Sampling Indoor Air in Virginia under the Voluntary Remediation Program

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Virginia's Voluntary Remediation Program

In today's session:

- Intro to VRP
- Expectations for IA sampling
- Modeling assumptions in VRP and appropriate tools
- Case Studies of sites in Virginia with indoor air concerns



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Evaluation of Contaminants in VRP

"*The **site characterization component** shall provide an understanding of the site conditions including the **identification** and **description** of each **area of concern** (or source); the **nature and extent of releases to all media**…"*

9VAC20-160-70 A.1

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Evaluation of Indoor Air in VRP

- Indoor air sampling is not recommended until other pathways are evaluated
  - Groundwater -> VI
  - Deep soil -> VI
  - Sub-slab ->VI
- Screening of COPCs before quantitative risk assessment
- Multiple rounds of sampling to evaluate seasonal variability



Image credit: ITRC Vapor Intrusion Technical and Regulatory Guidance, January 2026

Modeling Assumptions in VRP

- VRP recommends using EPA's Vapor Intrusion Screening Level Calculator (VISL)
- Sites should not alter the default VISL attenuation factors of
  - 0.001 for groundwater
  - 0.03 for sub-slab

Resident Vapor Intrusion Risk

Chemical	CAS Number	Site Groundwater Concentration C_{gw} (µg/L)	Site Indoor Air Concentration $C_{i,a}$ (µg/m³)	VI Carcinogenic Risk CDI (µg/m³)	VI Carcinogenic Risk CR	VI Hazard CDI (mg/m³)	VI Hazard HQ
Dichloroethylene, cis-1,2-	156-59-2	2.3	3.84E-01	1.37E-01	-	3.68E-04	9.20E-03
Tetrachloroethylene	127-18-4	1.9	1.37E+00	4.90E-01	1.27E-07	1.32E-03	3.30E-02
Trichloroethylene	79-01-6	1.6	6.44E-01	3.29E-01	1.35E-06	6.18E-04	3.09E-01
Vinyl Chloride	75-01-4	4.2	4.77E+00	6.47E+00	2.85E-05	4.58E-03	8.95E-02
*Sum		-	-	-	3.00E-05	-	4.41E-01

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Virginia Unified Risk Assessment Model: VURAM

- Based on EPA Regional Screening Levels
- Can select multiple scenarios
  - residential
  - commercial/industrial
  - recreator
  - trespasser
  - construction worker
- Screening Level Module
- Quantitative Risk Assessment Module

Report Summary

Hazard/risk values of zero (0.00+00) are reflective of non-calculated values. Hazard/risk for zero value analytes must be evaluated outside of quantitative risk assessment.

Hazard/Risk Summary for Air

Analyte	CAS	Hazard Adult	Hazard Child	Risk
Dichloroethylene, cis-1,2-	156-59-2	9.21E-03	9.21E-03	0.00E+00
Tetrachloroethylene	127-18-4	3.28E-02	3.28E-02	1.27E-07
Trichloroethylene	79-01-6	3.09E-01	3.09E-01	1.35E-06
Vinyl Chloride	75-01-4	8.95E-02	8.95E-02	2.85E-05

Total Hazard Index/Risk for All Media

Non-Cancer Adult		Non-Cancer Child		Cancer	
Ingestion:	0.00E+00	Ingestion:	0.00E+00	Ingestion:	0.00E+00
Dermal:	0.00E+00	Dermal:	0.00E+00	Dermal:	0.00E+00
Inhalation:	4.40E-01	Inhalation:	4.40E-01	Inhalation:	2.99E-05
Total:	**4.40E-01**	**Total:**	**4.40E-01**	**Total:**	**2.99E-05**
does not exceed hazard index		***does not exceed hazard index***		***does not exceed cumulative risk***	

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VRP and VURAM Modeling Assumptions

- **Screening:** Soil gas screening values are calculated by dividing the indoor air screening level by an attenuation factor of 0.03 (unitless) for shallow/sub-slab soil gas, and 0.01 for deep soil gas.
- **Quantitative Risk Assessment**: Volatile compound concentrations in multiple media – complete risk assessment using most conservative concentrations
  - Modeled air using VISL defaults to EPA-recognized attenuation factors
  - Or directly input indoor air results (max. concentration or 95% UCL) into VURAM



Contaminants of Potential Concern

In VRP these are some of the compounds for which VI may be a concern:

- Petroleum
- Chlorinated solvents
- PFAS
- Methane

Health Center - Northern Virginia

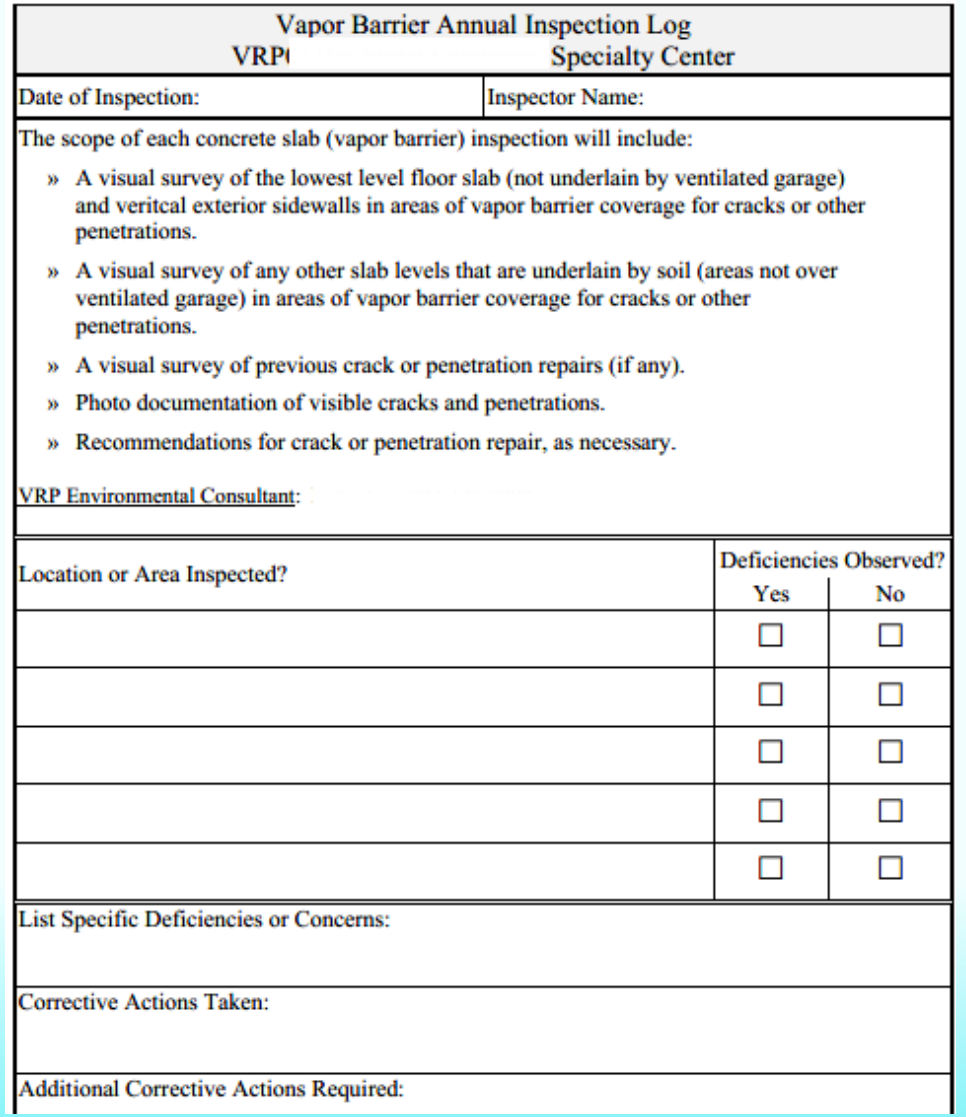
Former automotive shop with USTs

Part of a larger development

Participated in VRP during redevelopment (before buildout of new health center)

Some requirements for completing VRP:

- Operation of Vapor Mitigation System a requirement
- Operations and Maintenance Plan for Vapor Mitigation



Vapor Barrier Annual Inspection Log
VRP Specialty Center

Date of Inspection:	Inspector Name:

The scope of each concrete slab (vapor barrier) inspection will include:

- A visual survey of the lowest level floor slab (not underlain by ventilated garage) and veritcal exterior sidewalls in areas of vapor barrier coverage for cracks or other penetrations.
- A visual survey of any other slab levels that are underlain by soil (areas not over ventilated garage) in areas of vapor barrier coverage for cracks or other penetrations.
- A visual survey of previous crack or penetration repairs (if any).
- Photo documentation of visible cracks and penetrations.
- Recommendations for crack or penetration repair, as necessary.

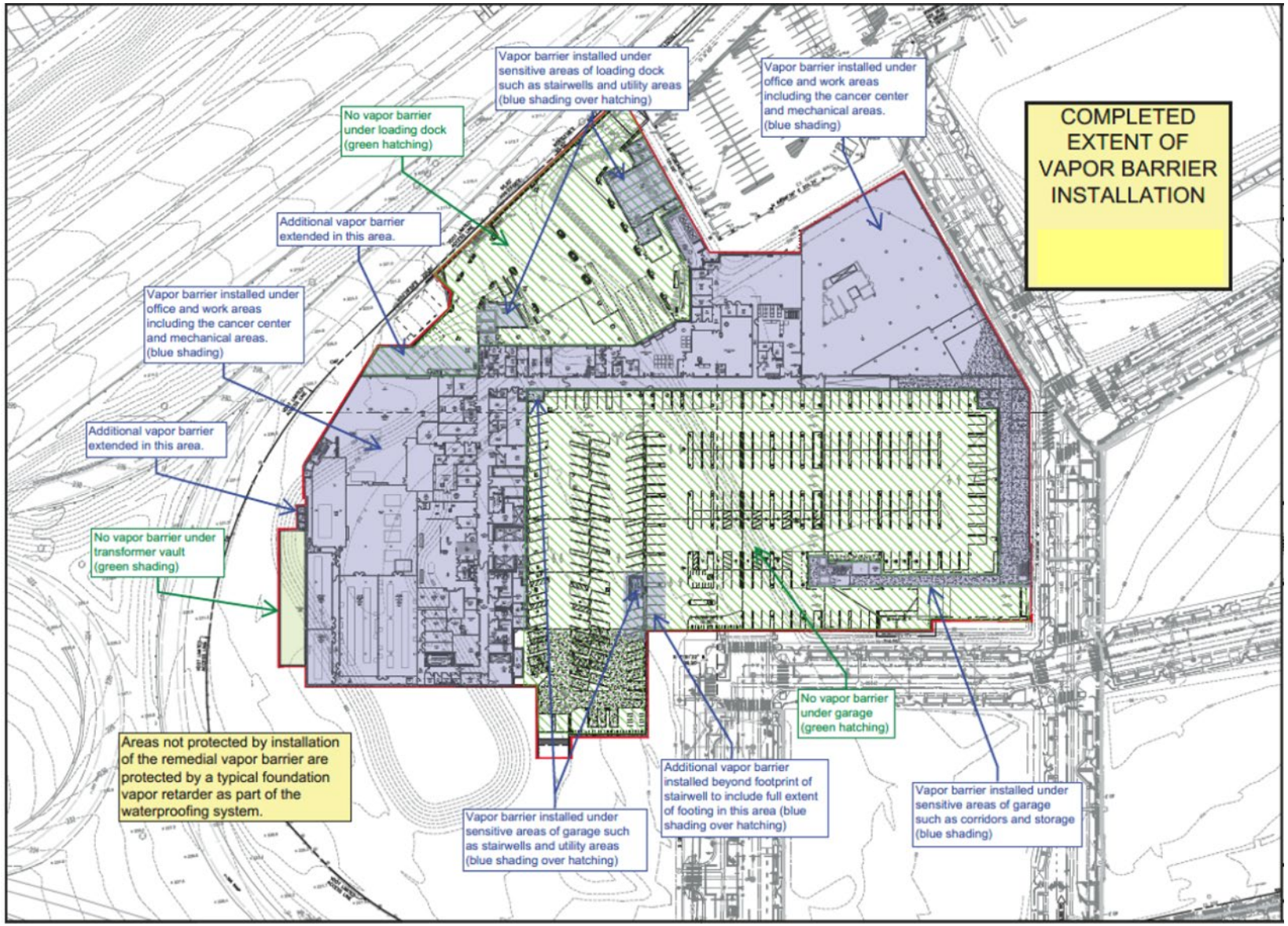
VRP Environmental Consultant:

Location or Area Inspected?	Deficiencies Observed? Yes	No
	☐	☐
	☐	☐
	☐	☐
	☐	☐
	☐	☐

List Specific Deficiencies or Concerns:

Corrective Actions Taken:

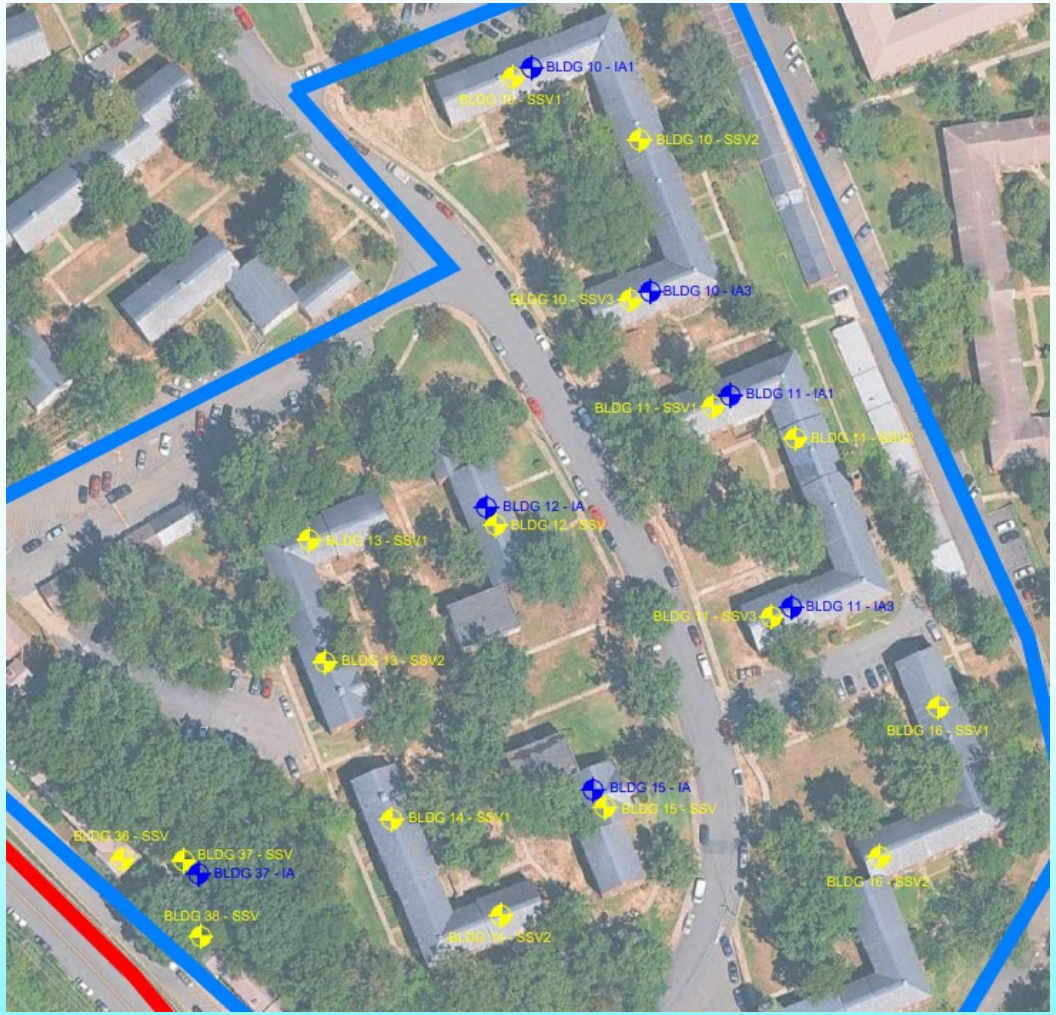
Additional Corrective Actions Required:


COMPLETED EXTENT OF VAPOR BARRIER INSTALLATION
Vapor barrier installed under sensitive areas of loading dock such as stairwells and utility areas (blue shading over hatching)
Vapor barrier installed under office and work areas including the cancer center and mechanical areas. (blue shading)
No vapor barrier under loading dock (green hatching)
Additional vapor barrier extended in this area.
Vapor barrier installed under office and work areas including the cancer center and mechanical areas. (blue shading)
Additional vapor barrier extended in this area.
No vapor barrier under transformer vault (green shading)
Areas not protected by installation of the remedial vapor barrier are protected by a typical foundation vapor retarder as part of the waterproofing system.
Vapor barrier installed under sensitive areas of garage such as stairwells and utility areas (blue shading over hatching)
Additional vapor barrier installed beyond footprint of stairwell to include full extent of footing in this area (blue shading over hatching)
No vapor barrier under garage (green hatching)
Vapor barrier installed under sensitive areas of garage such as corridors and storage (blue shading)

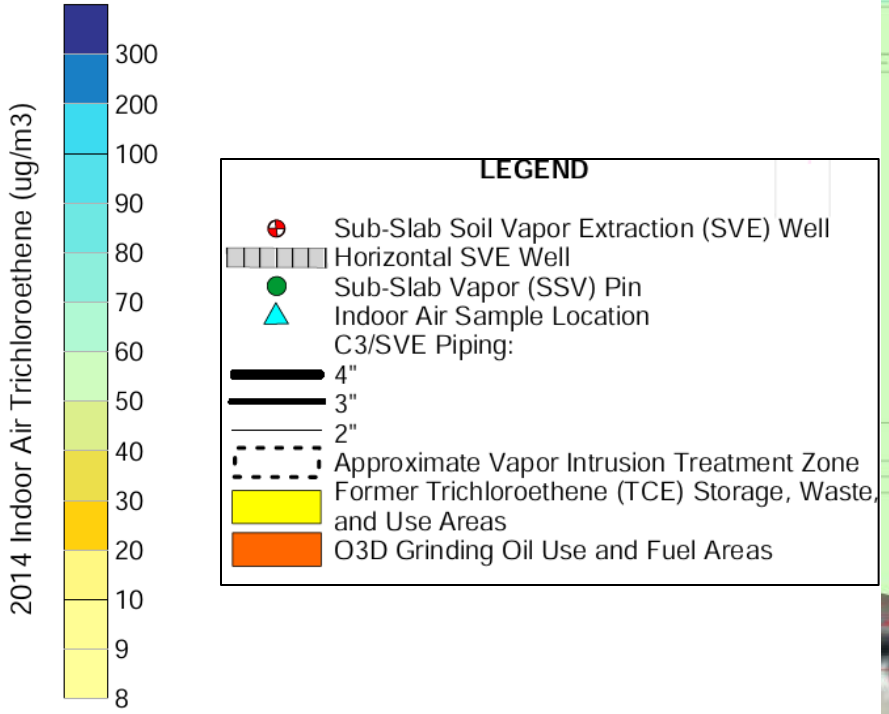
Residential Development in Arlington

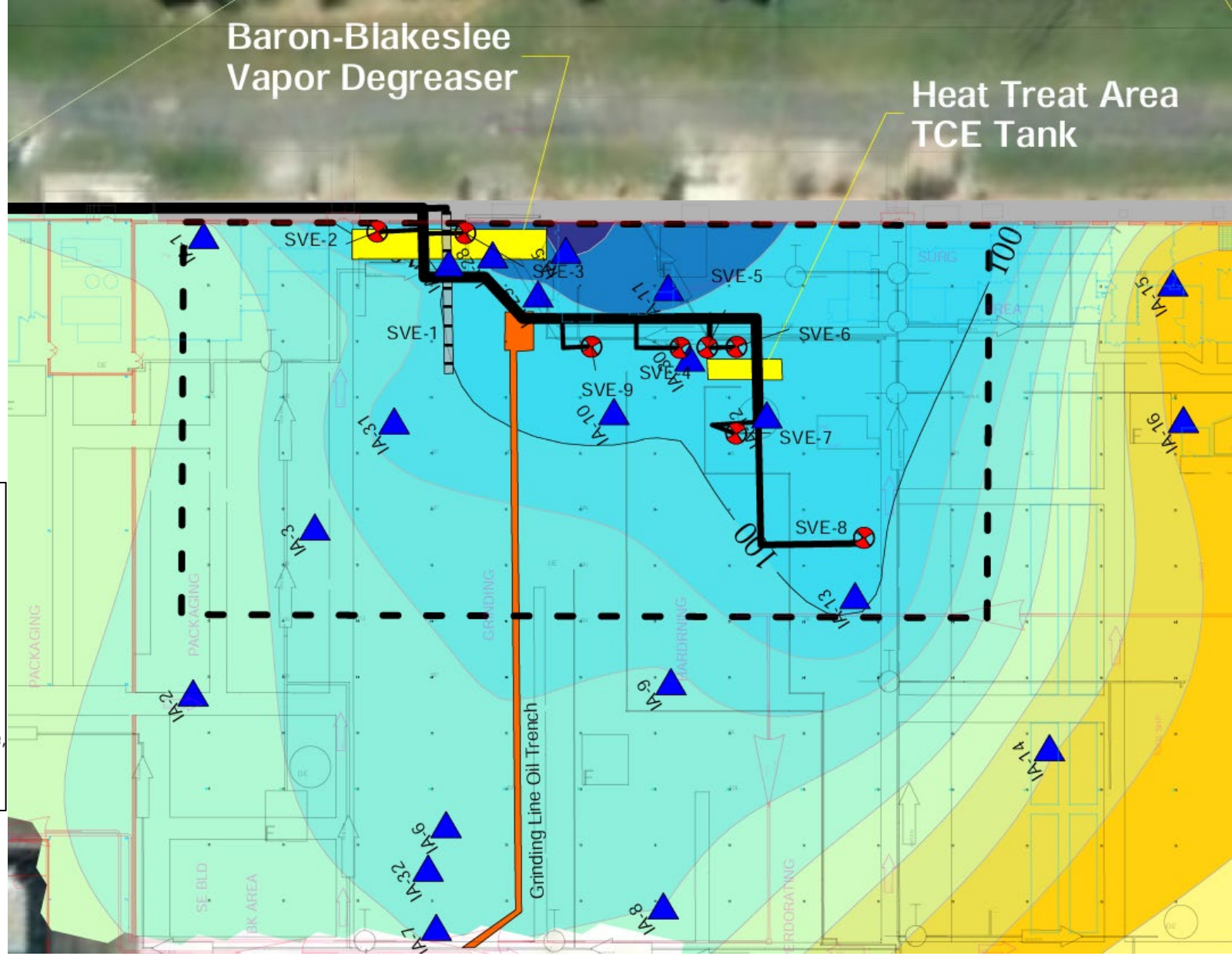
Current VRP Participant
COPC: Chloroform ($CHCl_3$)
Paired sub-slab and indoor air samples in June 2026

	SSV (ug/m3)	IA (ug/m3)
Building 1	17.8	<0.24
Building 2	9.15	1.93
Building 3	105	0.48
Building 4	141	0.5



Manufacturing Facility – Augusta County

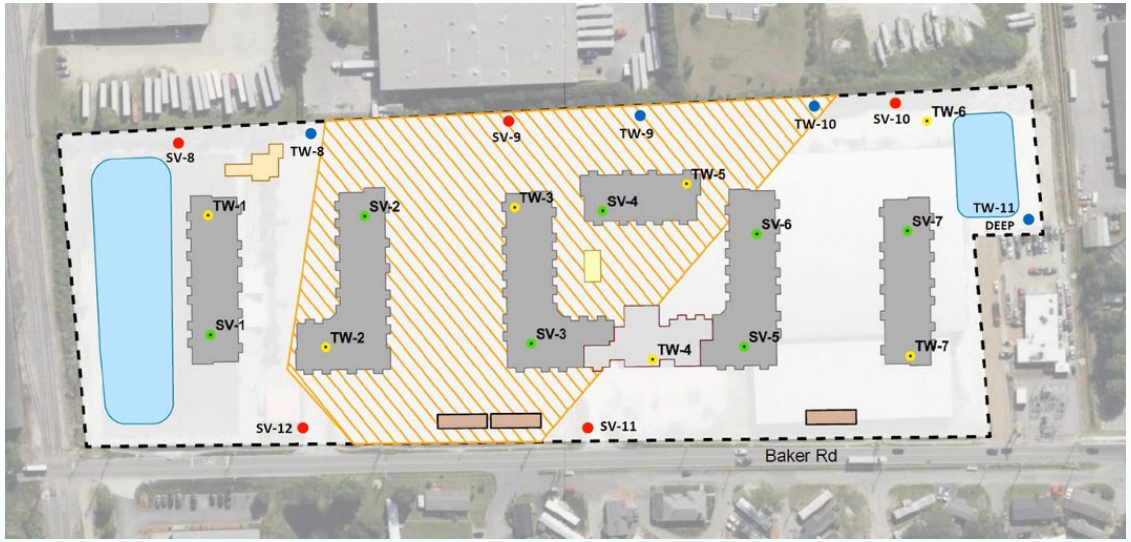




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Residential Development on Landfill

- Virginia Beach
- Former CDD landfill proposed for residential development
- COC: methane (yellow hatched area)
- After build-out, ongoing monitoring requirements



Conclusions

- VI needs to be evaluated for sites enrolled in Virginia's VRP
- Modeled or measured indoor air can be used in a QRA
- Mitigation is based on the severity of the VI issue
- Construction quality assurance is required
- Proof of operation is required, along with ongoing O&M

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