

# STATE OF CONNECTICUT

## DEPARTMENT OF PUBLIC HEALTH



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### Environmental Health Section

To: Alexandra Daum, Deputy Commissioner, DECD

From: Meg Harvey, Epidemiologist *MLH*

Subject: Evaluation of Air Data from former Winchester Arms, 275 Winchester Ave, New Haven

Date: February 17, 2021

As requested, enclosed is our evaluation of environmental data generated from a bench scale test of the volatilization potential from contaminated concrete in Building 34A of the former Winchester Repeating Arms site located at 275 Winchester Avenue in New Haven.

Please contact me if you have any questions about the information presented in our evaluation. Also, if you think it would be helpful, we would be happy to discuss our evaluation, conclusions and recommendations with you and other interested parties.



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## **Evaluation of Environmental Data from the Former Winchester Repeating Arms Site**

**275 Winchester Avenue, New Haven, Connecticut**

**February 17, 2021**

### **Background and Introduction**

The former Winchester Repeating Arms site is located at 275 Winchester Avenue in New Haven, CT. It is a 75- acre site, comprised of several buildings and structures, which manufactured rifles from the 1870's to 2006. The site itself and its building and structures are part of a historical district, so therefore any development is subject to review by the Connecticut State Historic Preservation Office (SHPO), which is part of the Connecticut Department of Economic Development. (CT DECD).

Because these are historical buildings, it has been SHPO's desire to preserve them despite the extensive contamination that resulted from historic munitions manufacturing. All of the other Winchester Repeating Arms property buildings besides the 4 listed below were remediated and redeveloped into residential and commercial properties without demolishing the buildings. The contractor for the developer of Winchester Repeating Arms, Langan Corporation, has explored several different ways to seal and treat the concrete slabs in the 4 buildings, but none of them were a suitable solution because the slabs were so badly contaminated. Floor slabs, structural columns and walls of the buildings are visibly stained and in some cases saturated with contaminants including various oils and solvents used in the gun manufacturing, cleaning, and degreasing process. More detail about the contamination is provided later in this document. CT DECD requested the assistance of Connecticut Department Public Health (CT DPH) to determine whether contamination present in the slabs could pose an unacceptable risk to future occupants of the buildings.

The 4 buildings of concern that are the subject of this document are located in the eastern side of the Tract A Buildings of the Winchester Repeating Arms property, (31A, 32A, 33A, and 34A) (Tract A).

CT DPH had several conversations with CT DECD, the property developer and their consultant regarding possible approaches that could be used to generate environmental data that would be helpful to CT DPH in trying to answer the question of whether contamination present in the slabs could pose an unacceptable risk to future occupants of the buildings. It was agreed that off-gassing of volatile contaminants in the slabs to indoor air is the relevant exposure pathway of concern. It was also agreed that data most useful to CT DPH would be data representative of potential future indoor air concentrations (post redevelopment). One of the principal challenges with generating such data is that the buildings are completely open structures, with no enclosed spaces in which to measure chemicals that could off-gas and accumulate in indoor air. In response to the conversations mentioned above, Langan proposed and conducted a bench scale off-gassing study to generate data that would be as representative as possible of future indoor air concentrations. CT DECD requested that CT DPH review the off-gassing bench scale test data, which were generated on October 6, 2020 on the second floor

of Building 34A of Tract A of the former Winchester Repeating Arms Property, located at 275 Winchester Avenue. This letter health consultation document summarizes CT DPH's evaluation.

The location for the off-gassing bench scale test was selected because the staining was consistent with other oil-stained floors throughout all other floors of the eastern Tract A buildings. The historical operations throughout the Tract A buildings are very similar and consisted of heavy manufacturing operations. These operations included metal working, woodworking, drilling, milling, and other heavy manufacturing processes. Various oils and solvents were extensively used throughout these buildings for the manufacturing and machining of gun barrels and various metal and wooden gun parts. Solvents such as trichloroethylene (TCE), methylene chloride, and methyl isobutyl ketone were commonly used for cleaning and degreasing metal parts during the manufacturing process (Langan 2020).

Langan Corporation noted that oil contamination is present in floor slabs, structural columns, and both interior and exterior walls of all 4 Tract A Buildings. They also have noted that on warm days, the general outdoor area often smells of petroleum. In addition, concrete slab contamination in many areas is so heavy that the chemicals have penetrated the entire thickness of the 12 to 18-inch-thick concrete slabs and have been observed breaking through to ceilings and walls below in numerous locations (See Appendix).

## **Evaluation Data**

As mentioned above, on October 6, 2020, Langan conducted a bench scale test of natural volatilization (off-gassing) potential of a 2 foot by 2 foot area of contaminated concrete slab floor on the second floor of Building 34A. Detailed methodology can be found in Langan, 2020. The temperature and relative humidity levels at the time of testing were 50 to 65 degrees Fahrenheit and 10% humidity over the duration of the testing event. An acrylic shroud was placed on the concrete floor to simulate an enclosed space with a contaminated concrete floor. The shroud was left in place for 24 hours to allow contaminants in the exposed concrete slab to volatilize and collect in the acrylic shroud.

After allowing the shroud to equilibrate for 24 hours, Langan collected an air sample from the shroud and analyzed the air sample for volatile organic compounds (VOCs), tentatively identified compounds, total VOCs and toluene, and air phase petroleum hydrocarbons (APHs).

### **Shroud Air Test Results**

Table 1 lists the contaminants detected in the air sample at concentrations exceeding health-based comparison values. For comparison values, CT DPH has selected the CT DEEP target indoor air concentrations that are based on the most current toxicity information. As shown in Table 1, TCE was detected in the sample at a concentration of 110 micrograms/cubic meter ( $\mu\text{g}/\text{m}^3$ ) which is 110 times greater than Connecticut's proposed Industrial/Commercial and Residential Target Indoor Air Concentration (ITIAC and RTIAC) of  $1 \mu\text{g}/\text{m}^3$  (CT DEEP 2003).

In addition, methylene chloride was detected in the sample at concentrations of 660 and 920<sup>1</sup>  $\mu\text{g}/\text{m}^3$ , over 200 times greater than the CT DEEP proposed 2003 RTIAC of 3  $\mu\text{g}/\text{m}^3$  and over 300 times the ITIAC value of 17  $\mu\text{g}/\text{m}^3$ .

Several VOCs (acetone, benzene, carbon tetrachloride, chloroform, ethylbenzene, isobutane, p-cymene, styrene, toluene, trichlorofluoromethane, methyl ethyl butyl ketone, 1,24-and 1,3,5 trimethylbenzenes, and xylenes) were detected at concentrations below indoor air comparison values or no comparison value was provided for those compounds.

C5-8 aliphatics were detected at a concentration of 930  $\mu\text{g}/\text{m}^3$ , approximately 7 greater than the CT DEEP RTIAC 130 and 3 times greater than the ITIAC of 330  $\mu\text{g}/\text{m}^3$  (CT DEEP 2018). C9-C12 aliphatics were detected at a concentration of 220  $\mu\text{g}/\text{m}^3$ , exceeding the CT DEEP RTIAC of 115  $\mu\text{g}/\text{m}^3$  (CT DEEP 2018).

**Table 1. Indoor air concentrations detected in acrylic shroud in Building 34A of former Winchester Repeating Arms and Comparison Values, October 2020.**

Contaminant	Concentration ( $\mu\text{g}/\text{m}^3$ )	Industrial/Commercial Comparison Value ( $\mu\text{g}/\text{m}^3$ )	Residential Comparison Value ( $\mu\text{g}/\text{m}^3$ )
Trichloroethylene	110	1 <sup>#</sup>	1 <sup>#</sup>
Methylene Chloride	660 and 920	17 <sup>#</sup>	3 <sup>#</sup>
Air Petroleum Hydrocarbons: C5-C8	930	330*	130*
Air Petroleum Hydrocarbons: C9-C12	220	No Exceedance	115*

<sup>#</sup>Proposed Revisions, Connecticut's Remediation Standard Volatilization Criteria (CT DEEP 2003).

\*Technical Support Document: Recommended Numeric Criteria for Common Additional Polluting Substances and Certain Alternative Criteria (CT DEEP 2018).

## Potential Health Implications and Discussion

Bench scale testing data shows that contaminant concentrations (TCE, methylene chloride, and air petroleum hydrocarbons) are significantly elevated above Connecticut's health-based standards for indoor air in industrial and residential settings. Of particular concern is that the TCE concentration is over 100 times greater than the proposed RTIAC/ITIAC of 1 $\mu\text{g}/\text{m}^3$  and methylene chloride concentrations are 200 and 300 times greater than the proposed ITIAC and RTIAC, respectively. This is significant because it means that even exposure durations and frequencies much less than the assumptions factored into the RTIAC and ITIACs (24 hours/day, 350 days/year for residential exposure (RTIAC) and 8 hours/day, 250 days/year for industrial/commercial exposure (ITIAC)) could result in unacceptable exposures. In addition, the TCE concentrations present a very significant

<sup>1</sup> Methylene chloride exceeded the calibration range for the initial analysis run (estimated value of 660  $\mu\text{g}/\text{m}^3$ ) so it was re-run at a high dilution (20 times) which resulted in a result of 920  $\mu\text{g}/\text{m}^3$ . It is standard operating procedure for labs to re-run at successively higher dilution, if needed (Langan 2020).

exposure concern because some scientific studies in humans indicate that TCE may cause harmful effects to the developing fetus and such effects could occur even with brief periods of exposure (ATSDR 2019).

#### Time to Reach Comparison Value Calculations

To better understand the potential indoor air concentrations that could occur once the buildings are enclosed and occupied, Langan utilized the data gathered from the shroud sample test results, coupled with some basic assumptions, to calculate the approximate time for specific target compounds to exceed a comparison value over the entire building floor area (See Langan 2020 for assumptions). In other words, they calculated whether it was likely that in a future occupied space, the off-gassing contaminants would “dilute” down to insignificant concentrations.

As shown in Table 2, Langan calculated that it would take only 1.4 hours for methylene chloride concentrations in the entire floor of Building 34A to reach the RTIAC and approximately 4 hours for TCE to reach the IARC/RTIAC. In addition, Langan believed that these times are biased low (and therefore the time to reach comparison values are likely much lower) due to a number of reasons. Some of which are:

1. The calculated volatilization rate does not take into account potential off-gassing from contaminated concrete columns or walls.
2. Contaminants present in the building materials will likely volatilize at a higher rate when constantly heated to ambient temperatures of approximately 70 degrees Fahrenheit following adaptive use.
3. The ambient temperature of the floor slab at the sampling location during the 24-hour period was likely lower than outdoor temperatures noted based on the sheltered location of the sample.
4. If the entire bottom of the shroud was exposed to contaminated concrete instead of just a small opening, the vapor concentrations in the shroud could be up to 7 times greater.
5. Due to gravity causing the contaminants present in the concrete slabs to migrate downward, the ceilings likely contribute a much higher load of vapor to the indoor air compared to the floors (Langan 2020).

**Table 2. Estimated Amount of Time Needed for the Trichloroethylene and Methylene Chloride Concentrations in Entire Second Floor of Building 34A to Exceed Residential Target Indoor Air Criteria**

Contaminant	Concentration ( $\mu\text{g}/\text{m}^3$ )	Residential Comparison Value ( $\mu\text{g}/\text{m}^3$ )	Time to Reach Comparison Value (hours)
Trichloroethylene	11	1 <sup>#</sup>	3.9
Methylene Chloride	920 <sup>*</sup>	3 <sup>#</sup>	1.4

<sup>#</sup>Proposed Revisions, Connecticut’s Remediation Standard Volatilization Criteria (CT DEEP 2003).

<sup>\*</sup>Only one concentration for methylene chloride, 920 ( $\mu\text{g}/\text{m}^3$ ) was used to calculate the time to reach comparison value.

#### Uncertainties

One must emphasize that there is a large degree of uncertainty in determining how well the bench scale test data from Building 34A represent future indoor air concentrations in all Tract A Buildings. First, the shroud air measurement reflects a single point in time in one area of one floor in one building. Langan states that they expect off-gassing in other buildings and on other floors to be similar to the location they selected for the study, but it is possible that other locations could have generated much higher or lower shroud air results.

In addition, the bench scale study is not subject to real life settings with changes in variables such as in temperature and humidity. It also does not consider future heating, ventilation, and air conditioning systems that could be present in a future building. Each of these variables could impact the rate and extent of contaminant off-gassing from the slab and the level of contaminants that accumulate in the indoor air space. These uncertainties could mean that the contaminant concentrations measured in the shroud are biased either low or high. Finally, the shroud measures only the off-gassing from the floor, not what could come from the walls and/or ceilings. Thus, there is uncertainty regarding whether the air concentration beneath the shroud could be biased low.

In their report, Langan acknowledges the many areas of uncertainty in their shroud measurement. However, they conclude that taken all together, they believe that the bench scale study represents a best-case scenario and that actual concentrations within the buildings could be worse following adaptive reuse.

## **Conclusions and Recommendations**

Based on bench scale test data reviewed for this evaluation, we conclude that contaminant concentrations are high enough to pose an exposure concern for industrial or residential use. We have come to this conclusion because concentrations of several chemicals off-gassing from the contaminated concrete greatly exceed Connecticut's health-based target indoor air concentrations for industrial/commercial and residential settings.

In addition, because concentrations exceed Connecticut's commercial/industrial and residential indoor air targets by a large margin, we also conclude that even brief periods of exposure (i.e. less than residential or commercial/industrial) could be unacceptable.

Finally, estimates of the time it would take for off-gassing contaminants to reach indoor air targets are on the order of a few hours. This means that it is unlikely that off-gassing contaminants will be diluted to low levels in a future occupied room or space.

Even with all the uncertainties discussed in this document, these multiple lines of evidence indicate that contamination levels off-gassing from the contaminated concrete slabs could pose an exposure concern for any future human occupancy, even brief exposure frequencies and durations. And for this reason, we cannot conclude that future use of the Tract A Buildings for human occupancy would be safe.

We recommend that CT DECD use the information CT DPH has presented in this evaluation to guide its decisions about redevelopment of the 4 Tract A Buildings at former Winchester Repeating Arms.

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## References

ATSDR 2019. Toxicological Profile for Trichloroethylene. Agency for Toxic Substances and Disease Registry. June 2019.

CT DEEP 2003. Proposed Revisions. Connecticut's Remediation Standard Regulations Volatilization Criteria. Connecticut Department of Energy and Environmental Protection, March 2003.

CT DEEP 2018. Technical Support Document: Recommended Numeric Criteria for Common Additional Polluting Substances and Certain Alternative Criteria. Connecticut Department of Energy and Environmental Protection, September 20, 2018.

Langan 2020. Summary of Concrete Volatilization Bench-Scale Test, Former Winchester Repeating Arms Factory, 275 Winchester Avenue, New Haven, Langan Project No. 140203902, December 31, 2020.

## Appendix

### Pictures of the Ceiling and Floor Contamination from the Buildings in Tract A of Winchester Arms







