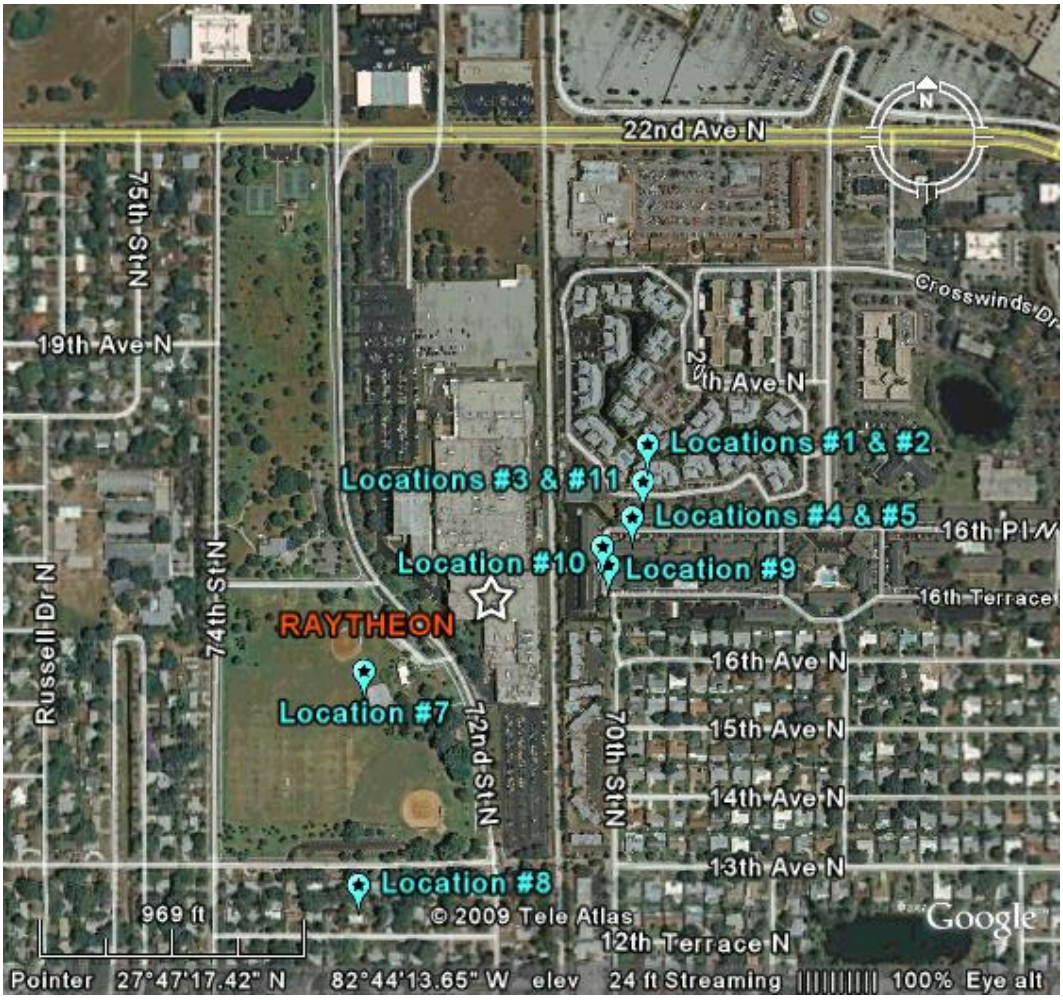


Figure 3. Indoor Air Sample Locations



Note: Location #6 (background) is on 65th Street North, approximately 0.5 miles NE of Raytheon.

Table 1. Ground Water Elevations near Raytheon, April 2008

Well I.D.	Ground Elevation (feet local datum)	Top-of-Casing Elevation (feet local datum)	Ground Elevation (feet msl NGVD)	Top-of-Casing Elevation (feet msl NGVD)	Well Diameter (inch)	Screen Interval (feet b/s)	Hydrostratigraphic Unit	Depth to Water (feet below TOC)	Water Elevation (feet msl NGVD)
ETMW-1	120.4	120.34	23.40	23.34	2.00	2 - 12	Upper Sand	2.64	20.70
ETMW-2	120.3	120.19	23.30	23.19	2.00	2 - 12	Upper Sand	2.47	20.72
ETMW-3	120.2	120.04	23.20	23.04	2.00	2 - 12	Upper Sand	2.38	20.66
IMW-1	120.1	119.93	23.10	22.93	2.00	32.9 - 37.9	Interbedded	2.33	20.60
DMW-1	120.0	119.73	23.00	22.73	2.00	59.8 - 69.8	Hawthorn	4.59	18.14
SMW-2	119.79	119.54	22.79	22.54	2.00	2 - 12	Upper Sand	2.01	20.53
IMW-2	119.77	119.50	22.77	22.50	2.00	30 - 40	Interbedded	1.96	20.54
DMW-2	119.79	119.56	22.79	22.56	2.00	57 - 67	Hawthorn	4.25	18.31
SMW-3	120.8	120.64	23.80	23.64	2.00	1.8 - 11.8	Upper Sand	3.31	20.33
IMW-3	120.5	120.19	23.50	23.19	2.00	30.3 - 40.3	Interbedded	3.08	20.11
DMW-3	120.6	120.41	23.60	23.41	2.00	57 - 72	Hawthorn	5.12	18.29
SMW-4	120.03	119.81	23.03	22.81	2.00	2 - 12	Upper Sand	1.87	20.94
IMW-4	120.06	119.89	23.06	22.89	2.00	30 - 40	Interbedded	2.14	20.75
DMW-4	120.04	119.80	23.04	22.80	2.00	56 - 71	Hawthorn	4.92	17.88
SMW-5	120.81	120.47	23.81	23.47	2.00	2 - 12	Upper Sand	2.59	20.88
IMW-5	120.78	120.56	23.78	23.56	2.00	30.1 - 35.1	Interbedded	2.70	20.86
SMW-6	120.1	119.81	23.10	22.81	2.00	2 - 12	Upper Sand	3.57	19.24
IMW-6	120.1	119.78	23.10	22.76	2.00	30 - 40	Interbedded	3.74	19.02
SMW-7	120.28	119.96	23.28	22.96	2.00	1.5 - 11.5	Upper Sand	3.27	19.71
IMW-7	120.3	120.11	23.30	23.11	2.00	29.8 - 39.8	Interbedded	3.95	19.16
DMW-7	120.32	120.17	23.32	23.17	2.00	60 - 70	Hawthorn	5.85	17.32
SMW-8	119.23	118.87	22.23	21.87	2.00	2 - 12	Upper Sand	0.77	20.90
IMW-8	119.25	118.88	22.25	21.88	2.00	29.75 - 39.75	Interbedded	1.89	19.99
IMW-9	120.29	120.02	23.29	23.02	2.00	30 - 40	Upper Sand	2.21	20.81
SMW-10	120.02	119.74	23.02	22.74	2.00	2 - 12	Upper Sand	1.73	21.01
IMW-10	120.07	119.74	23.07	22.74	2.00	32.5 - 37.5	Interbedded	2.02	20.72
SMW-11	120.31	120.14	23.31	23.14	2.00	2 - 12	Upper Sand	3.11	20.03
IMW-11	120.27	120.14	23.27	23.14	2.00	28.8 - 38.8	Interbedded	3.68	19.48
IMW-12	120.29	120.11	23.29	23.11	2.00	45.5 - 55.5	Interbedded	2.33	20.78
IMW-13	119.50	119.39	22.50	22.39	2.00	44 - 54	Lower Sand	2.62	19.77
SMW-14	120.10	119.92	23.10	22.92	2.00	2 - 12	Upper Sand	4.59	18.33
IMW-14	120.10	120.04	23.10	23.04	2.00	43 - 53	Lower Sand	4.53	18.51
SMW-15	120.28	120.50	23.28	23.50	2.00	5 - 15	Upper Sand	4.21	19.29
IMW-15	120.25	120.53	23.25	23.53	2.00	44 - 54	Lower Sand	4.69	18.84
SMW-16	119.71	120.00	22.71	23.00	2.00	5 - 15	Upper Sand	5.03	17.97
IMW-16	119.71	120.00	22.71	23.00	2.00	46 - 56	Lower Sand	4.81	18.19
SMW-17	117.55	117.58	20.55	20.58	2.00	5 - 15	Upper Sand	1.93	18.65
IMW-17	117.30	117.52	20.30	20.52	2.00	44 - 54	Lower Sand	1.82	18.70

Reference: Arcadis 2008

Table 2. Raytheon Area Ground Water Contaminant Concentrations in 2007 & 2008 (micrograms per liter)

	Upper Sand (2-22')			Interbedded (23-56')			Lower Sand (43-60')		
TCE									
2007	4.9	→	740	<1U	→	59,000	<1 U	→	1200
2008	<1 U	→	130	<1U	→	37,000	<1 U	→	4800
Vinyl Chloride									
2007	<1 U	→	8.2	<1U	→	1900	0.6 I	→	350
2008	<1 U	→	1800	<1U	→	7600	<1 U	→	660
cis-1,2-DCE									
2007	<1 U	→	1200	<1U	→	6700	<1 U	→	870
2008	<1 U	→	1200	<1U	→	5100	<1 U	→	360
trans-1,2-DCE									
2007	<1 U	→	<25 U	<1U	→	<500 U	<1 U	→	.4
2008	<1 U	→	110	0.5	→	52 JI	<1 U	→	5.8

Note: due to the variations wells and hydrogeology of the three layers, there is some overlap in the depths of wells in the interbedded and lower sand layers (i.e.2 wells in the interbedded were IDPT2 is 40-50' and IMW12 and IMW21 are 45-55'. All others in the interbedded are 23-43')
I= between the pratical quantitation limit (PQL) and the maximum detection limit (MDL)
U= non-detect
J=estimated amount

Table 3. Indoor Air Concentrations (µg/m^3)

Chemical	#1B Stone's Throw	#1C Stone's Throw	#1D Stone's Throw	#2 B Stone's Throw	#3B Brandy wine Bldg 6947	#3C Brandy wine Bldg 6947	#3D Brandy wine Bldg 6947	#4B Brandy wine Bldg 6946	#5A Vacant Brandy wine Bldg 6946	#5B Vacant Brandy wine bldg 6946	
	Evening	Morning	Evening	Evening	Evening	Morning	Evening	Evening		Evening	
1,2-Dichloroethane	2.6	1.6 J	2.4	2.1	52.0	38.0	37.0	50.0	ND	1.9 J	1,2-dichloroethane
1,4-Dichlorobenzene	1.9 J	2.2 J	2.0 J	ND	ND	ND	ND	ND	2.2 J	3.4	1,4-Dichlorobenzene
2-Butanone	12.0	9.0	11.0	9.5	150E	110 E	83 E	36.0	6.1	8.0	2-Butanone
Acetone	130 E	140 E	170 E	180 E	360E	140 E	140 E	440 E	120.0 E	110.0 E	Acetone
Benzene	2.2	1.5 J	1.7	ND	2.8	1.5 J	3.6	40.0	2.3	2.6	Benzene
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Bromoform
Carbon Disulfide	ND	ND	2.0	ND	ND	ND	4.4	1.7	ND	ND	Carbon Disulfide
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Carbon Tetrachloride
Chloroform	ND	ND	ND	2.0 J	1.9 J	2.6	ND	5.6	ND	ND	Chloroform
Chloromethane	2.9	2.2	2.1	2.6	4.9	ND	8.5	53.0 E	3.0	3.4	Chloromethane
Cyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	4.6	3.1	Cyclohexane
Ethylbenzene	1.4 J	ND	ND	ND	ND	ND	1.4 J	23.0	8.9	8.7	Ethylbenzene
Hexane	ND	ND	ND	ND	ND	ND	ND	47.0	87.0 E	58.0	Hexane
Methylene Chloride	4.7	ND	ND	ND	1.9	ND	ND	24.0	ND	ND	Methylene Chloride
Styrene	2.8	1.6 J	2.0 J	1.7 J	7.3	3.9	3.8	15.0	2.0 J	2.0 J	Styrene
Tetrachloroethene	ND	ND	ND	16.0	ND	ND	ND	ND	ND	ND	Tetrachloroethene
Toluene	23.0	23.0	25.0	11.0	18.0	7.5	11.0	390 E	80 E	66.0	Toluene
1,1,1-Trichloroethane	3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,1,1-Trichloroethane
Xylenes (total)	2.9 J	2.4 J	2.9 J	ND	4.8	ND	2.7 J	86.0	47.0	43.0	Xylenes (total)

All results are micrograms per cubic meter (ug/m3)
Samples A and B were collected in August 2008. Samples C and D were collected in October 2008
N/A = not analyzed as the shipping company lost one box of canisters (#1A, 2A, 3A and 4A)
#7A canister was inadvertently switched with an empty canister so not analyzed (7C & 7D is the complete 24 hr re-test)
Note - acetaldehyde was detected, but was a tentatively identified compound. This means that the lab showed a peak but it was not positively identified. Therefore, since these levels are inaccurate, this chemical was excluded from the results table. The background sample location #6 detected low levels of acetaldehyde, benzene, chloromethane, ethylbenzene, hexane and toluene #4A and #4B - 3 smokers at this location during this testing so some chemical levels were higher than other locations.
For the 24 hour averages, if the levels were ND, then ½ the detection limit was used for the average rather than zero to be even more protective of human health
J= estimated amount ND = non-detect E = analyte exceeded the lab's highest standard and a dilution was applied to bring it back on scale

Table 3. Indoor Air Concentrations (µg/m^3)(cont)

Chemical	#6A Background 65th Av. N Morning	#6B Background 65th Av. N. Evening	#7A Azalea Park Bldg Morning	#7B Azalea Park Bldg Evening	#7C Azalea Park Bldg Morning	#7D Azalea Park Bldg Evening	#8A Lynnwood Ave. Morning	#8B Lynnwood Ave. Evening	Morning	Evening	Morning	Evening	#11C Brandy Wine Bldg 6947 Morning	#11D Brandy Wine Bldg 6947 Evening
1,2-dichloroethane	ND	ND	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	N/A	ND	ND	ND	56.0	48.0	ND	ND	3.8	ND	ND	ND
2-Butanone	2.7	1.2	N/A	1.0	1.3 J	0.92 J	4.1	3.5	ND	13.0	ND	5.4	3.1	6.6
Acetone	28.0	26.0	N/A	30.0	15.0	14.0	110 E	99 E	110.0 E	140 E	95.0	140 E	48.0 E	100 E
Benzene	1.2 J	2.9	N/A	ND	ND	ND	2.8	1.5 J	1.1 J	ND	1.9	1.5 J	ND	1.1 J
Bromoform	ND	ND	N/A	ND	ND	ND	ND	3.3 J	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ND	ND	N/A	ND	ND	ND	1.8	ND	ND	6.8	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	N/A	ND	ND	ND	1.8 J	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	N/A	ND	ND	ND	1.7 J	1.9 J	5.9	6.9	ND	ND	ND	ND
Chloromethane	1.7	1.4	N/A	1.4	1.0	1.1	2.9	3.0	3.1	ND	3.9	2.6	2.4	2.8
Cyclohexane	ND	ND	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	2.4	3.2	N/A	2.7	ND	ND	4.4	3.2	1.9 J	3.1	ND	ND	ND	2.6
Hexane	1.9	2.3	N/A	ND	ND	ND	8.2	3.9	2.7	ND	1.2 J	ND	1.4 J	1.1 J
Methylene Chloride	ND	ND	N/A	ND	ND	ND	ND	1.5 J	ND	3.0	9.6	1.6 J	ND	ND
Styrene	ND	ND	N/A	ND	ND	ND	4.7	4.0	2.7	2.1 J	1.5 J	1.2 J	ND	1.5 J
Tetrachloroethene	ND	34.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	22.0	26.0	N/A	5.8	ND	ND	41.0	27.0	32.0	31.0	14.0	14.0	3.1	6.4
1,1,1-Trichloroethane	ND	ND	N/A	ND	ND	ND	2.6 J	2.5 J	ND	ND	ND	ND	ND	ND
Xylenes (total)	10.3	13.4	N/A	5.8 J	ND	ND	21.6	16.4	10.7	12.4	2.6 J	3.8	6.4 J	15.9

Note: 4 canisters were lost in transit by the shipping company. These 4 canisters were 12 hour samples collected from morning to afternoon and were labeled 1A (Stones Throw), 2A (Stones Throw), 3A (Brandywine Bldg 6947) and 4A (Brandywine Bldg 6946). Therefore there are no lab analyses for these 4 samples.

Note: the following chemicals were also tested for each sample in the chart and the results for all samples were all non-detect (ND):
bromomethane, chloroethane, trans 1,2-DCE, 1,1-Dichloroethene, 1,2-dibromoethane, 1,2-Dichloropropane, 1,3-dichloropropene, Hexachlorobutadiene, methyl- t-butyl ether , ,1,1,2-Trichloroethane, trichloroethylene, 1,1,2,2-Tetrachloroethane, vinyl acetate and vinyl chloride

Table 4. Air Comparison Values

	ATSDR Comparison Values			EPA Comparison Values		
Volatile Organic Compounds	**acute (ug/m^3)**	**interm (ug/m^3)**	**chronic (ug/m^3)**	**cancer (ug/m^3)**	**EPA RFC (ug/m3)**	**EPA Inhalation Unit Risk 1/(ug/m^3)**
1,2-dichloroethane (DCA)	none	none	2000	0.04	none	2.6E-05
1,4-Dichlorobenzene	10,000	1000	60	none	800	See EPA IRIS website for provisional toxicity values for this chemical. http://www.epa.gov/iris
2-Butanone	none	none	none	none	5000	none
Acetone	60000	30000	30000	none	none	none
Benzene	30	20	10	0.1	30	7.8E-06 - Inhal Unit Risk ranges from 2.2x10-6 to 7.8x10-6 (ug/m3)-1.
Bromoform	none	none	none	0.9	none	1.1E-06
Carbon Disulfide	none	none	900	none	700	none
Carbon Tetrachloride	none	200	200	0.07	none	1.5E-05
Chloroform	500	200	100	0.04	none	2.3E-05
Chloromethane	1000	400	100	none	90	none
Cyclohexane	none	none	none	none	6000	none
Ethylbenzene	40,000	3000	1000	none	1000	none
Hexane	none	none	2000	none	700	none
Methylene Chloride	2000	1000	1000	2.0	none	4.7E-07
Styrene	none	none	300	none	1000	none
Tetrachloroethene	1000	none	300	none	none	none
Toluene	4000	none	300	None	5000	none
1,1,1-Trichloroethane	10,000	4000	none	none	5000	
Xylenes (total)	9000	3000	200	none	100	MRLs have been derived for mixed xylenes that applies to the individual isomers as well (see 2005 Tox Profile).

Table 5. Outdoor Air Test Results (Main Contaminants) in ug/m3

Chemical	2008 (Jan-June)	2007	2006
vinyl chloride			
Annual Min	<0.100	<0.100	<0.08
Annual Max	<0.100	<0.100	<0.08
Annual Avg	<0.100	<0.100	<0.08
cis-1,2-dichloroethene			
Annual Min	<0.071	<0.071	<0.08
Annual Max	<0.071	0.095	0.08
Annual Avg	<0.071	<0.071	<0.08
trichloroethene			
Annual Min	<0.134	<0.134	<0.16
Annual Max	<0.134	<0.134	0.16
Annual Avg	<0.134	<0.134	<0.16

Please note the grab and 24 hour samples taken on 8/26/08 and 8/27/08 for these three chemicals were all non-detect.

Reference: DEM 2008

Photographs

Photograph 1. Stones Throw Condos

Photograph 2. Azaela Park

Photograph 3. View of Brandywine Apartments and Raytheon from Azaela Park

Photograph 4. Seventieth Condos South of Brandywine Apartments

Photograph 5. Raytheon

APPENDIX B

Cancer Risk Calculations

Cancer risk calculations for Raytheon Indoor Air Testing Locations – August Sampling

Location #1B – StonesThrow Condos – based on one 12-hr sample

1,2-DCA – (2.6 ug/m^3)(2.6x10^{-5} (ug/m3)$^{-1}$) = 1.0 x10^{-4} = low increased risk

benzene - (2.2 ug/m^3)(7.8x10^{-6} (ug/m3) $^{-1}$) = 1.7x10^{-5} = very low increased risk considered to be a no apparent health hazard

methylene chloride – (4.7 ug/m3)(4.7 x 10^{-7} (ug/m3)$^{-1}$) =2.2 x 10^{-6} = very low increased risk considered to be an extremely small health hazard

Location #2B – Stones Throw Condos – based on one 12-hour sample

1,2-DCA - (2.1 ug/m^3)(2.6 x 10^{-5} (ug/m^3)-1) = 1.0 x 10^{-4} = low increased risk

chloroform - (2.0 ug/m^3)(2.3 x 10^{-5} (ug/m^3)-1) = 4.6 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #3B – Brandywine apts – based on one 12-hr sample –

1,2-DCA - (52 ug/m^3)(2.6 x 10^{-5} (ug/m3)$^{-1}$) = 1.4 x 10^{-3} = moderate increased risk

benzene – (2.8 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 2.2 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

chloroform - (1.9 ug/m^3)(2.3 x 10^{-5} (ug/m3)$^{-1}$) = 4.4 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #4B – Brandywine apts – based on one 12-hr sample – 3 active smokers in this household – after the 2nd 12 hrs, canister was handed to us outside still on

1,2-DCA - (50 ug/m^3)(2.6 x 10^{-5} (ug/m3)$^{-1}$) = 1.3 x 10^{-3} = moderate increased risk

benzene - (40 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 3.12 x 10^{-4} = low increased risk

chloroform - (5.6 ug/m^3)(2.3 x 10^{-5} (ug/m3)$^{-1}$) = 1.3 x 10^{-4} = low increased risk

methylene chloride – (24.0 ug/m3)(4.7 x 10^{-7} (ug/m3)$^{-1}$) =1.1 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #5A&5B – Brandywine vacant apartment - 24-hr avg from two 12-hr samples calculated and included below

1,2-DCA - (1.25 ug/m^3)(2.6 x 10^{-5} (ug/m3)$^{-1}$) = 3.25 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

benzene - (2.5 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 2.0 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #6 – Background Sample – 65th Ave North - 24-hr avg from two 12-hr samples calculated and included below

benzene - (2.1 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 1.6 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #7 – based on one 12 hr sample

no elevated contaminants with CREGs to calculate the cancer risk (i.e. benzene, chloroform, bromoform and 1,2-dca all ND)

Location #8 – Lynnwood Ave - 24-hr avg from two 12-hr samples calculated and included below

benzene - (2.2 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 1.7 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

bromoform - (2.2 ug/m^3)(1.1 x 10-6 (ug/m3)$^{-1}$) = 2.4 x 10^{-6} = very low increased risk considered to be an extremely small health hazard

carbon tetrachloride - (1.4 ug/m^3)(1.5 x 10-5 (ug/m3)$^{-1}$) = 2.1 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

chloroform - (1.8 ug/m^3)(2.3 x 10^{-5} (ug/m3)$^{-1}$) = 4.1 x 10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #9 – 70th Street North - 24-hr avg from two 12-hr samples calculated and included below

benzene - (0.8 ug/m^3)(7.8x10^{-6} (ug/m3)$^{-1}$) = 6.2 x 10^{-6} = very low increased risk considered to be an extremely small health hazard

chloroform - (6.4 ug/m^3)(2.3 x 10^{-5} (ug/m3)$^{-1}$) = 1.5 x 10^{-4} = low increased risk

Location #10 – 70th Street North - 24-hr avg from two 12-hr samples calculated and included below

benzene - (1.7 ug/m^3)($7.8x10^{-6}$ $(ug/m3)^{-1}$) = 1.3×10^{-5} = very low increased risk considered to be a no apparent health hazard

methylene chloride – (5.6 ug/m3)(4.7×10^{-7} $(ug/m3)^{-1}$) =2.6×10^{-6} = very low increased risk considered to be an extremely small health hazard

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Cancer risk calculations for Raytheon Indoor Air Testing Locations – October Sampling

Location #1C and #1D – StonesThrow Condos – based on a 24 hour avg

1,2-DCA – (2.0 ug/m^3)($2.6x10^{-5}$ $(ug/m3)^{-1}$) = 1.0×10^{-4} = low increased risk

benzene - (1.6 ug/m^3)($7.8x10^{-6}$ $(ug/m3)^{-1}$) = 1.25×10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #3C and #3D – Brandywine apts – based on a 24 hour avg

1,2-DCA - (38.0 ug/m^3)(2.6×10^{-5} $(ug/m3)^{-1}$) = 1.0×10^{-3} = moderate increased risk

benzene – (2.6 ug/m^3)($7.8x10^{-6}$ $(ug/m3)^{-1}$) = 2.0×10^{-5} = very low increased risk considered to be a no apparent health hazard

chloroform - (1.7 ug/m^3)(2.3×10^{-5} $(ug/m3)^{-1}$) = 3.9×10^{-5} = very low increased risk considered to be a no apparent health hazard

Location #7 C and #7D – concession stand – based on a 24 hour average

no elevated contaminants with CREGs to calculate the cancer risk (i.e. benzene, chloroform, bromoform and 1,2-DCA all ND)

Location #11C and #11D – Brandywine apts – based on a 24 hour avg

benzene - (0.8 ug/m^3)($7.8x10^{-6}$ $(ug/m3)^{-1}$) = 6.24×10^{-6} = very low increased risk considered to be an extremely small health hazard

Certification

The Florida DOH, Bureau of Community Environmental Health, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) prepared this report on air sampling for the Raytheon Site. This health consultation was prepared in accordance with approved methodology and procedures existing at the time. Editorial review was completed by the Cooperative Agreement Partner.

Jennifer Freed
Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

Alan Yarbrough
Team Lead, CAT, CAPEB, DHAC, ATSDR