

North Carolina Division of Waste Management Supplemental Vapor Intrusion Guidance

Trichloroethylene (TCE) Indoor Air Inhalation Immediate Action Levels and Response

July 2019

Introduction

In 2011, the U.S. Environmental Protection Agency’s (USEPA) Integrated Risk Information System (IRIS)¹ issued an update to the toxicological evaluation for trichloroethylene (also known as trichloroethene or “TCE”, CASN 79-01-6). In that update [USEPA 2011], IRIS established revised toxicity values for oral and inhalation exposures to TCE. The current North Carolina Department of Environmental Quality (DEQ) Risk Calculator² which reflects the revised IRIS values is to be used to evaluate vapor intrusion risk. Additionally, the Division of Waste Management (DWM) has established additional indoor air inhalation exposure immediate action levels (Table 1) for TCE to protect sensitive populations (groups of people most likely to suffer adverse health effects) from short-term exposures that may result in long-term health effects.

The TCE-sensitive exposure population for short-term exposures is women of child-bearing age, defined as women of age 15–50 years. Short-term exposure is defined as 24 hours for residential and 8 hours for workplace locations. Site-specific consideration of the appropriate age range should be discussed and evaluated in concert with the exposed women and DWM. **When TCE-sensitive populations may be exposed to concentrations above the DWM action levels found in Table 1, immediate steps must be taken to eliminate or reduce the exposure concentration below the action level.**

Table 1. Division of Waste Management’s (DWM) Immediate Action Levels for Trichloroethylene (TCE) Inhalation Exposures

Exposure Scenario	TCE Action Level - Inhalation	Required Action by the Property Owner, State-Lead Contractor, Brownfields Program Applicant or Remediating Party
Residential	2.1 µg/m ³ (0.39 ppbv)	<ol style="list-style-type: none"> 1. Notify DWM within 1 business day of receiving the validated laboratory data 2. Immediately* coordinate with DWM to provide fact sheets to potentially affected individuals 3. Immediately* initiate measures to reduce exposure below the action level to the TCE-sensitive population
Non-residential	8.8 µg/m ³ (1.6 ppbv)	
* The goal is to reduce exposures to below the Action Level within 72-hours or less for women in their first trimester.		
µg/m ³ – micrograms per cubic meter		ppbv – parts per billion vapor

¹ IRIS – <http://www.epa.gov/iris>

² DEQ Risk Calculator - <https://deq.nc.gov/permits-rules/risk-based-remediation/risk-evaluation-resources>

The USEPA IRIS toxicological review identifies fetal cardiac malformation as one of the non-cancer critical health effects for TCE. Because cardiac development begins during the earliest stages of fetal development, at a time before a woman may realize she is pregnant, TCE exposure to women during their first trimester of pregnancy is of particular concern. Permanent adverse effects to fetal cardiac development may occur as a result of short-term maternal exposures. The USEPA identifies that a single fetal exposure to a developmental toxicant may be sufficient to produce an adverse developmental effect (EPA 2014b). DWM's TCE short-term inhalation action levels are developed from the USEPA IRIS reference concentration (RfC) of 2.0 µg/m³ [USEPA 2011]. The DWM action levels found in Table 1 are equivalent to the USEPA's TCE regional screening levels³ (RSLs) for residential and "composite worker" (non-residential) exposure.

The DWM's immediate action levels and response in this guidance apply to exposure from vapor intrusion due to subsurface contamination. These action levels do not apply to air contamination existing within commercial and industrial buildings resulting from workplace chemical usage. If TCE is a chemical currently in use in the building being investigated for vapor intrusion, the Occupational Safety and Health Administration's (OSHA) standards govern the amount of chemical allowed in indoor air. The OSHA standard for TCE is higher than the USEPA targets used for structural vapor intrusion which are protective of the general population, and while DWM's environmental cleanup programs do not regulate the day-to-day operational emissions at a business, they do recommend that best management practices be used in the workplace to reduce operational TCE emissions to minimize potential health risks.

Additionally, as contaminant remediation efforts are undertaken, it is important to consider future changes in the use of the building or land when OSHA standards no longer apply. For example, a property that is currently used for an active dry-cleaning business may be changed to residential or mixed use in the future when the dry-cleaning business is no longer in operation.

The DWM recognizes that various USEPA Regions and state/federal agencies have adopted a wide range of action levels regarding TCE in indoor air. At this time, DWM considers the USEPA TCE RfC published on IRIS to be health protective with respect to cardiac developmental effects. The DWM's TCE action level response aligns with current recommendations from USEPA Region 4. DWM will continue to monitor recommendations from USEPA and other state/federal agencies and update this guidance to reflect relevant developments in the future.

Notification

State-Funded Contaminant Assessments:

When contractors working for DWM receive analytical data (indoor air results) indicating that women of child-bearing age may be exposed to TCE concentrations above the action level, they are required to notify the applicable DWM program they are working for within **1 business day** of receipt of the data from the laboratory.

³ USEPA RSLs - <https://www.epa.gov/risk/regional-screening-levels-rsls>

Property Owner/Remediating Party/Brownfields Program Applicant's Contaminant Assessments:

When a property owner, remediating party or Brownfields Program applicant receives analytical data (indoor air results) indicating that women of child-bearing age may be exposed to TCE concentrations above the action level, they must contact DWM within **1 business day** of receipt of the data from the laboratory. Failing to do so may cause extended exposure to contamination and make the property owner/remediating party/Brownfields Program applicant and environmental consultant (through their license) more vulnerable to private and public legal actions. Note that for sites having DEQ permits or compliance orders for the contaminant release and those sites undergoing remediation under DWM's Registered Environmental Consultant (REC) Program, the remediating party or their environmental consultant are required to **notify DEQ within 24 hours**. Environmental consultants should make clients aware of DWM's position that all parties discovering such hazards notify DWM within 24 hours of receipt of laboratory data and coordinate immediately with DWM to provide fact sheets to potentially affected individuals. A DWM fact sheet is available for environmental consultants to provide to their clients explaining the notification and response actions associated with TCE.

Closed Sites:

The DWM is currently evaluating and implementing plans to review and screen closed sites with known TCE contamination to identify ongoing exposures of concern, focused on the particular risks of TCE and the vapor intrusion pathway. Property owners and/or potentially responsible parties of previously closed TCE sites should not wait for DWM to make the initial contact. The DWM encourages parties to review existing information about a site and begin to evaluate current conditions to determine if there is a potential for ongoing exposure to TCE. Parties should notify DWM if closed sites are discovered to have a potential TCE exposure pathway. Updates on the progress of TCE closed sites review will be posted as they become available.

Sampling Considerations

The DWM recommends time-integrated air sampling methods to account for temporal variability in vapor intrusion. Time-integrated samples provide a direct measurement of the average TCE concentration over a fixed period of time (e.g., 8 hours, 24 hours, 3 days, 7 days, etc.), which should be compared to the DWM action levels in Table 1. TCE concentrations are to be quantified using USEPA-approved volatile organic chemical laboratory analytical methods and sample collection and handling procedures.

Because TCE is a developmental toxicant which may cause these effects following short-term maternal exposures, the goal of a time-integrated sampling plan is to identify peak exposures that may exceed the applicable action level over an exposure period that results in an unacceptable level of risk to the developing fetus. The DWM defines "unacceptable peak exposures" as those occurring in one 24-hour event for a resident and one 8-hour event for a non-residential worker.

Passive samplers are useful in conducting sampling over multiple days, however peak exposures above action levels are not captured by this method since the reported passive sampler concentration reflects a time-weighted average concentration. The DWM recommends working with the program with regulatory oversight to determine the significance of potential concentration averaging for TCE with passive samplers given the site-specific conditions and available lines of evidence. Concentration

averaging should also be considered if passive samplers are used in a commercial setting where sampling will occur under normal operation conditions (assumed to be 8-hours under a commercial exposure) and approximately 16-hours under non-operating conditions. When using passive samplers, it may be appropriate to combine Summa© canister sampling in side by side measurements to better interpret the results.

In addition to time-integrated sampling methods, the DWM will consider automated continuous monitoring of TCE as a line of qualitative evidence. Automated sampling, performed by a competent practitioner, may provide a better understanding of temporal patterns and durations of exposure above action levels. Contact the DWM prior to utilizing automated continuous monitoring systems to discuss appropriate analytical system calibration and quality control/assurance procedures.

For all sampling methods, it is recommended to collect cross-slab differential pressures, temperature, other meteorological parameters, and other pertinent lines of evidence to support that peak exposures have been captured.

Response Actions

Since the exposure duration to TCE that may result in developmental effects is short, the DWM will work with responding parties to identify appropriate mitigation options and begin implementation quickly for locations where women of child-bearing age are present. **For women in their first trimester of pregnancy the goal is to reduce exposures to below the Action Level within 72-hours or less.** Women of child-bearing age should not be reintroduced to the contaminated area until laboratory data for two consecutive sampling events collected after temporary or permanent mitigation shows that TCE levels are below action levels.

Initial response actions that should be implemented immediately (typically within 24 hours) include:

- Risk communication with the potentially-at-risk population should be made by a toxicologist, health professional, human health risk assessor, risk communication expert or qualified DWM personnel knowledgeable of the potential TCE health effects. A DWM risk assessor will be consulted by the DWM program with oversight. The DWM risk assessor can assist parties in providing health risk information to potentially affected individuals.
- Ensure appropriate fact sheets are provided to potentially affected individuals. (see links below).
- Vent the basement (if a basement exists in the building) or lowest level of the building by opening windows.
- Seal potential conduits where vapors may be entering the bottom floor of the building and any subsurface walls.
- Enclose and passively vent sumps.

Response actions that should be implemented as soon as possible, but which may require several days to two weeks to implement include:

- Adjust the building's pressurization (over-pressurize) by utilizing the HVAC system.

- Install carbon filtration on the HVAC system.
- Utilize portable air-purifying units in the building.

Response actions that should be implemented as soon as possible, but which may require several weeks to two months to design, install and test include:

- Installation of a sub-slab depressurization system.
- Installation of a soil vapor extraction system.
- Installation of new HVAC equipment to over-pressurize the building or bottom floor.

Links to TCE factsheets including medical follow-up factsheets for primary care physicians:

- DWM's *Frequently Asked Questions about Trichloroethylene (TCE) in Residential Indoor Air*,
 - English: <https://deq.nc.gov/documents/tce-residential-indoor-air>
 - Spanish: <https://deq.nc.gov/TCE-en-su-casa>
- DWM's *Frequently Asked Questions about Trichloroethylene (TCE) in Workplace Indoor Air*
 - English: <https://deq.nc.gov/documents/tce-workplace-indoor-air>
 - Spanish: <https://deq.nc.gov/TCE-en-el-trabajo>
- DWM's *Notification and Response Actions Associated with Trichloroethylene (TCE) in Indoor Air for Property Owners, Remediating Parties, Prospective Purchasers or Brownfields Program Applicants, February 2019*: <https://deq.nc.gov/documents/tce-remediating-parties>
- NC DPH's *Trichloroethylene (TCE) and Trichloroethylene (TCE) Information for Health Professionals* <http://epi.publichealth.nc.gov/oe/az.html#tce>
- ATSDR's *TCE ToxFAQs, TCE ToxGuide and Toxicological Profile for Trichloroethylene (TCE)*, available at: <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30>

References:

ATSDR (Agency for Toxic Substances & Disease Registry). *Toxic Substances Portal Trichloroethylene (TCE)*, CAS ID #: 79-01-6. Agency for Toxic Substances and Disease Registry, 4770 Buford Hwy NE, Atlanta, GA 30341. <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30>

DWM 2014. *Vapor Intrusion Guidance*. Division of Waste Management, Department of Environmental Quality.

MassDEP (Massachusetts Department of Environmental Protection). 2014. *Fact Sheet – TCE Toxicity Information: Implications for Chronic and Shorter-Term Exposure*.

MassDEP (Massachusetts Department of Environmental Protection). 2014. *USEPA Trichloroethylene Toxicity Values and Office of Research and Standards Recommendations Regarding Remediation Targets and Timeframes to Address Potential Developmental Risks*.

USEPA (United States Environmental Protection Agency). 2011. *Toxicological Review of Trichloroethylene (CAS No. 79-01-6) In Support of Summary Information on the Integrated Risk Information System (IRIS)*. EPA/635/R-09/011F.

USEPA (United States Environmental Protection Agency). 2014a. *Memorandum – EPA Region 9 Interim Action Levels and Response Recommendations to Address Potential Developmental Hazards Arising from Inhalation Exposures to TCE in Indoor Air from Vapor Intrusion*. Region 9, San Francisco, CA.

USEPA (United States Environmental Protection Agency). 2014b. *Memorandum – Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment*. To Superfund Division Directors, EPA Regions 1 – 10, from Office of Superfund Remediation and Technology Innovation (OSRTI). August 27, 2014.