



# Issues & Trends

April 20, 2021

Acute Risks Associated with TCE

# Zoom

- We're recording.
- No video, please.
- Mute your line.
- Questions?
  - Raise hand or use chat feature.
- Technical problems?
  - [Zoom.us](https://zoom.us) for help.



# 2021 Issues & Trends

Schedule at:

[dnr.wisconsin.gov/topic/Brownfields/Training.html](http://dnr.wisconsin.gov/topic/Brownfields/Training.html)

Stay updated at the RR Report:

[https://public.govdelivery.com/accounts/WIDNR/subscriber/new?topic\\_id=WIDNR\\_567](https://public.govdelivery.com/accounts/WIDNR/subscriber/new?topic_id=WIDNR_567)



Today's recording and previous  
webinars at:

[dnr.wisconsin.gov/topic/Brownfields/Training  
Library.html](http://dnr.wisconsin.gov/topic/Brownfields/TrainingLibrary.html)



# Jodie Peotter

Chief - Brownfields, Outreach and Policy



# Currently Out for Public Input Updated Guidance

*RR-649 - Guidance for Documenting the Investigation of  
Human-made Preferential Pathways Including Utility  
Corridors*

*Comment through May 3, 2021.*



# Going Out Soon for Public Input New Guidance

RR-982, Guidance on Post-Closure Modifications

*Public comment begins: April 21, 2021*

*Public comment through: May 11, 2021*



# Going Out Soon for Public Input New Guidance

RR-115, Guidance: Contaminated Sediment Fact Sheet

*Public comment period: TBD*





# Public Comment at

<https://dnr.wisconsin.gov/topic/brownfields/publicnotices.html>

# Get notified at the RR Report

[https://public.govdelivery.com/accounts/WIDNR/subscriber/new?  
topic\\_id=WIDNR\\_567](https://public.govdelivery.com/accounts/WIDNR/subscriber/new?topic_id=WIDNR_567)



Jennifer Borski,  
Vapor Intrusion Team Leader

Jim Walden  
Vapor Intrusion Technical Expert

Curtis Hedman  
DHS Toxicologist



# Issues & Trends 2021

Tuesday, April 20

Jim Walden and Jennifer Borski  
Wisconsin Department of Natural Resources

## Trichloroethylene (TCE) Vapor Intrusion Health Concerns and Responses

Zoom recording at [DNR.WI.GOV](https://dnr.wi.gov) (search: rr training library)

Questions/Comments/Suggestions to: [DNRRRComments@wisconsin.gov](mailto:DNRRRComments@wisconsin.gov)





## ISSUES AND TRENDS WEBINARS

The issues and trends training sessions cover a variety of technical and policy issues affecting environmental practitioners, local government specialists and others whose work involves assistance or oversight by the RR Program.

### 2020-2021 SERIES

Date	Presentation	Audio/Video
12/16/20	<a href="#">Vapor Intrusion: Screening and Mitigation Decisions, Scope and Timing [PDF]</a>	<a href="#">Webinar recording [VIDEO Length 54:11] [exit DNR]</a>
11/18/20	<a href="#">Site Investigation: Scoping, RR's SI Toolkit and Related Documents, SIR/SIWP Checklist and more [PDF]</a>	<a href="#">Webinar recording [VIDEO Length 49:40] [exit DNR]</a>
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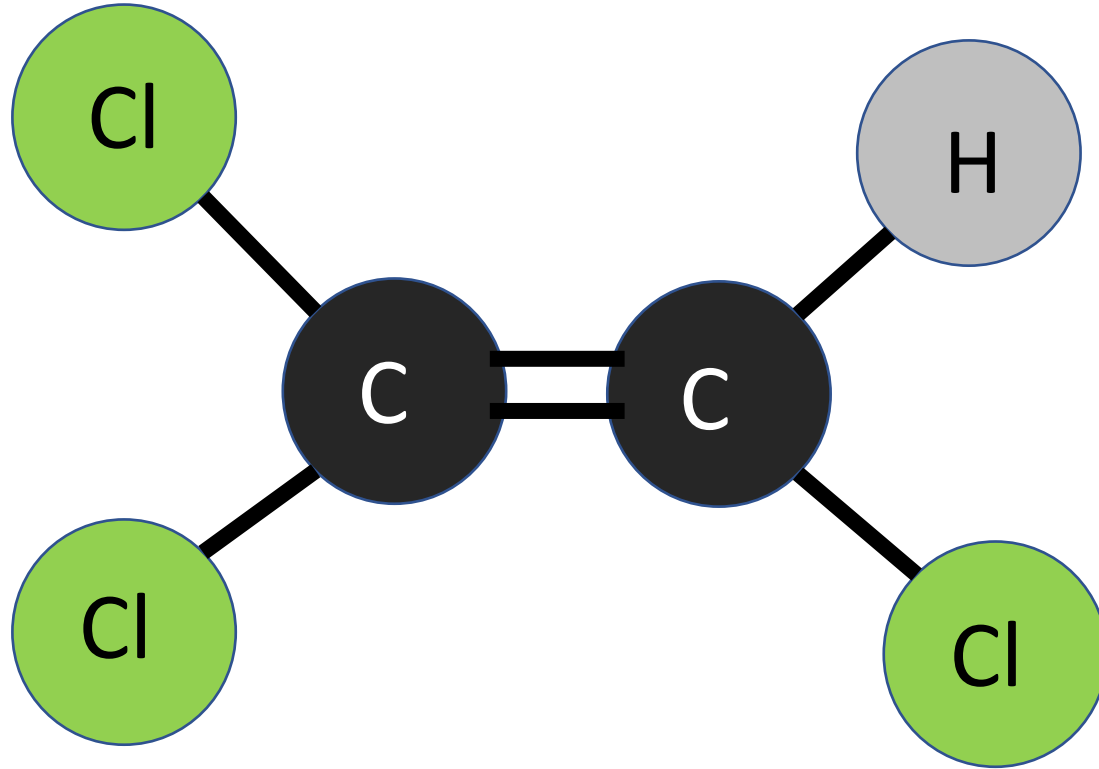
[Vapor Intrusion Resources](#)

### 2017-2018 SERIES

# Overview: TCE Vapor Intrusion Health Concerns and Responses

- Characteristics and use
- Health effects
- Prevalence in the environment
- Regulation of discharges
- **Recommended actions when TCE is present**

# TCE



- Clear
- Denser than water
- Vapor forming
- Odorless at low concentrations





# Use of TCE

1920s

First widespread use

255\*

Million pounds used in US

84%\*

Manufacture of refrigerants

15%\*

Metal degreasing

2,632\* –

Number of firms using as a degreaser

6,232

23,225

Plants using TCE (1981-1983 NIOSH survey)

2020

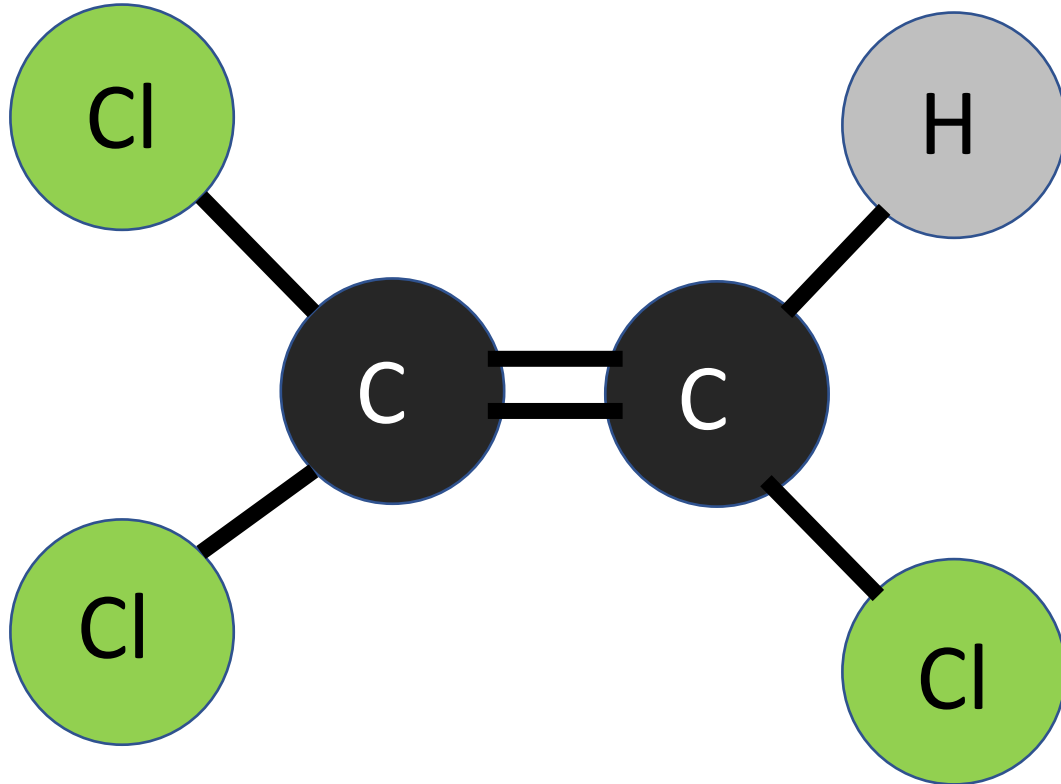
First bans enacted:

MN (eff. June 1, 2022), NY (eff. Dec 2021)

\* 2011 TCE use in US,  
Federal Register 2017



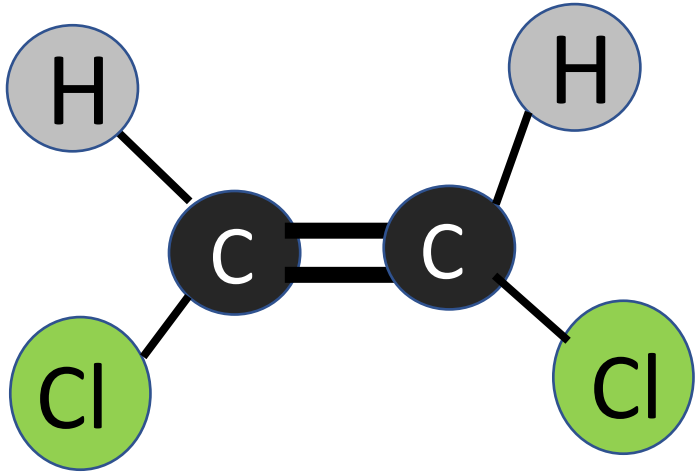
# Reductive De-chlorination



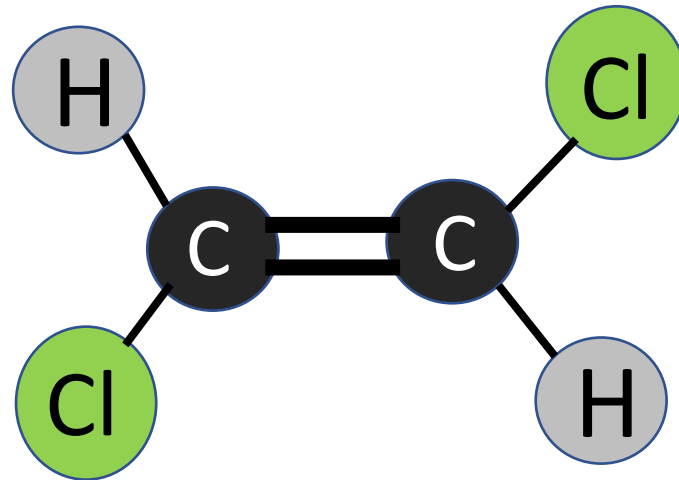
TCE



# Reductive De-chlorination



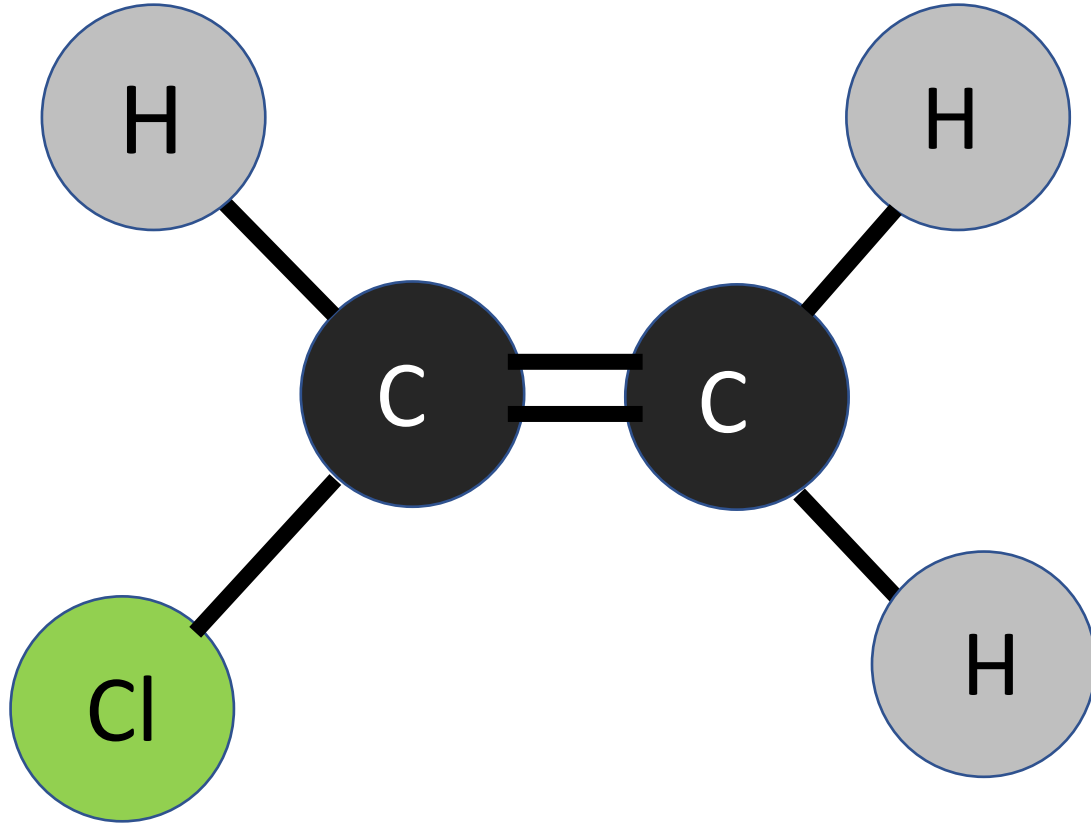
cis 1,2  
dichloroethene



trans 1,2  
dichloroethene



# Reductive De-chlorination



vinyl chloride

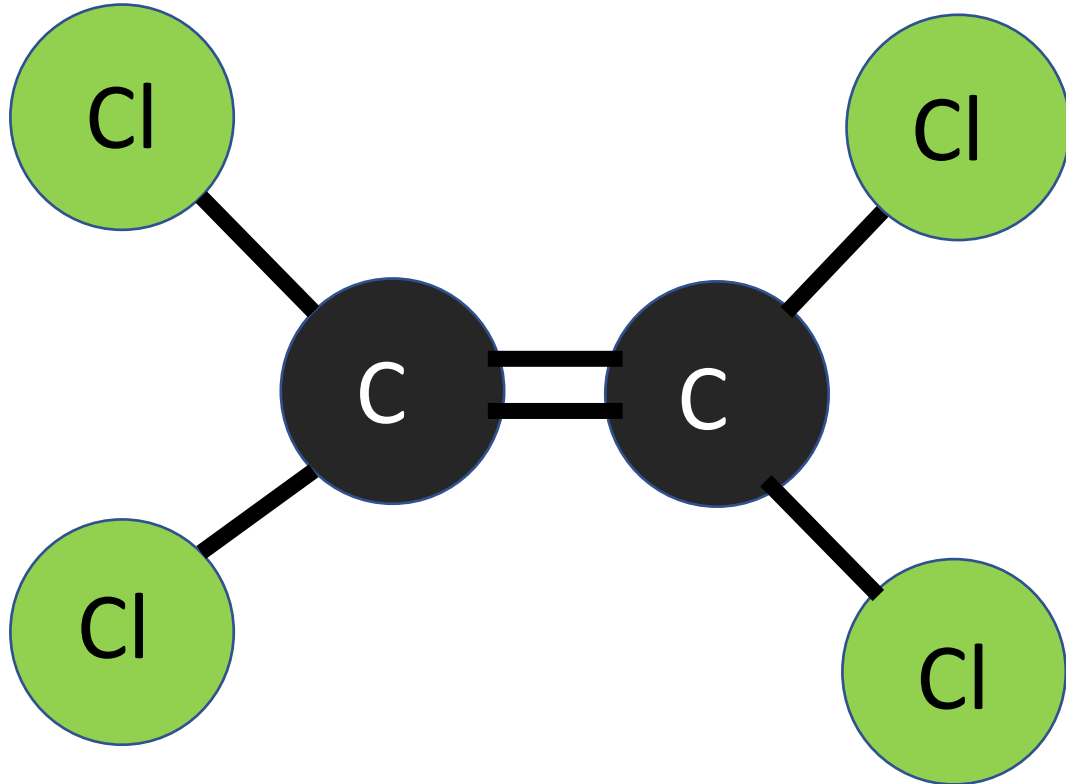
Reductive De-chlorination

Requires:

- Low oxygen
- Microbes
- Food for microbes



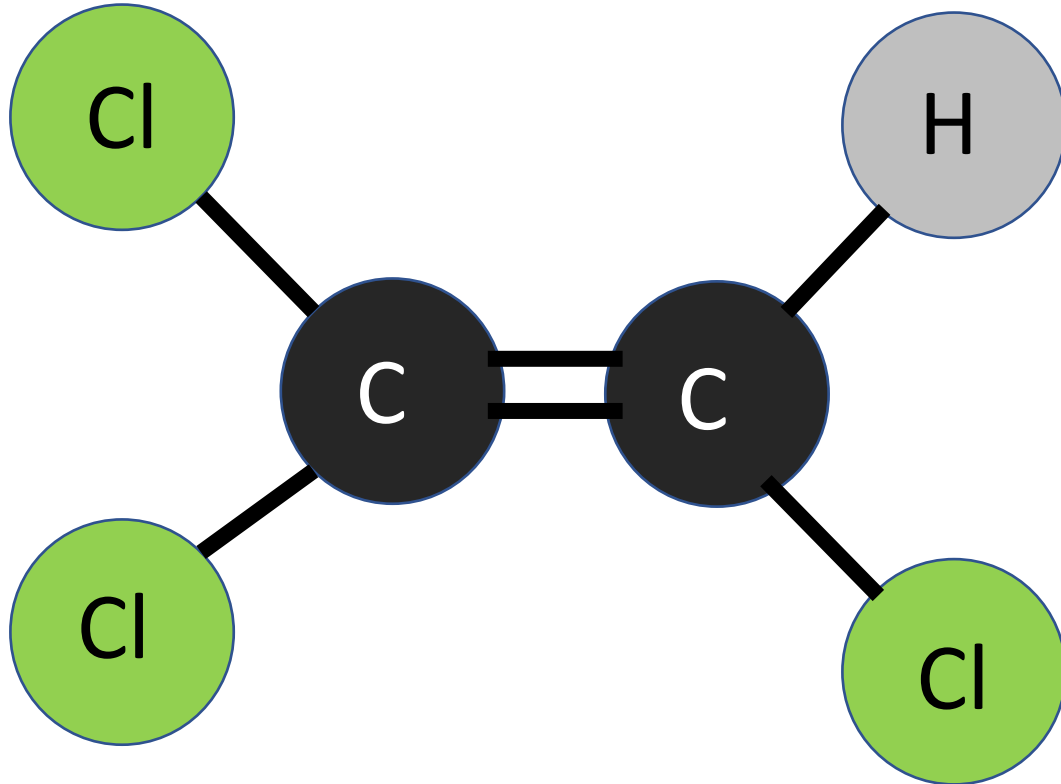
# Reductive De-chlorination



Tetrachloroethylene  
(PCE) or "Perc"  
Drycleaning Solvent



# Reductive De-chlorination



TCE



History of Changes <sup>(1)</sup> to Vapor Action Levels (VAL) <sup>(2)</sup>, Vapor Risk Screening Levels (VRSL) and Attenuation Factors (AF) <sup>(3)</sup> for Common Volatile Organic Compounds (VOC) in Wisconsin - August 2017

Trichloroethylene (TCE)													
Date	Residential				Small Commercial				Large Commercial & Industrial				Sub-slab AF for Res/ Sm Comm vs. Lg Comm & Industrial
	Indoor Air VAL		Sub-slab VRSL		Indoor Air VAL		Sub-slab VRSL		Indoor Air VAL		Sub-slab VRSL		
	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	
2010	12	2.2	--	--	61	11.4	--	--	61	11.4	--	--	AF not yet established
May 2010	12	2.2	<b>120</b>	<b>22</b>	61	11	<b>610</b>	<b>110</b>	61	11	<b>6,100</b>	<b>1,100</b>	AF = 0.1 / 0.01
Nov 2011	<b>2.1</b>	<b>0.39</b>	<b>21</b>	<b>3.9</b>	<b>8.8</b>	<b>1.6</b>	<b>88</b>	<b>16</b>	<b>8.8</b>	<b>1.6</b>	<b>880</b>	<b>160</b>	AF = 0.1 / 0.01
Jun 2015	<b>2.1</b>	0.39	<b>70</b>	<b>13</b>	<b>8.8</b>	1.6	<b>290</b>	<b>53</b>	<b>8.8</b>	1.6	<b>880</b>	160	AF = 0.03 / 0.01

**Notes:**

1. This historical table supplements the DNR's Quick Look-Up Table and is intended to be used in understanding previous site-specific decisions regarding vapor data.
2. The VAL is either Residential or Non-residential (i.e., Small Commercial VAL = Large Commercial & Industrial VAL). "Residential setting" includes educational, child care and elder care settings per s. NR 700.03(49g), Wis. Adm. Code.
3. The AF is either Residential/Small Commercial or Large Commercial & Industrial (i.e., Residential AF = Small Commercial AF).

**Key:**

µg/m<sup>3</sup> = micrograms per cubic meter  
ppbV = parts per billion by volume

-- not established  
Changes noted in **BOLD**

<https://dnr.wi.gov/topic/Brownfields/documents/vapor/HistoricalVALVRSLAF1708.pdf>



# WI Department of Health Services (DHS) TCE in the Air Fact Sheet (10/2020)

<https://www.dhs.wisconsin.gov/publications/p02480.pdf>

## TCE in the Air

Trichloroethylene (TCE) health effects and actions you can take to protect your home's air

TCE is a man-made chemical used at dry cleaners, in some factories to clean metal, and in some household items like paint, spot removers, and varnishes. If spilled, it can stay in the ground for a long time.

### Why should I care?

- It can enter your home through cracks in the floor or walls of your basement, and other openings.
- It evaporates quickly and breathing the vapors is not healthy.
- It can cause cancer if you breathe it over a long period of time.

### Who has more risk?

Babies whose mother's breathe in TCE while pregnant can have:

- Lower birth weights
- Heart defects
- Nervous or immune system problems

### What if TCE is in my community?

If there is a known concern, environmental professionals will ask to check your home to make sure there is no TCE inside.

They need your permission to test the air in and below your basement.

If they find high levels of TCE, they will suggest that you have a special system installed to fix the problem.

### Do I have to pay?

The people responsible for the contamination will probably have to pay for the testing and any system that has to be installed.

A "sub-slab mitigation" system moves air from below to outside the house.



### What else can I do?

- Wear protective gloves if you use products with TCE (like paint remover).
- Use only small amounts of products containing TCE.
- Use the chemical in well-ventilated areas.
- Do not stay in the room for long periods of time if you can smell the chemical while using it or after using it.

### Where can I learn more?

- **TCE chemical basics:** [www.dhs.wisconsin.gov/chemical/trichloroethylene.htm](http://www.dhs.wisconsin.gov/chemical/trichloroethylene.htm)
- **Vapor intrusion health concerns:** [www.dhs.wisconsin.gov/air/vi.htm](http://www.dhs.wisconsin.gov/air/vi.htm)
- **Vapor intrusion 101 video:** [www.youtube.com/watch?v=izo0QKqCToU](https://www.youtube.com/watch?v=izo0QKqCToU)





# DHS

## TCE in the Air

### Fact Sheet

<https://www.dhs.wisconsin.gov/publications/p02480.pdf>

Also available in Spanish!  
<https://www.dhs.wisconsin.gov/publications/p02480s.pdf>

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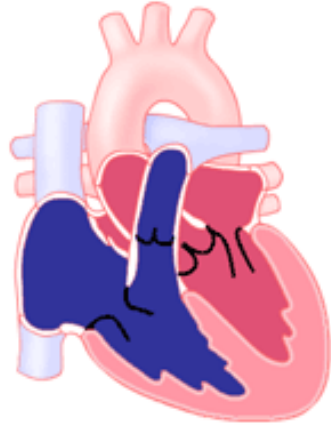
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- **Vapor intrusion health concerns:** [www.dhs.wisconsin.gov/air/vi.htm](http://www.dhs.wisconsin.gov/air/vi.htm)
- **Vapor intrusion 101 video:** [www.youtube.com/watch?v=izo0QKqCToU](http://www.youtube.com/watch?v=izo0QKqCToU)

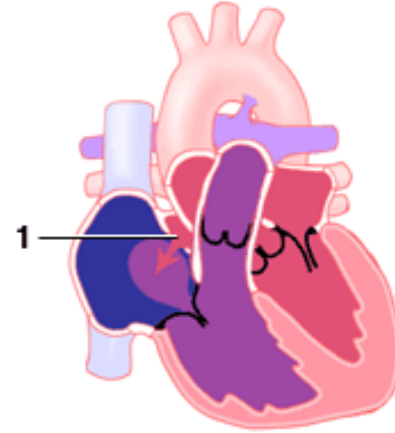


# Cardiac Malformations

Normal



Atrial Septal Defect



1. Atrial septal defect (ASD). Oxygenated blood from the left atrium shunts via this hole into the right atrium. This volume load causes enlargement of both atria, the right ventricle and the pulmonary artery.

[www.cincinnatichildrens.org](http://www.cincinnatichildrens.org)



# RR-800 TCE Provisions

## Section 3.4.1

**As soon as possible:** Determine demographics and sample if women of child-bearing age present (15 to 44)

## Section 7.1 Immediate Actions (Residential)

Women child-bearing age	1X VAL	2.1 $\mu\text{g}/\text{m}^3$
Entire population	3X VAL	6.3 $\mu\text{g}/\text{m}^3$

Wisconsin DNR – Vapor Intrusion

Remediation and Redevelopment Program



January 2018

Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin

Wis. Stat. ch. 292; Wis. Admin. Code ch. NR 700

Publication: RR-800

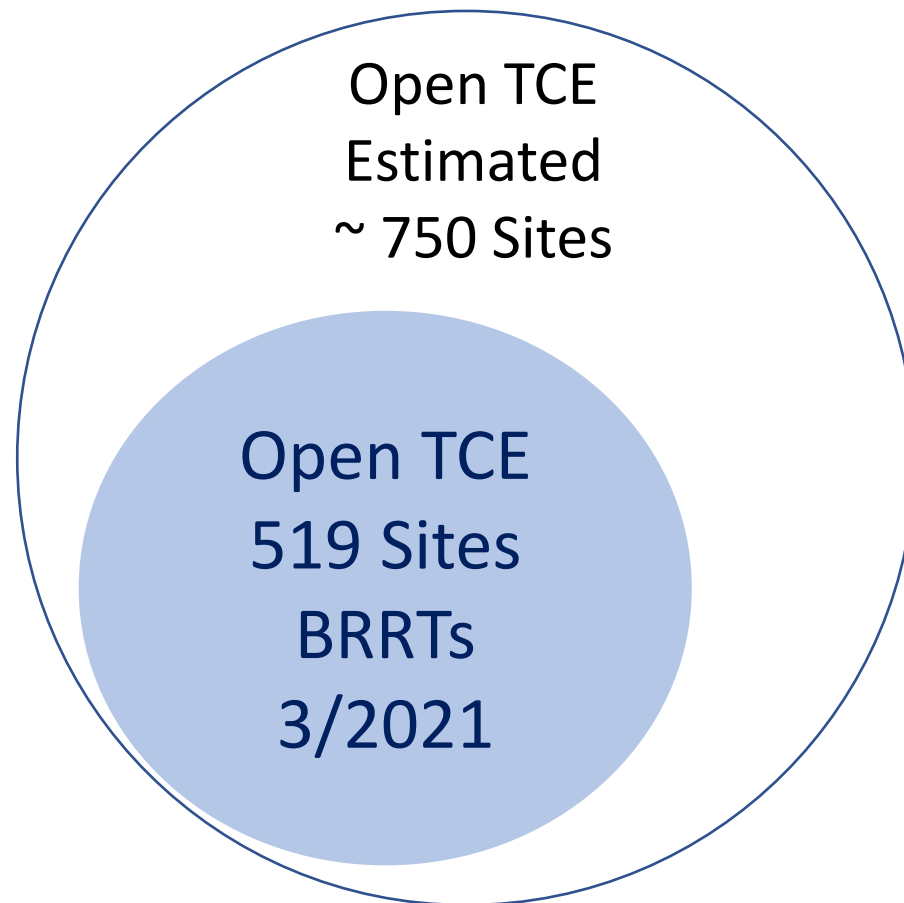


# TCE Developmental Concern Implementation Issues

- Timeframes for screening, initiating sampling, completing investigations, making mitigation decisions, implementing mitigation, & follow-up sampling have far exceeded the period of concern (short durations during early pregnancy)
- Determining demographics lacking
- Infrequent mitigation system verification



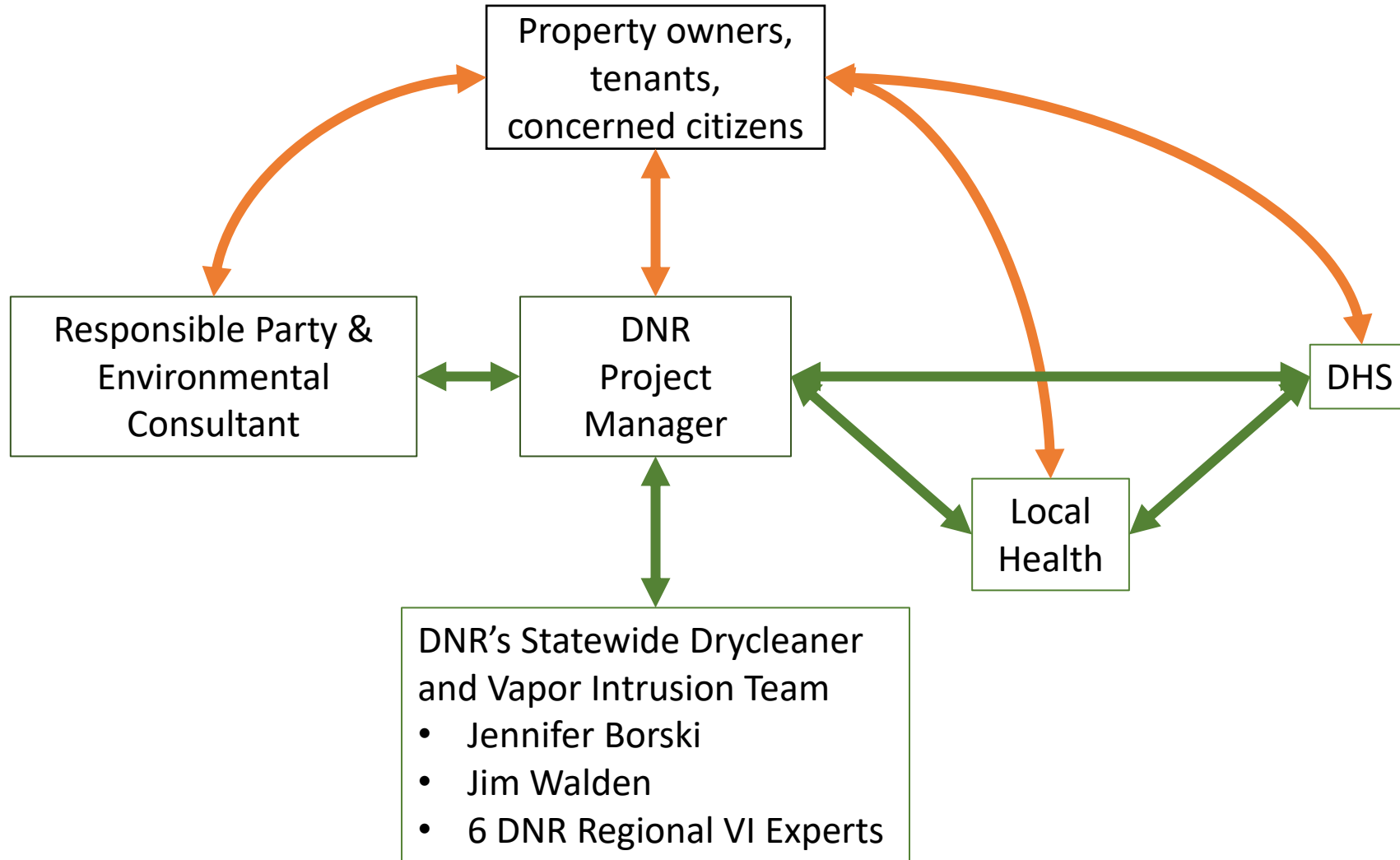
# TCE Prevalence at NR700 Sites



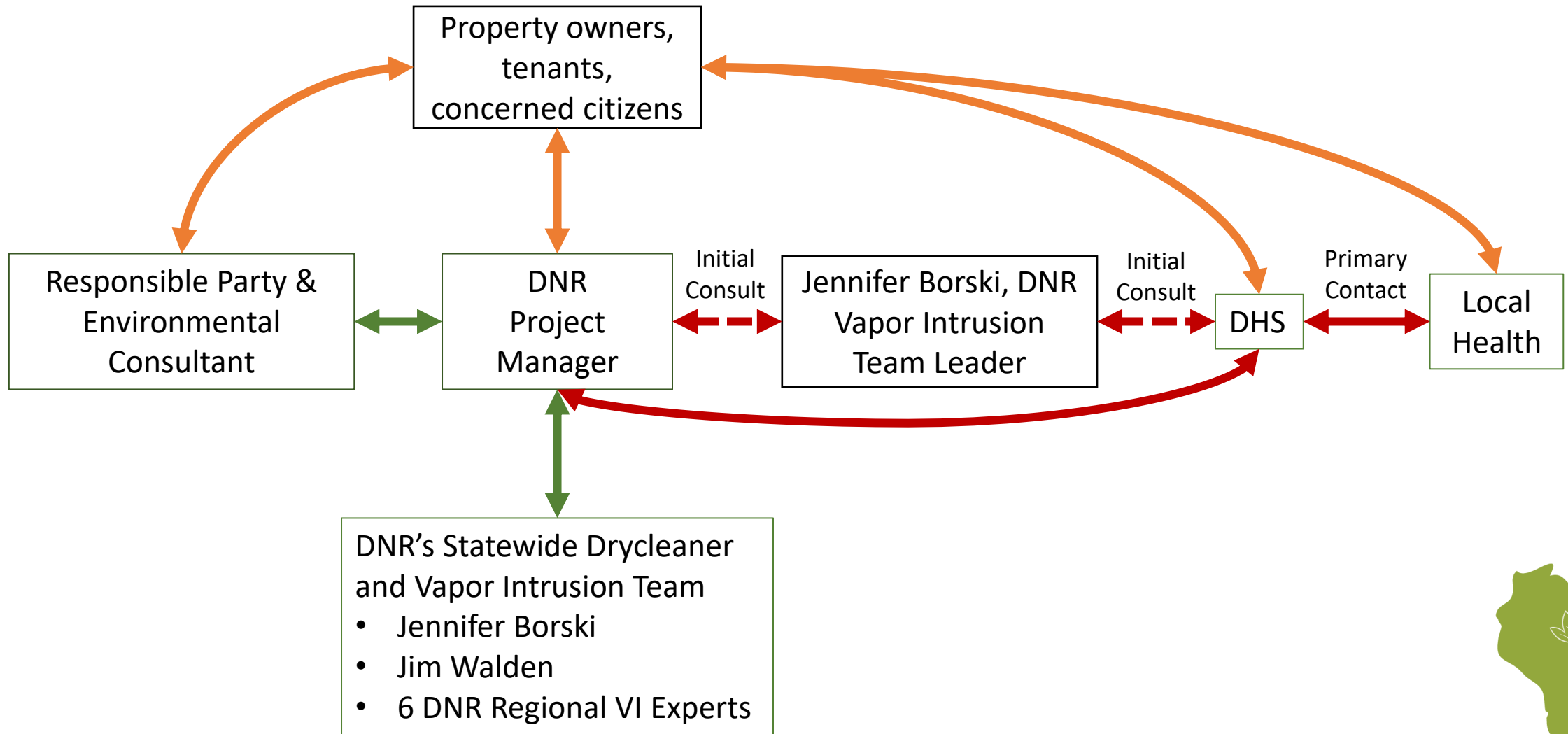
\* Estimate based on screening ~ 17,000 closed sites with electronic files. Another 11,000 sites have only paper files and aren't being currently screened.



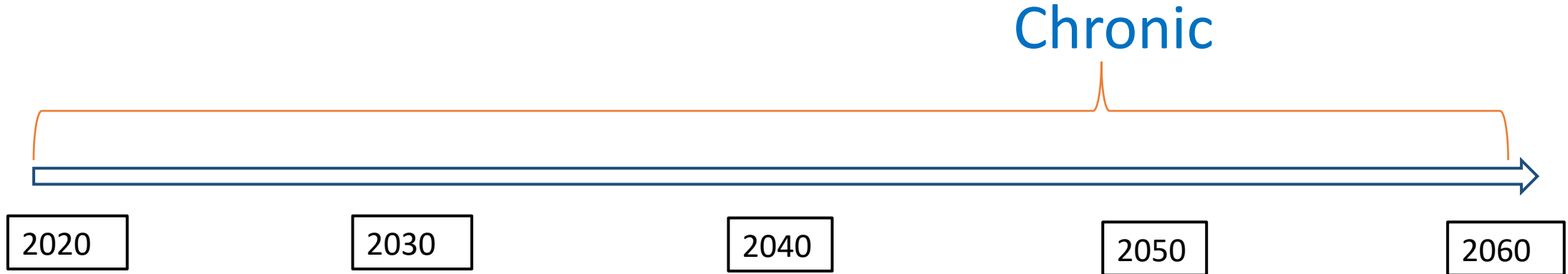
# DNR – DHS Consultation



# DNR – DHS Consultation and Compliance Assistance Requests During Pandemic



# Exposure Duration

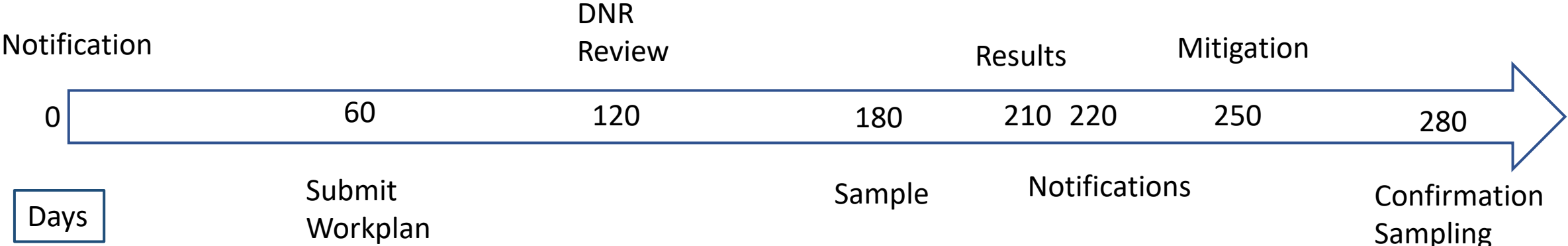
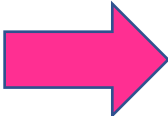






# TCE Fetal Heart Window of Concern vs Typical Investigation Timeframes

Fetal Heart Developmental Window (pregnancy weeks 3 to 6)



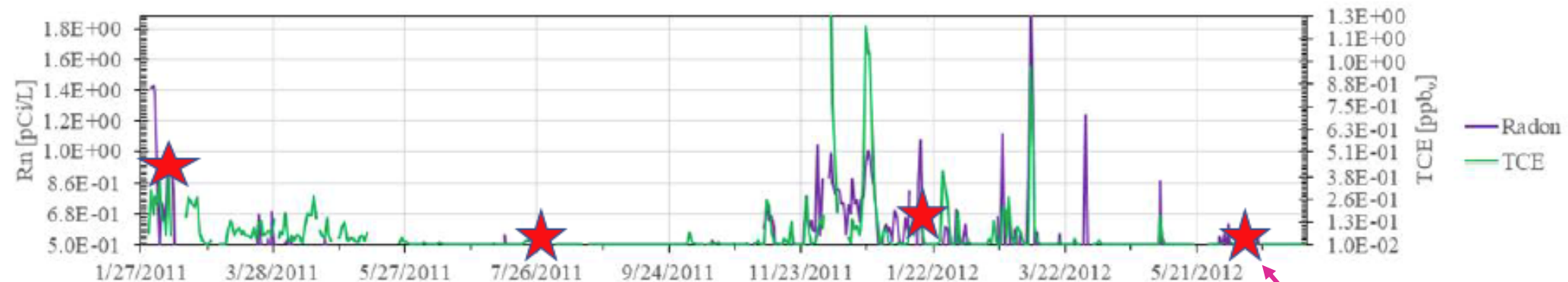
# How confident are we of VI exposure est.? What level of confidence is appropriate?

- **Chronic** risk

- Long-term Average (95%UCL)
- Typical quarterly ~ OK ?

- **Sub-chronic** (developmental) risk

- Reasonable Max. Exposure (RME)
  - ~ 95<sup>th</sup>ile
- Could be as short as 1-day



Henry Schuver, EPA, Introduction, Regulatory Context and Quantitative Confidence, October 22, 2019: US EPA Workshop on: Measurement-Based Methods for Protective & Defensible Chlorinated VI Exposure Determinations, Amherst, MA.

Quarterly  
Samples



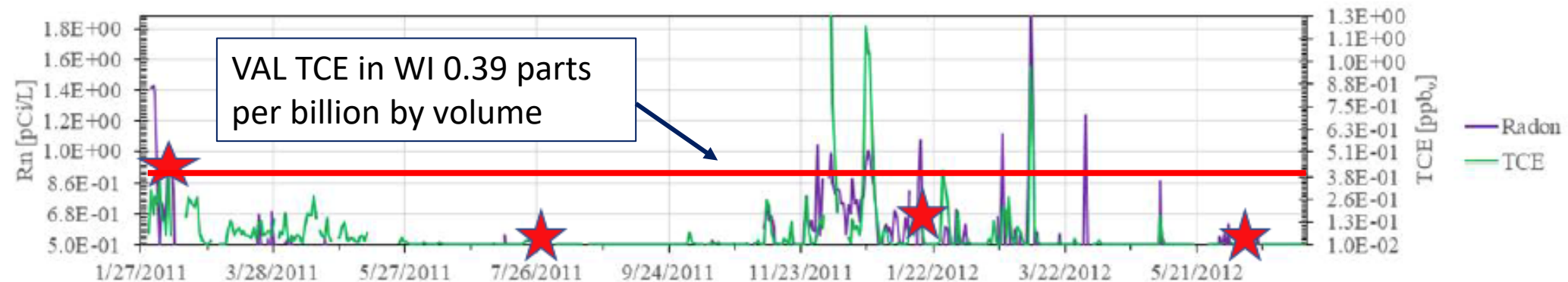
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Henry Schuver, EPA, Introduction, Regulatory Context and Quantitative Confidence, October 22, 2019: US EPA Workshop on: Measurement-Based Methods for Protective & Defensible Chlorinated VI Exposure Determinations, Amherst, MA.



# RR-800 Possible Revisions – TCE Acute Concern

- Screening criteria
- Response time frames
- Number of samples and sampling rounds
- Response actions
- Commissioning
- Operation and Stewardship



# Responsible Party Letter (after 11/2020)

## Special Vapor Intrusion Concern with Trichloroethylene:

Contamination that includes trichloroethylene (“TCE”), a chlorinated solvent and common degreaser, is of special concern from a human health perspective due to its potential for acute (short-term) health risks at relatively low concentrations in air. TCE is also a breakdown product of tetrachloroethylene (“PCE,” also known as “Perc”), a historically common dry-cleaning chemical. Vapors can travel from contaminated soil or groundwater and along preferential pathways, such as within sewer lines, and enter occupied buildings. This is known as vapor intrusion (VI). Screening for VI must be conducted at every contaminated site in Wisconsin, as defined in Wis. Admin. Code § 716.11 (5) (a). **However, when TCE is present, screening for VI should be made a priority and an interim action under Wis. Admin. Code § NR 708.11 may be necessary.** For an overview on VI, see *What is Vapor Intrusion?* (RR-892). For more information, go to [dnr.wi.gov](http://dnr.wi.gov) and search “vapor.” Additional technical guidance on VI is available in *Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin*, (RR-800).



# Statewide VI/TCE Letter to Open NR 700 Cases

April 6, 2021

Dear Sir or Madam:

This letter is being sent to all Responsible Parties (RPs) that currently have an active contamination response site on the Department of Natural Resources (DNR's) Bureau for Remediation and Redevelopment Tracking System (BRRTS). It reiterates and enhances information about vapor intrusion risk that has been previously provided to you by DNR, either in a letter sent by DNR in 2011 regarding assessment of the vapor pathway or in your responsible party letter if your case was opened after 2011. Recent studies indicate that vaporized trichloroethylene (TCE) in indoor air is more toxic than previously understood and the risk posed by TCE vapors requires an immediate response when women of child-bearing years are present.

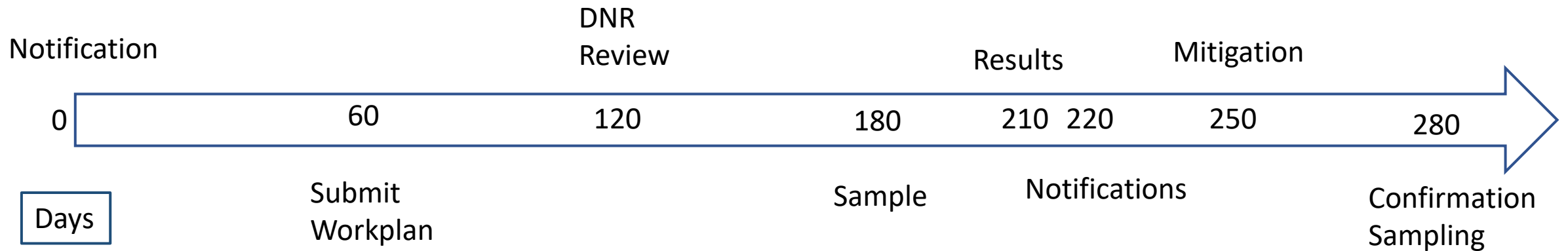
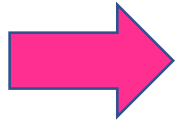
**The purpose of this letter is to communicate three points related to vapor intrusion:**

- 1. TCE poses short-term risks to human health that justify accelerated assessment, investigation and mitigation of the vapor intrusion pathway.**
2. Assessment of the vapor intrusion pathway is part of the investigation process and should be assessed as early as possible and routinely re-assessed throughout the life of a project.
3. Immediate and interim actions may be necessary early in the site investigation process to protect human health from contaminated vapors.



# TCE Fetal Heart Window of Concern vs Typical Investigation Timeframes

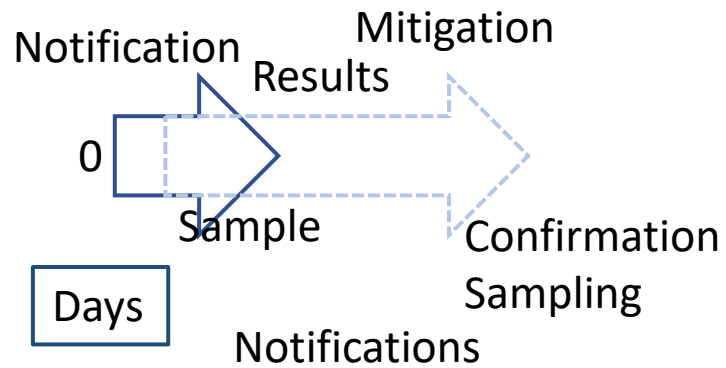
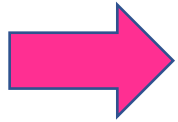
Fetal Heart Developmental Window (pregnancy weeks 3 to 6)





# TCE Fetal Heart Window of Concern vs Accelerated Investigation Timeframes

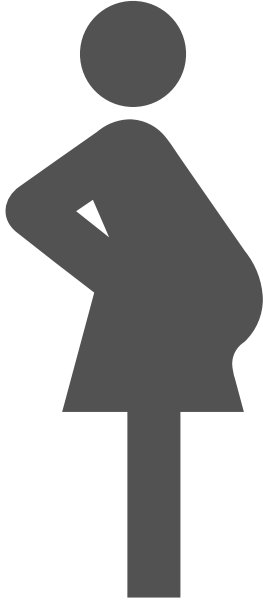
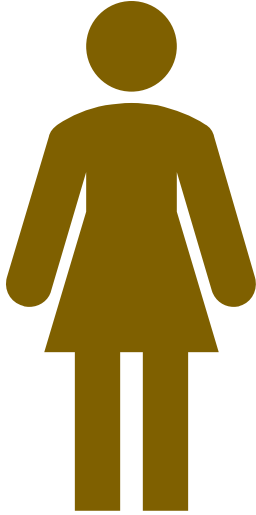
Fetal Heart Developmental Window (pregnancy weeks 3 to 6)



# DNR Interaction



# Demographic Information



# Demographic, Access and Personally Identifiable Information (PII)

“Wife is trying to get pregnant, would like house sampled.”

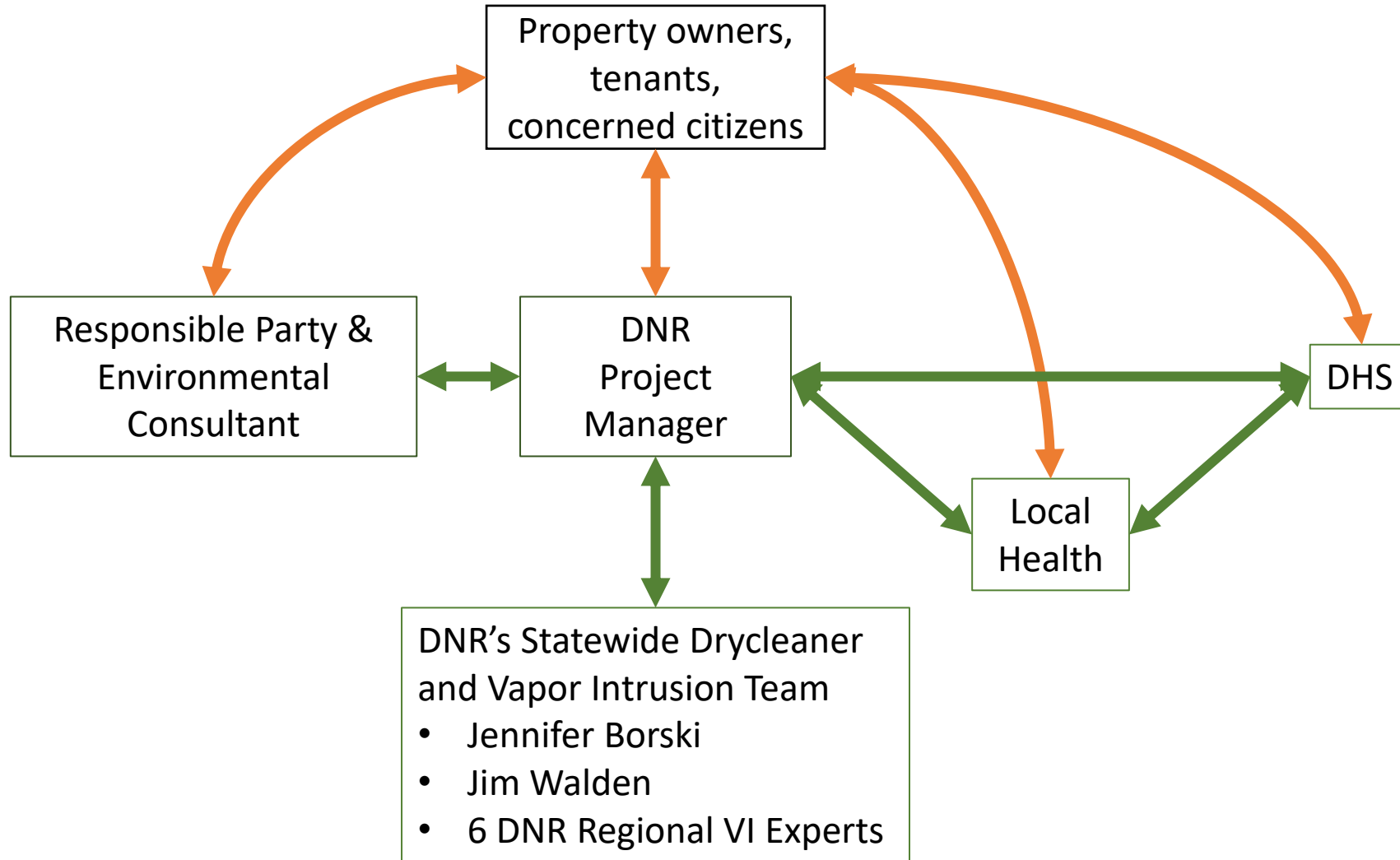
“Couple in their 50s with teenage daughter reside at the location”

“Owner will be out of the country for several weeks. Will call to schedule sampling then.”

“Single woman in 70s undergoing chemotherapy lives in house”



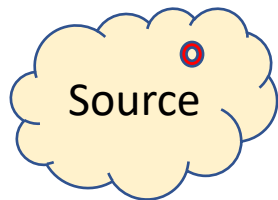
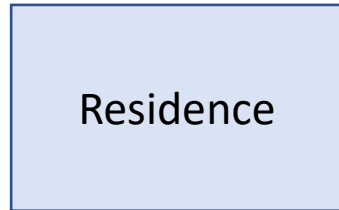
# DNR – DHS Consultation





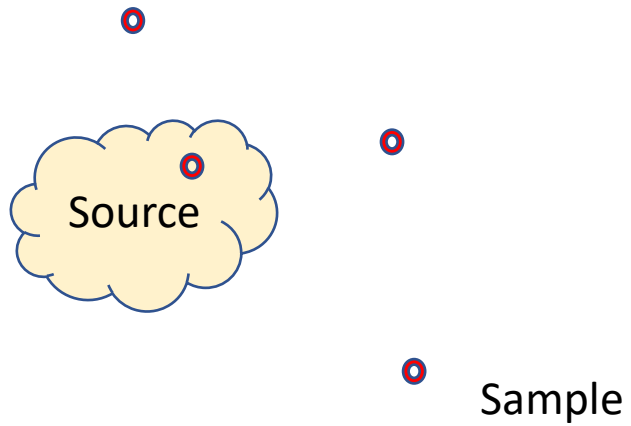
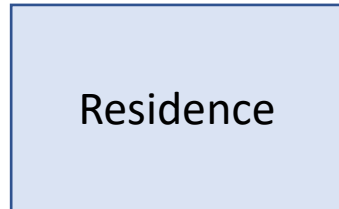
# Sampling Strategy

Chronic Risk



# Sampling Strategy

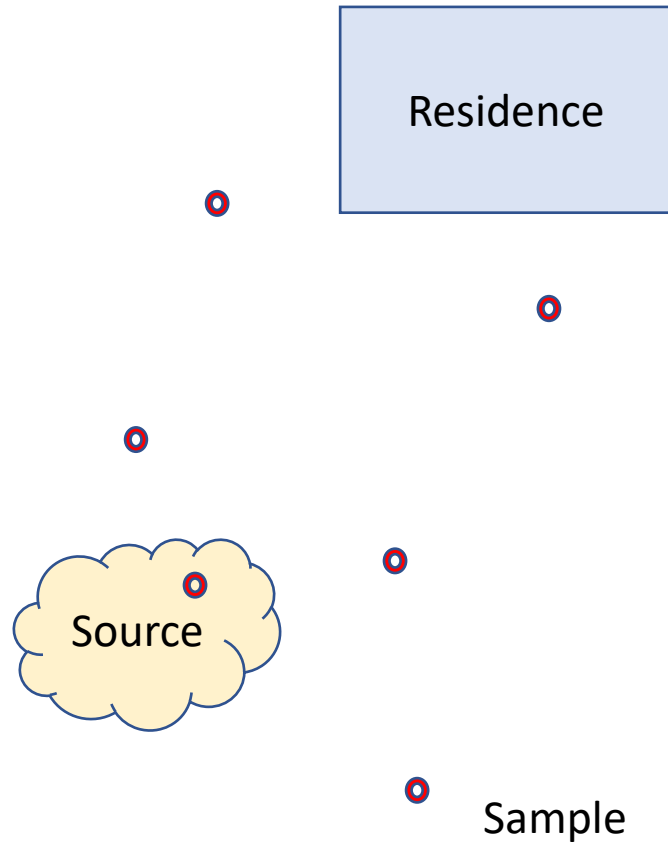
Chronic Risk





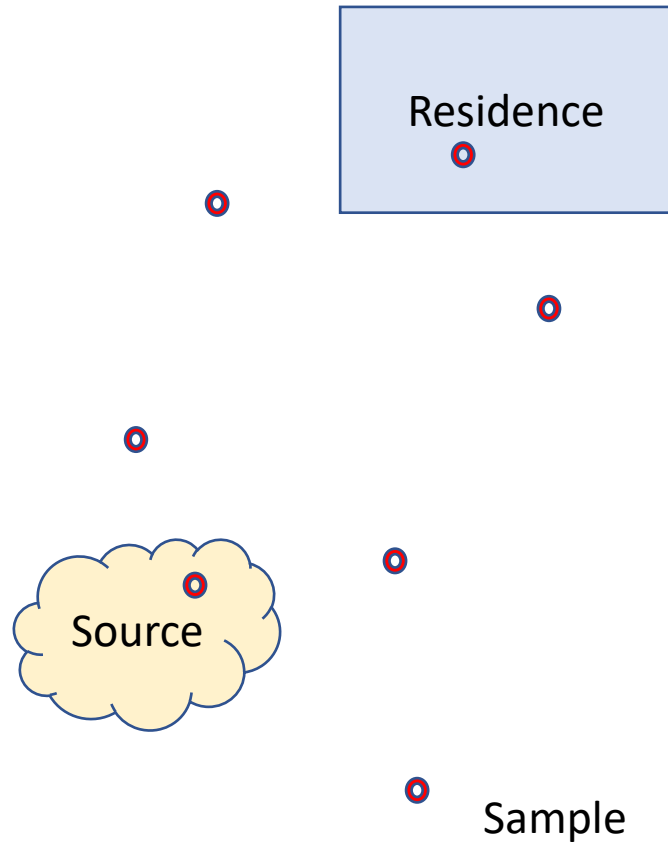
# Sampling Strategy

Chronic Risk



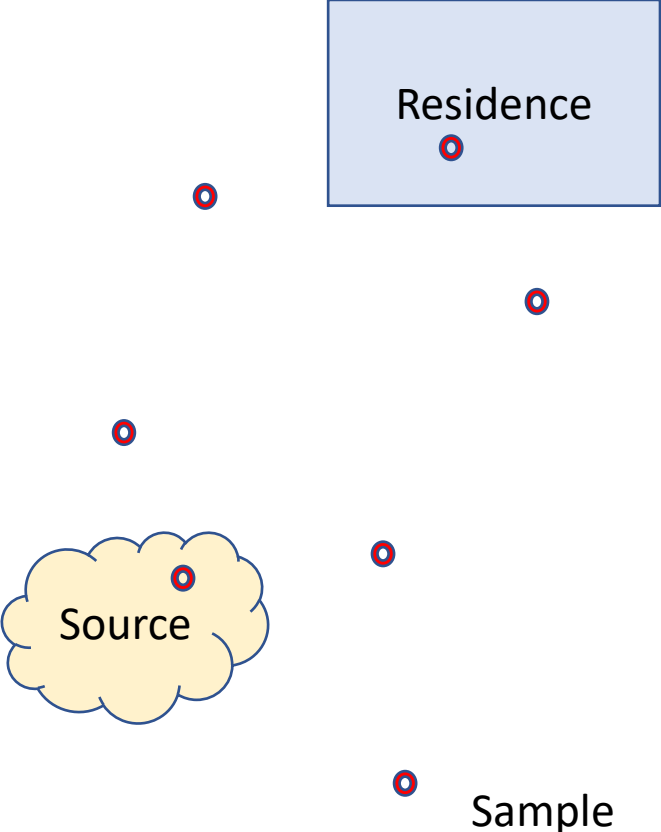
# Sampling Strategy

Chronic Risk

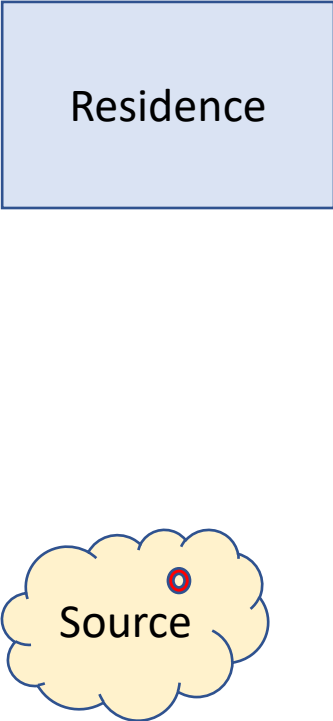


# Sampling Strategy

Chronic Risk

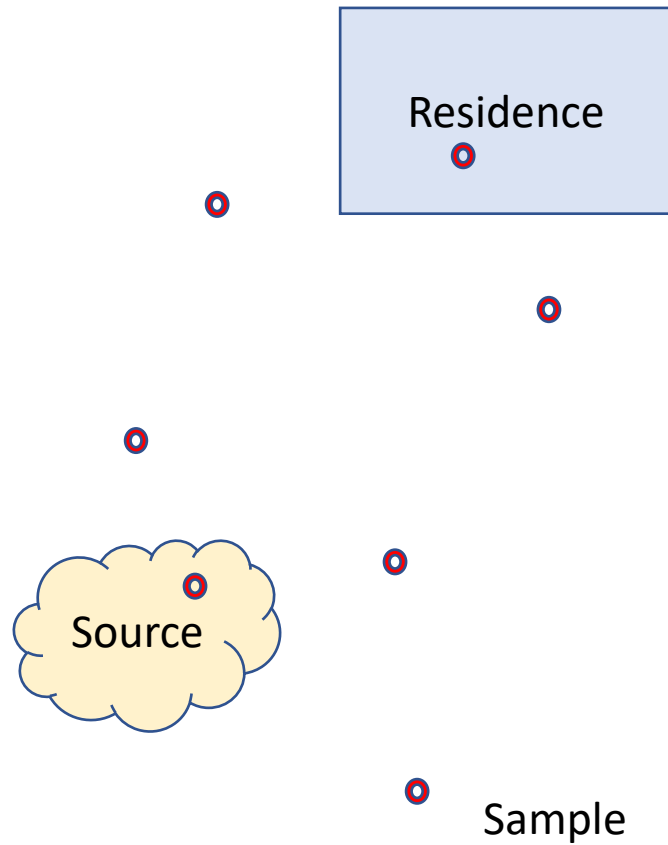


TCE Acute Risk

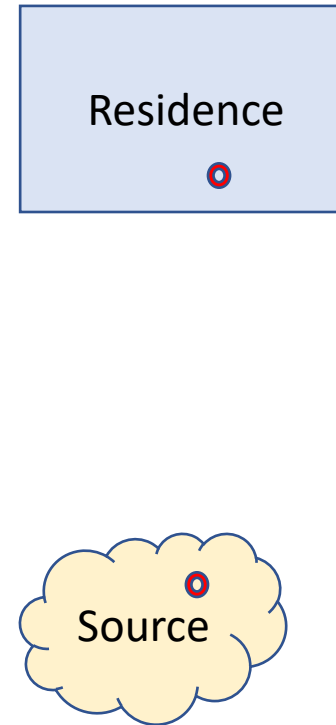


# Sampling Strategy

Chronic Risk



TCE Acute Risk


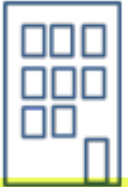



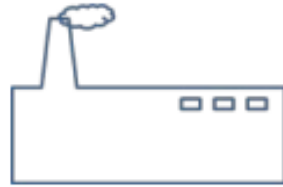


# Timing of Indoor Air Sampling RR-800 (1/2018)

RR-800 Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin

January 2018

**TABLE 5c**  
**GUIDELINES & RECOMMENDATIONS FOR SCOPING VAPOR INVESTIGATIONS**

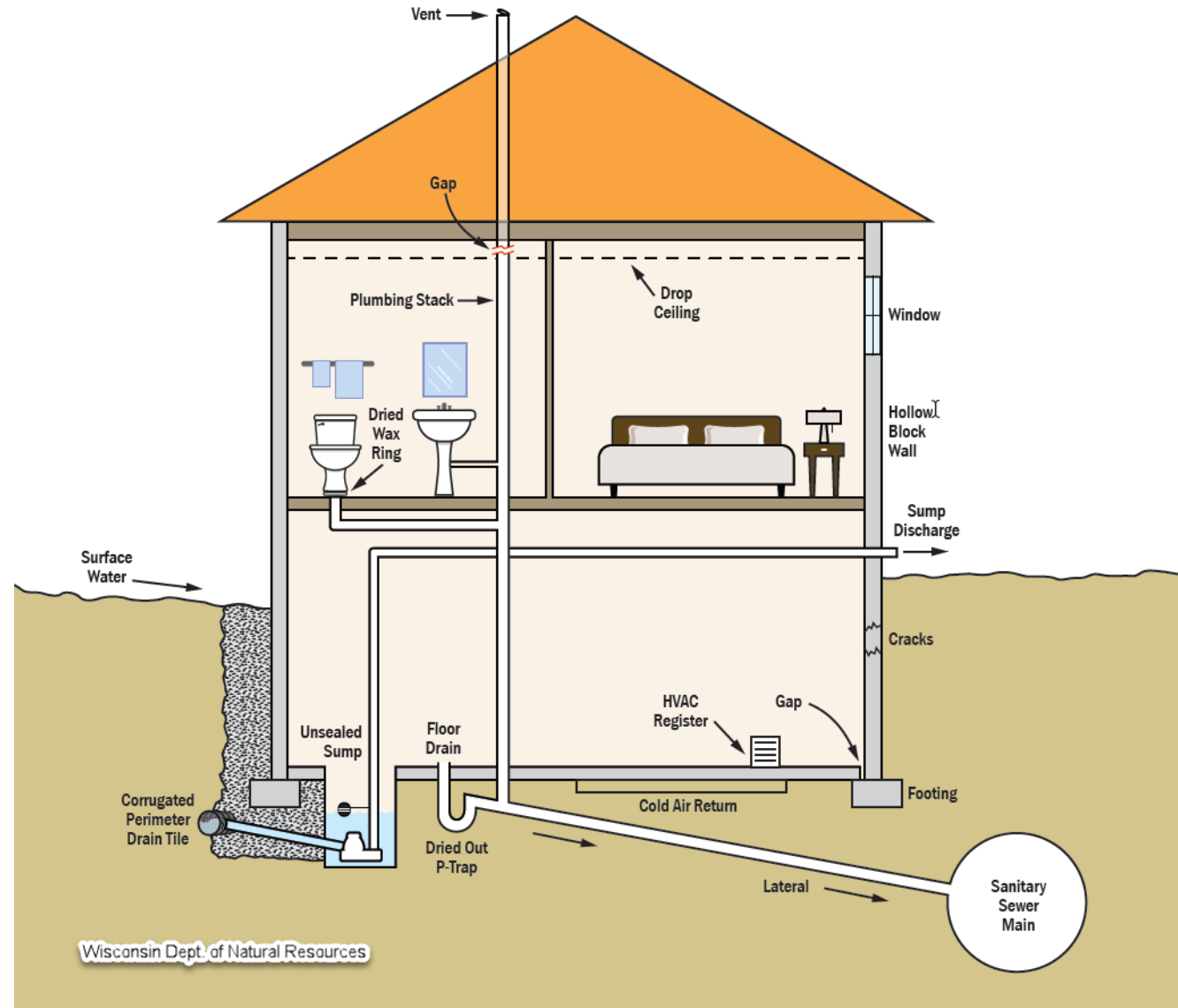
SCOPE ITEM	SETTING					
	 RESIDENTIAL	 RESIDENTIAL MULTI-FAMILY	 LARGE RESIDENTIAL (e.g. SCHOOL or DAYCARE)	 MIXED USE	 COMMERCIAL	 INDUSTRIAL
SUB-SLAB SAMPLES <sup>(a) (b)</sup>	~1/1,500 sf	~1/ 2,000 sf or 1/residence on lowest level	Fewer samples/sf than residential homes. Number of samples will depend on site conditions: - Focus samples near areas where highest vapor contamination is expected. - Depending on results, additional samples may be needed over an expanded area to delineate extent of vapor impacts. - <b>Barriers (e.g. footings or old exterior walls) should be factored into the selection of sample locations.</b> - Fewer sample points are needed for high purge volume sampling as compared to standard sub-slab vapor sampling.			
INDOOR AIR RECOMMENDED? <sup>(c)</sup>	Yes			Depends on sub-slab results (Not recommended if contaminants of concern are in use at the business.)		
SAMPLING FREQUENCY <sup>(d)</sup>	3 times	2 – 3 times		1 time (high purge volume sampling) <sup>(e)</sup> 2 – 3 times (standard sampling)		
TIME OF YEAR	At least one sample in winter and one sample in another season. (Times during decreasing temperature change may be best time to sample).			Winter preferred for at least one sample. (No restrictions for high purge volume sampling)		

Will be updated to reflect recommendation to sample indoor air for TCE at any occupied building and to consider preferential pathways & risk to occupants.



# Rule out preferential pathways

RR-649 (draft),  
Figure 1



# Lab - turnaround



# Response Actions RR-800 (1/2018)

## 7 RESPONSE ACTIONS FOR VAPOR INTRUSION

*Response actions for vapor intrusion are required primarily based on sub-slab vapor concentrations, but the timing for vapor mitigation can take into account other factors, such as indoor air results and land use setting.*

### 7.1 IMMEDIATE ACTION TO PREVENT EXPOSURE

In some cases, immediate action pursuant to Wis. Admin. Code § NR 708 will be needed to interrupt the vapor pathway while the site undergoes additional monitoring or remediation.





# Mitigation Standards

<https://standards.aarst.org/#pb>

View/Purchase Standards   Public Access   AARST.org   NRPP.info

**Alarm**

## National Consensus Standards for Every Building Type

The impact of occupant exposure to radon in buildings is an important public protection issue that requires standardized approaches to measurement and mitigation, and long-term concentrations in buildings remain below the EPA Action Level. Whether the source of radon is through soil or water, or by emanation from building materials, preventing radon exposure to building occupants is one of the most important environmental health challenges we face today.

**“DNR strongly encourages RPs/consultants to hire NRPP-certified mitigators and to follow ANSI/AARST standards for chemical vapor mitigation.”**



# Communicate Results



- 10 Business Days Maximum
- Quickly for acute situations



# Rapid Response Measures

- Sealing foundation cracks
- Integrity of plumbing features
- Increased Ventilation
- Increased indoor air pressure
- Indoor air treatment units (ATUs)
- Relocation



# ITRC Vapor Intrusion Interactive Directory



Search this website

- Navigating This Website
- About ITRC
- Interactive Directory
- Introduction and Overview of Vapor Intrusion Mitigation Training Team
- Conceptual Site Models for Vapor Intrusion Mitigation
- Public Outreach during Vapor Intrusion Mitigation
- Rapid Response & Ventilation for Vapor Intrusion Mitigation
- Active Approaches
- Passive Approaches
- Checklists for Active & Passive Mitigation Approaches

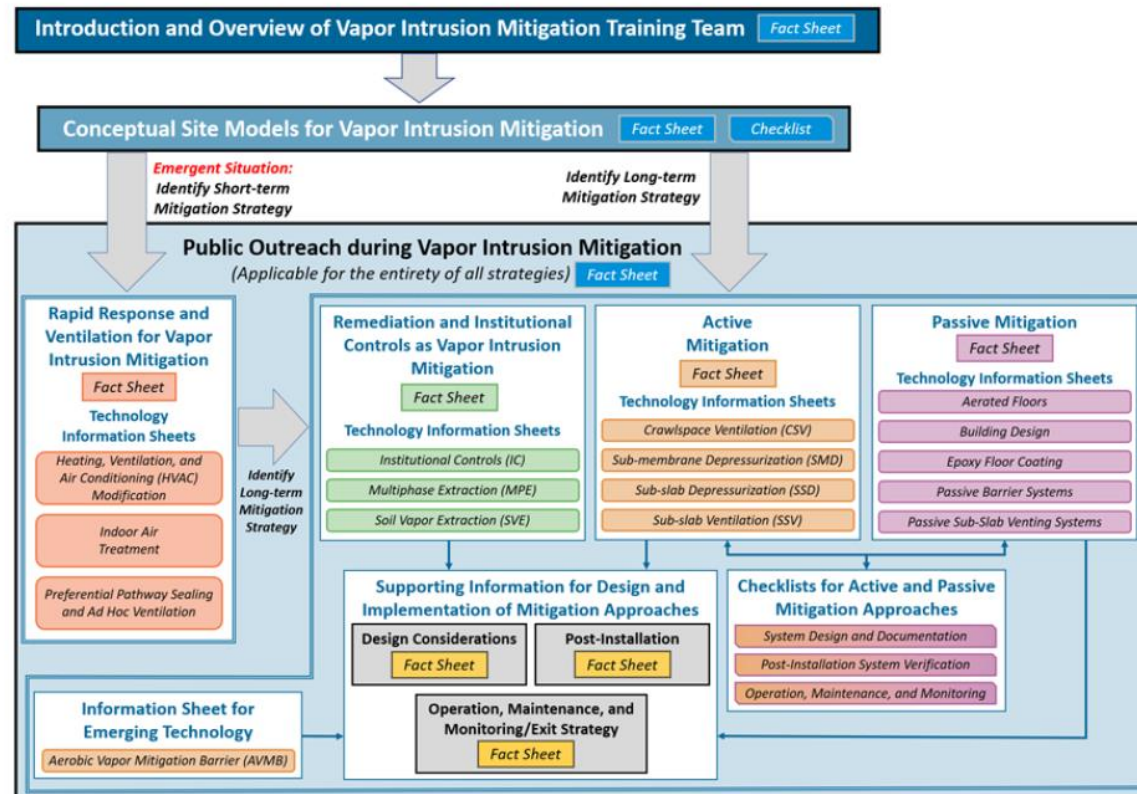
Lists of [acronyms](#), [glossary terms](#), and [references cited in the fact sheets](#) are also available on this website.

## Interactive Directory of Vapor Intrusion Mitigation Training Team Work Products

The Interactive Directory below presents the relationship between work products prepared by the VIMT team.

**User Instructions for Interactive Directory:** Click on the individual buttons within the graphical interactive directory to navigate to each fact sheet, technology information sheet, or checklist.

<https://vim-1.itrcweb.org/>





Search this website

Rapid Response &  
Ventilation for Vapor  
Intrusion Mitigation

Overview

Fact Sheet

Heating, Ventilation, and Air  
Conditioning (HVAC)  
Modification Tech Sheet

Indoor Air Treatment Tech  
Sheet

Preferential Pathway Sealing  
& Ad Hoc Ventilation Tech  
Sheet

▼ Active Approaches

▼ Passive Approaches

Checklists for Active &

▼ Passive Mitigation

Approaches

▼ Remediation & Institutional  
Controls

▼ Emerging Technologies

## Rapid Response & Ventilation for Vapor Intrusion Mitigation Fact Sheet

ITRC has developed a series of fact sheets that summarizes the latest science, engineering, and technologies regarding [vapor intrusion](#) (VI) mitigation. The fact sheets are tailored to the needs of state regulatory program personnel who are tasked with making informed and timely decisions regarding VI-impacted sites. The content is also useful to consultants and parties responsible for the release of these contaminants, as well as public and tribal stakeholders. This fact sheet:

- provides an overview of rapid response as a preliminary method to consider
- describes the typical options related to rapid response
- describes the advantages and limitations of implementing a rapid response
- provides general cost considerations related to rapid response
- describes other special circumstances to consider when deciding if rapid response is applicable

More detailed information on specific rapid response options is included in the ITRC [Preferential Pathway Sealing and Ad Hoc Ventilation](#), [Indoor Air Treatment](#), and [HVAC Modification Technology Information Sheets](#).

### 1 Introduction

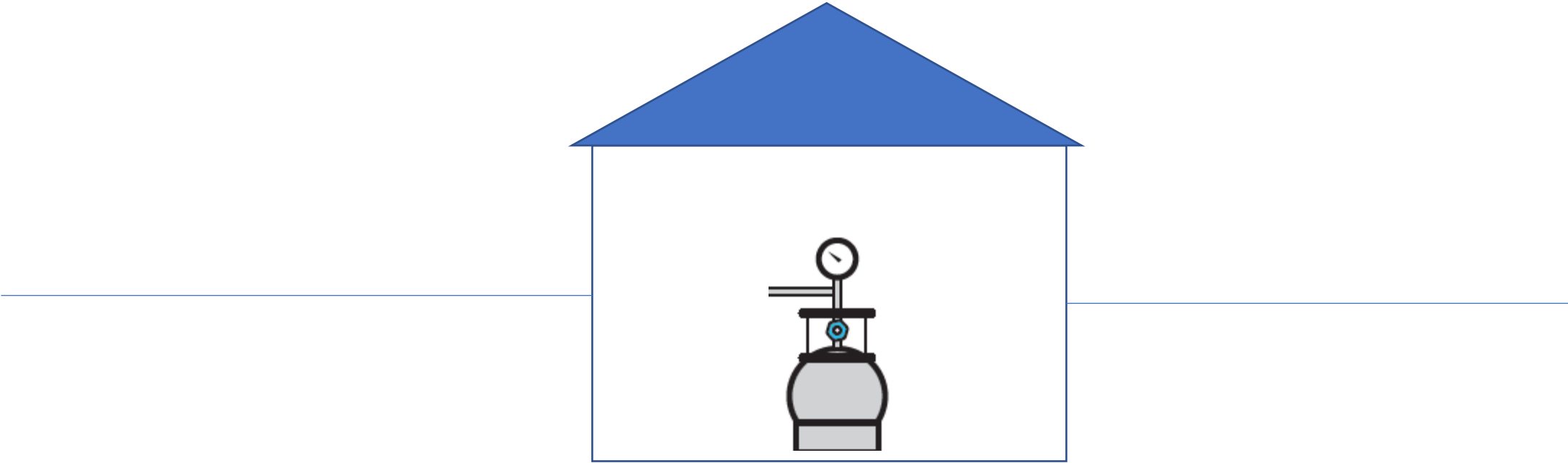
Rapid response is an interim VI mitigation approach that may be appropriate, under certain conditions (e.g., high contaminant concentrations and sensitive populations present), prior to implementing a long-term [mitigation](#)

#### ***Other Terminology Used to Describe a Rapid Response***

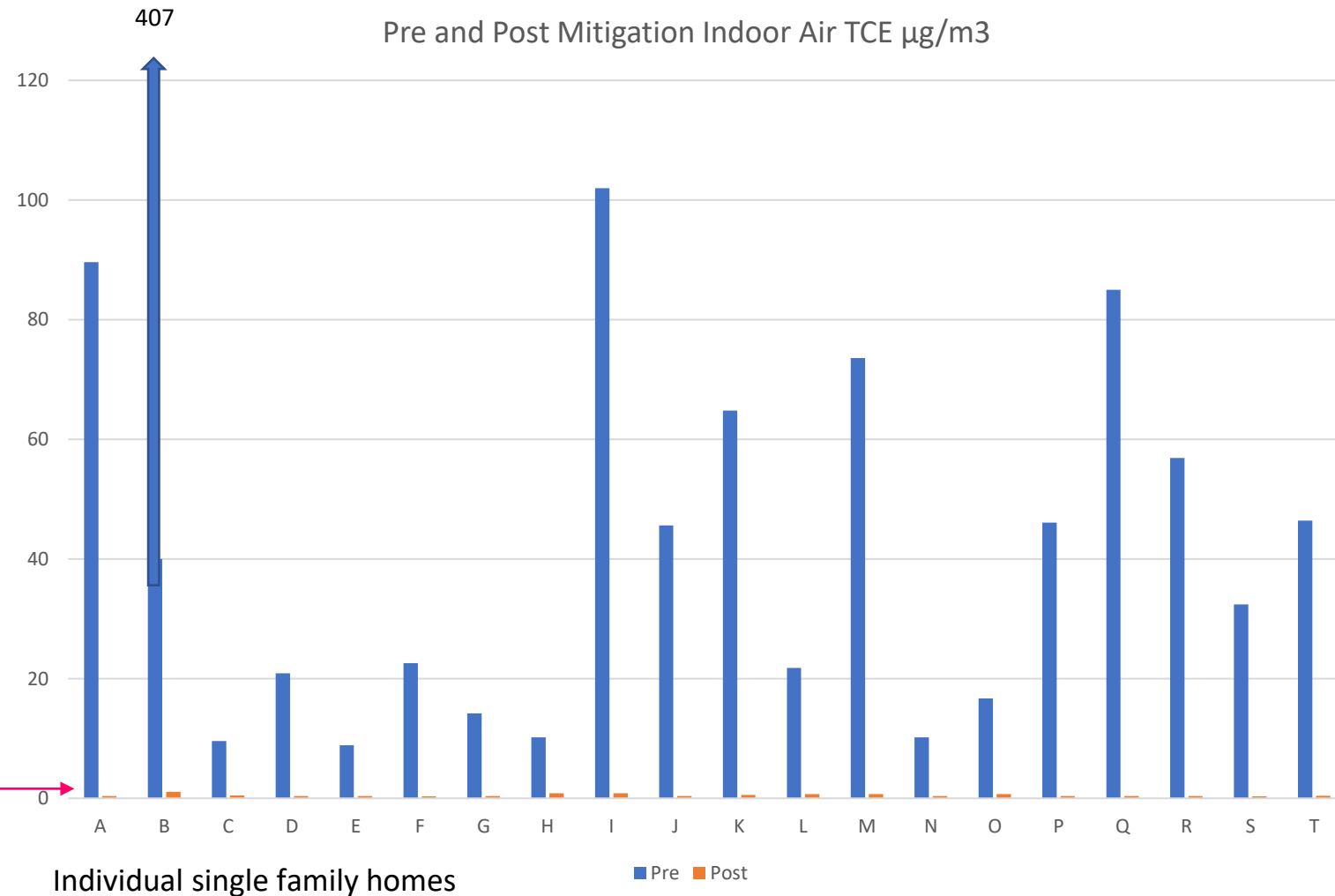
- *Depending on the regulatory framework and the*



# Confirm Effectiveness of Mitigation



# SSDS – Must remain operational to be effective!

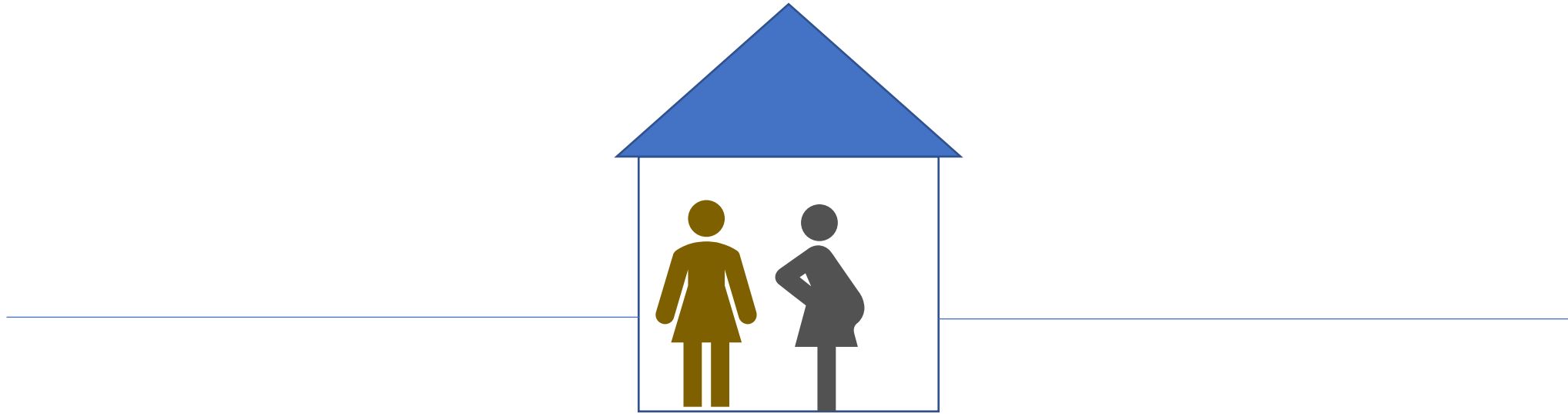


VAL = 2.1  
 $\mu\text{g}/\text{m}^3$

Post Mitigation - all 1  $\mu\text{g}/\text{m}^3$  or less

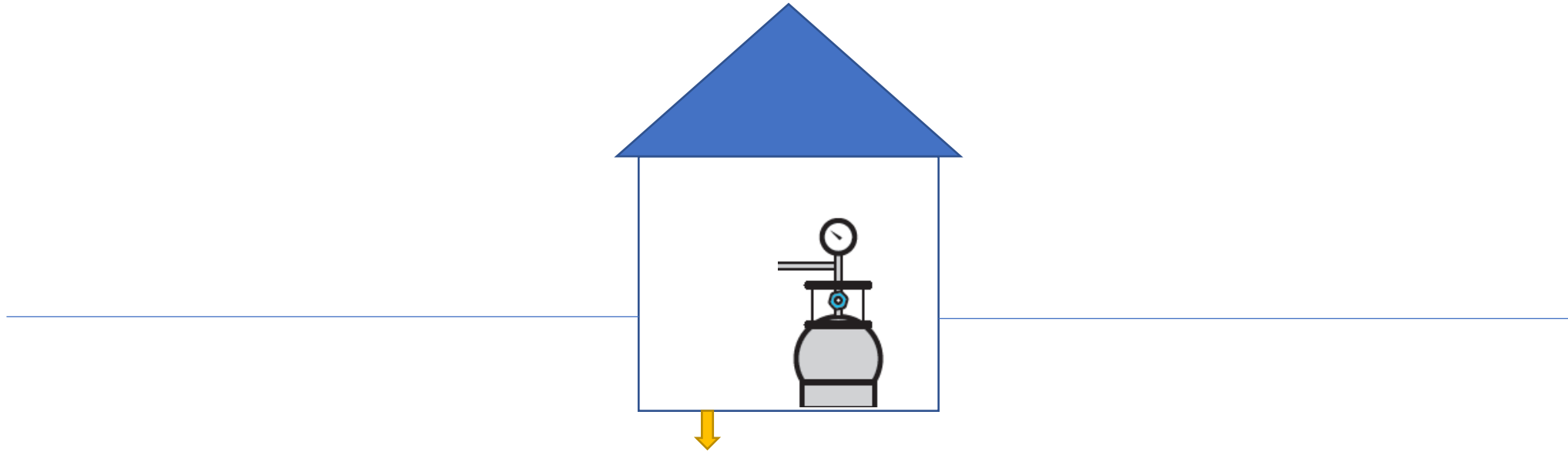


# Protective Mitigation

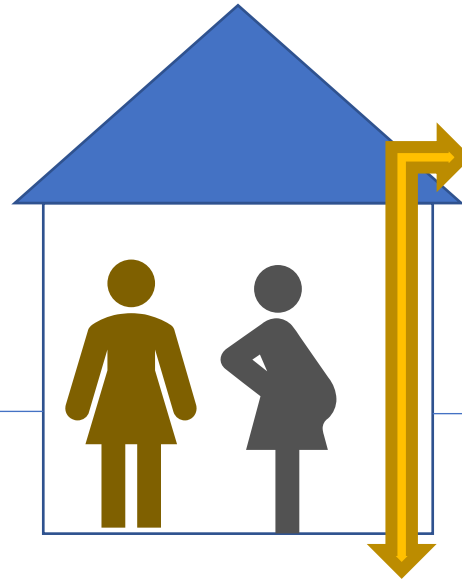




# Protective Mitigation



# Protective Mitigation



Mitigation  
System



# Successful Examples

Sampled	ATU Installed	Mitigation Installed
1/10	1/16	1/28
1/16	1/20	2/10
1/16	1/21	2/4
4/9	4/18	4/27
4/21	4/27	5/14
4/28	5/6	5/28
9/15	9/19	9/20
9/17	9/24	10/10
9/19	10/2	10/7
9/25	10/8	10/30
10/3	10/11	11/5
10/7	10/18	10/29
10/10	10/23	10/30



# References

- Federal Register/Volume 82, No. 12/Thursday January 19, 2017/Proposed Rules Environmental Protection Agency 40 CFR Part 751
- Massachusetts Dept. of Environmental Protections, Field Assessment and Support Team, An Expedited Approach to the Investigation and Mitigation of the Vapor Intrusion Pathway, Newton, MA, October 2016. <https://www.mass.gov/doc/an-expedited-approach-to-the-investigation-and-mitigation-of-the-vapor-intrusion-pathway/download>



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