

Petroleum Vapor Intrusion (PVI)

2024 Updates

Latysha Pankratz | *Section Supervisor*
Petroleum Tank Cleanup Section

Contaminated Site Cleanup Bureau
Montana Department of Environmental Quality
Office: 406-556-4512 | Bozeman Office

lpankratz@mt.gov



Technical Guidance Documents:

- [NAPL Glossary of Terms](#)
- [Monitored Natural Attenuation](#)
- [Site Closure Evaluation, Including Petroleum Mixing Zones](#)
- [Prioritization of Petroleum Release Sites](#)
(Priority Ranking Guidance for Petroleum Tank Releases)
- [Permeations of Waterlines by Petroleum Constituents](#)
- [Purge Water Disposal Flowchart](#)
- [Groundwater Sampling Guidance](#)
- [Montana LNAPL Recovery and Monitoring Guidance](#)
- [Data Validation Summary Form](#)
- [Montana Vapor Intrusion Guide](#)

The following are links to example field sampling forms that may be of assistance.

- [Ambient Air Sampling Form](#)
- [Indoor Air Sampling Form](#)
- [Subslab Soil Vapor Sampling Form](#)

APH VI Calculator

*The Air-Phase Petroleum Hydrocarbon Vapor Intrusion (APH VI) Screening Level Calculator is designed as a simple screening tool to determine if vapor intrusion exceeds generic risk-based screening levels at sites with only **petroleum contamination**. This calculator is **not** meant to be used with solvent sites or mixed waste sites containing a combination of petroleum and other sources. The results from this calculator should be considered one of the multiple lines of evidence in your vapor intrusion investigation. Below you will find the APH VI Screening Level Calculator as well as the VI APH Calculator Discussion that explains how to use the calculator and the general assumptions used for site-specific vapor intrusion risk assessment/analysis (also found on [DEQ SRS's FAQs website](#)).

[APH VI Calculator](#)

Vapor Intrusion Assessment

- DEQ Work Plan Request Letter and/or Guidance
 - “Complete a Vapor Intrusion Assessment...”
 - This is a desktop analysis of:
 - Conceptual Site Model
 - Lateral Inclusion Zone
 - Vertical Screening Distances
 - Foundations of Structures
 - Preferential Pathways
 - Utility Locations
 - Historical (and current) soil and groundwater data
- After desktop analysis discuss with DEQ Project Officer.
 - Multiple lines of evidence approach
- **DO NOT GO DIRECTLY TO INDOOR AIR SAMPLING!**

Development of CSM

- When completing the CSM several questions should be asked to identify any precluding factors or preferential pathways that would likely prohibit the site from using lateral and vertical screening distances.
- Protective of human health.
- **Note that if COC concentrations in soil and groundwater are below regulatory criteria screening distances are not necessary.**

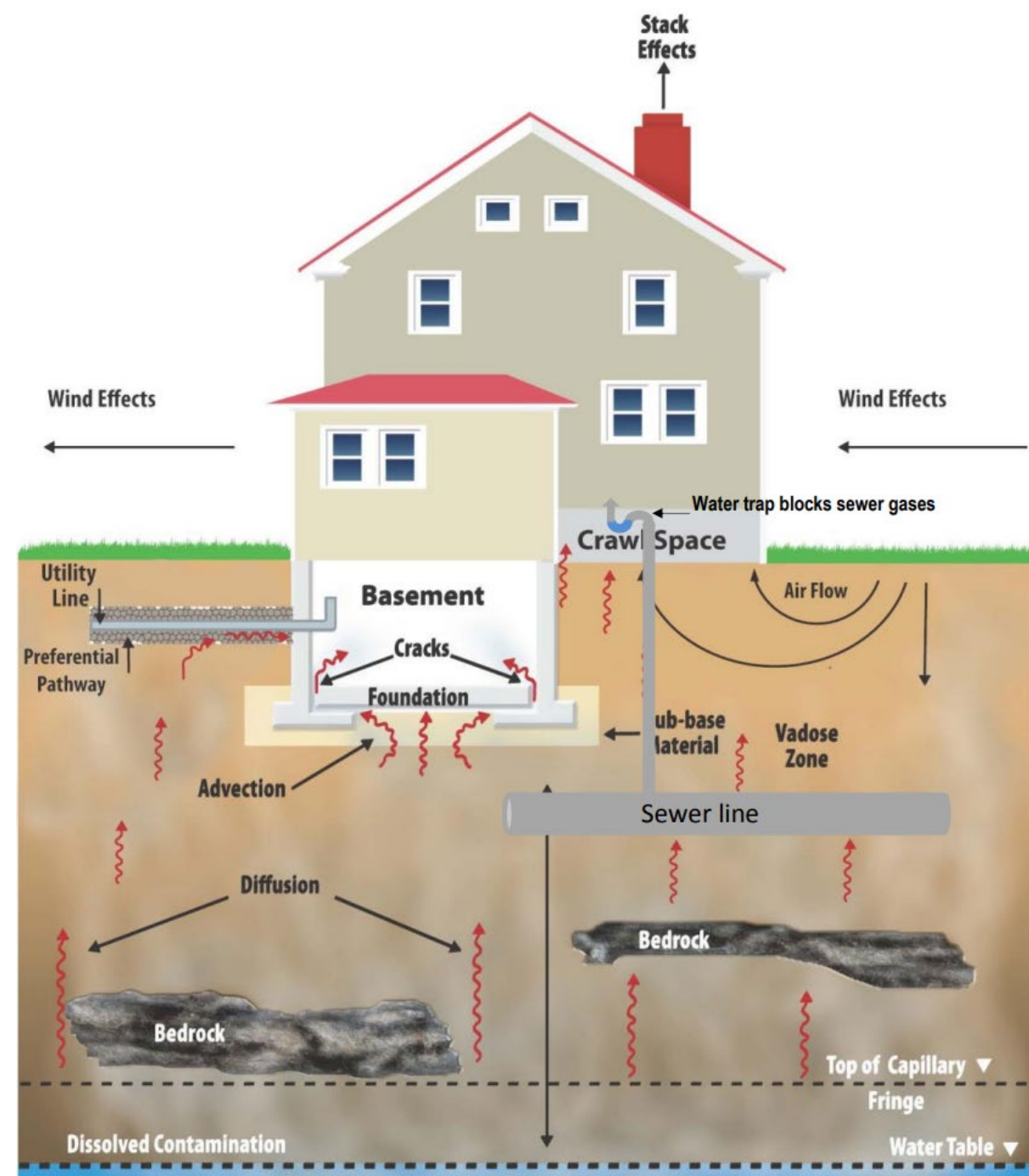
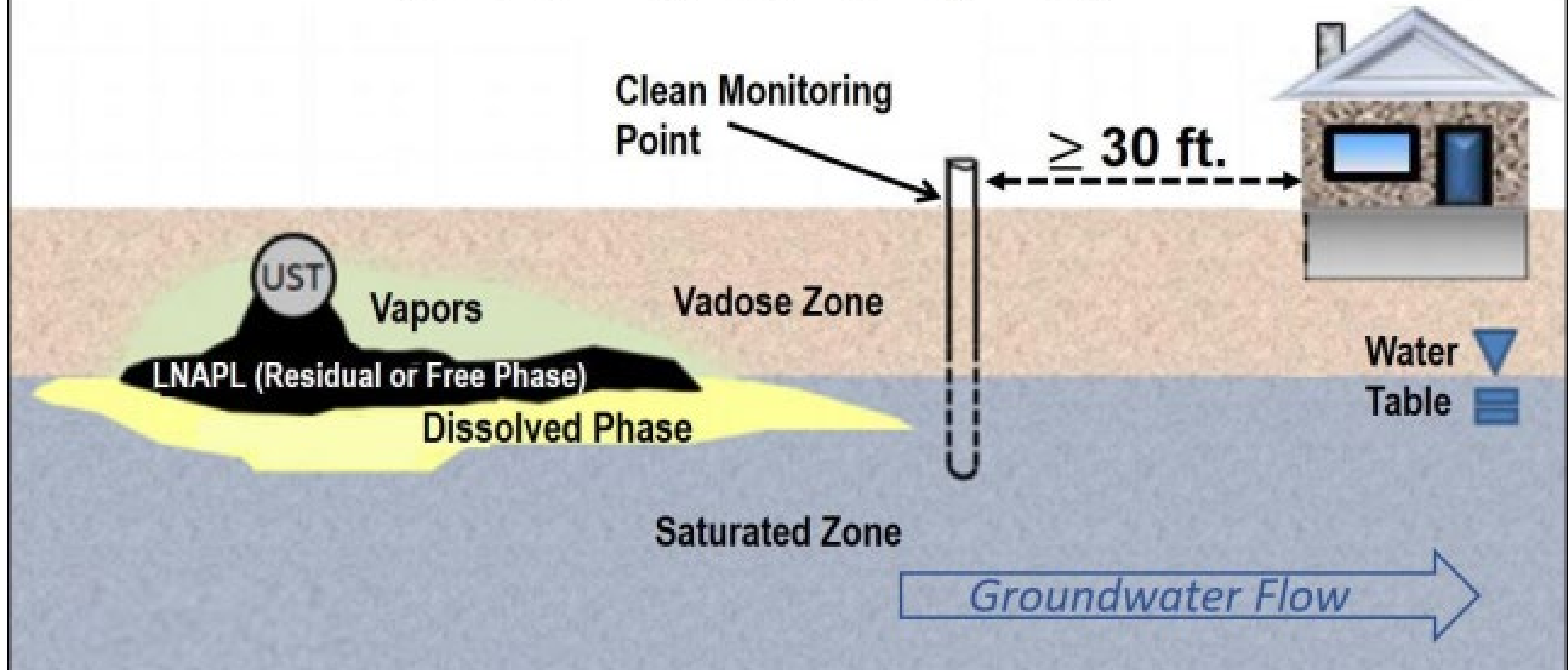


Figure 2.4.1

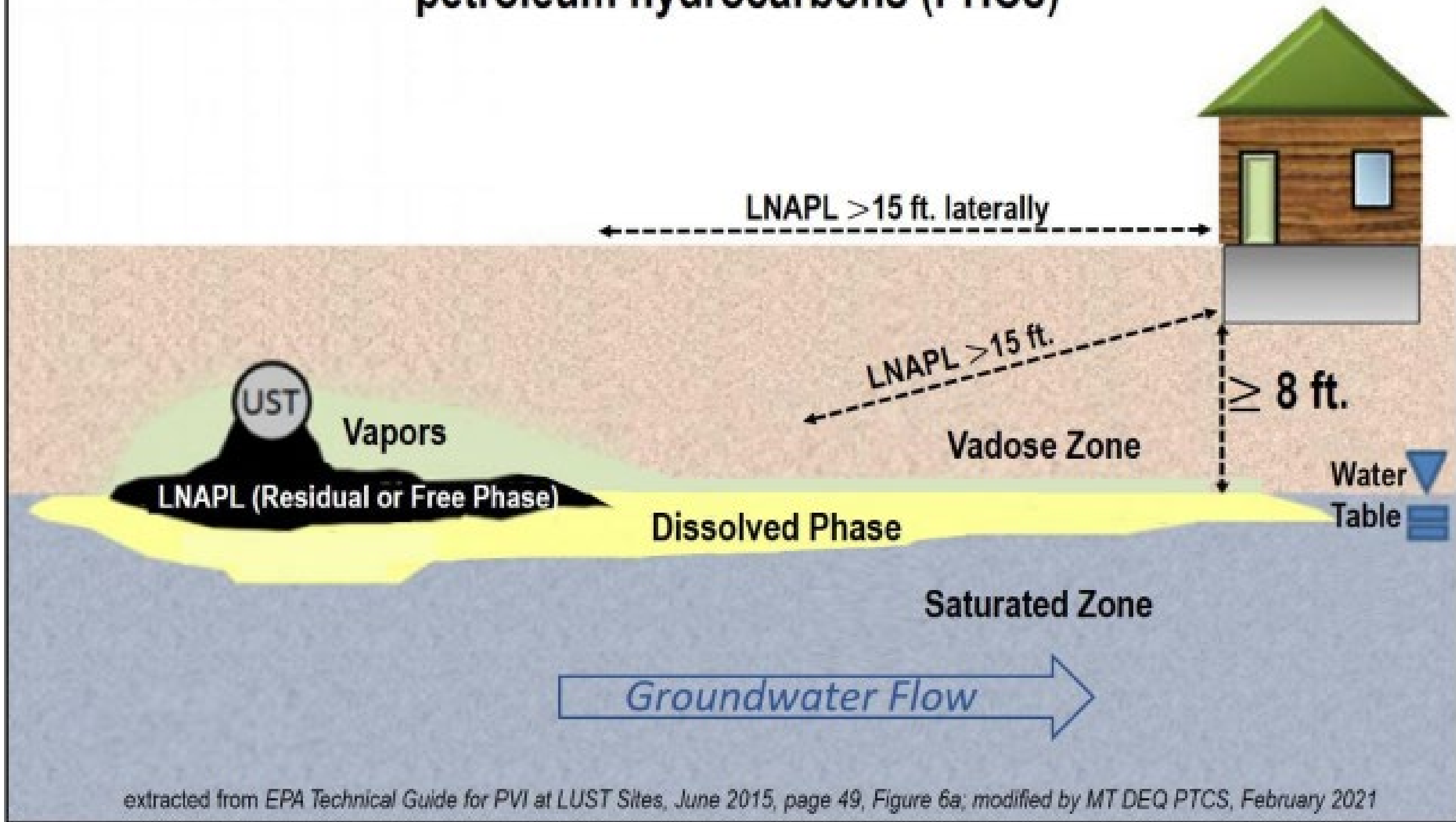
Lateral separation distance for dissolved-phase source of petroleum hydrocarbons (PHCs)



EPA Technical Guide for PVI at LUST Sites, June 2015, page 45, Figure 5; modified by MT DEQ PTCS, January 2021

Figure 2.4.3

Vertical separation distance for dissolved-phase source of petroleum hydrocarbons (PHCs)



extracted from EPA Technical Guide for PVI at LUST Sites, June 2015, page 49, Figure 6a; modified by MT DEQ PTCS, February 2021

Next Steps

- When the PVI pathway does not screen out...
- Mitigation (when appropriate)
 - Michael Gustafson is the radon coordinator
- Sampling
 - Section 3.5 SAP Development: Area of VI Investigation
 - When building is in direct contact with petroleum contaminated soil/groundwater direct to indoor air sampling
 - Building is not in direct contact with petroleum contaminated soil/groundwater use a phased approach starting with exterior soil vapor probes

Vapor Intrusion Screening Levels

Sub-slab and Soil-Vapor

- Only applicable to sub-slab and/or soil-vapor samples collected below or adjacent to a completed concrete foundation.
- **Not applicable to vapor samples collected from crawl space, building/structure living space, or any confined space lacking a solid concrete slab.**

**Vapor Intrusion Screening Levels* (VISL), $\mu\text{g} / \text{m}^3$
for Exterior Subsurface Soil & Sub-Slab Vapor Samples**

Chemical / Analyte / Compound	Residential VISL, $\mu\text{g} / \text{m}^3$	Industrial VISL, $\mu\text{g} / \text{m}^3$
Benzene	10 ^a	60
Ethylbenzene	40	200
Toluene	20,000	70,000
Xylenes	300	1,000
MTBE	400	2,000
Naphthalene	3 ^a	10
Butadiene	3	20
C5-C8 Aliphatic	3000	9,000
C9-C12 Aliphatic	1,000	1,000
C9-C10 Aromatic	300	1,000
DCA (1,2 dichloroethane)	4 ^a	20
EDB (ethylene dibromide)	0.2	0.8

DEQ/EPA Regional Screening Levels Crawl Space, Indoor Air

- For samples collected from Crawl Spaces, Indoor Air, or in the absence of a solid concrete slab
- More conservative (protective) than VISLs
- Use DEQ's APH Calculator

Tier II APH Calculation

	RSL (Industrial)	Sample 1	Sample 2	Sample 3
Benzene	1.8	1	2.6	4.8
Ethylbenzene	5.5	4	6.3	4.2
C5-C8 Aliphatics	260	300	140	210
Naphthalene	0.4	2.6	6	8.3
DCA	0.52	0.3	0.48	2.7

APH Calculator

Crawl Space & Indoor Air

APH VI Screening Level Calculator

- Instructions: 1. Compare your analytical results to DEQ/EPA RSL Screening value in [Table 1](#).
 2. All compounds that exceed the [Table 1](#): DEQ/EPA RSL Screening values must be added to the to drop down boxes under "Chemical" in [Table 2](#) to view the adjusted screening value.

Table 1

Chemical	DEQ/EPA RSL Screen ($\mu\text{g}/\text{m}^3$)*	
	Residential	Industrial
1,2 Dichloroethane (DCA)	0.23	0.52
1,3 Butadiene	0.1	0.46
Aliphatic (C5-C8)	94	260
Aliphatic (C9-C12)	44	44
Aromatic (C9-C10)	10	44
Benzene	1.3	1.8
Ethylbenzene	1.2	5.5
Ethylene Dibromide (EDB)	0.0052	0.022
MTBE	12	52
Naphthalene	0.39	0.4
Toluene	520	2200
Xylenes (mix of mp & o)	10	44

Table 2

	Chemical	Adjusted RSL ($\mu\text{g}/\text{m}^3$)**	
		Residential	Industrial
1	1,2 Dichloroethane (DCA)	0.31	1.3
2	Benzene	1.3	4.5
3	Aliphatic (C5-C8)	630	2600
4	Naphthalene	0.39	1
5	Ethylbenzene	3.1	14
6			
7			
8			
9			
10			
11			
12			

*DEQ/EPA RSL Screening values are based on a cancer risk of 1×10^{-6} (adjusted for 78-year lifespan) and a hazard index of 0.1 for non-carcinogens.

**Adjusted RSL values are based on a cumulative cancer risk of 1×10^{-5} (adjusted for 78-year lifespan) and a cumulative hazard index of 1.0 (non-carcinogens) for only those chemicals selected.

[Please see DEQ's VI APH Calculator Discussion document for additional information.](#)

Proceed with Caution

- **Assessment is NOT Sampling**
- Incorrect or Incomplete Laboratory Analysis
- Reporting Limits
- Leak Tracer Testing

Incorrect or Incomplete Lab Analysis

- Only analyzing for BTEX and not including all analytes from APH calculator:

Chemical	DEQ/EPA RSL Screen ($\mu\text{g}/\text{m}^3$)
1,2 Dichloroethane (DCA)	0.23
1,3 Butadiene	0.10
Aliphatic (C5-C8)	94
Aliphatic (C9-C12)	44
Aromatic (C9-C10)	10
Benzene	1.3
Ethylbenzene	1.2
Ethylene Dibromide (EDB)	0.0052
Xylenes (mix of m,p & o)	10.0
Methyl Tert Butyl Ether (MTBE)	12
Naphthalene	0.39
Toluene	520

- Some analytes may be excluded based on soil and groundwater data

Reporting Limits

- Laboratory difficulty meeting reporting limits for EDB, 1,3 Butadiene and Naphthalene
- Discuss with lab prior to sampling to determine RLs and how they will be addressed

Leak Tracer Testing

- Will be performed on soil vapor samples and sub-slab samples
- DEQ's preferred method is helium
- Can use 'other' methods however a description of the method and how it will detect leaks is required in the work plan and be approved by DEQ Project Officer.

Future of PVI Guide

- Updates to address lessons learned
- ITRC Vapor Intrusion Updates
- Looking at options to address historical heating oil releases
- Welcome consultant input

Questions?