Soil Vapor Extraction (SVE) for VI Protectiveness Across Multiple Buildings

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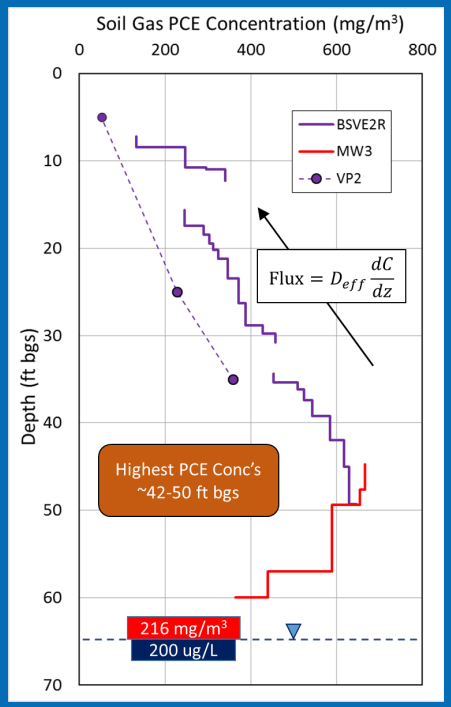
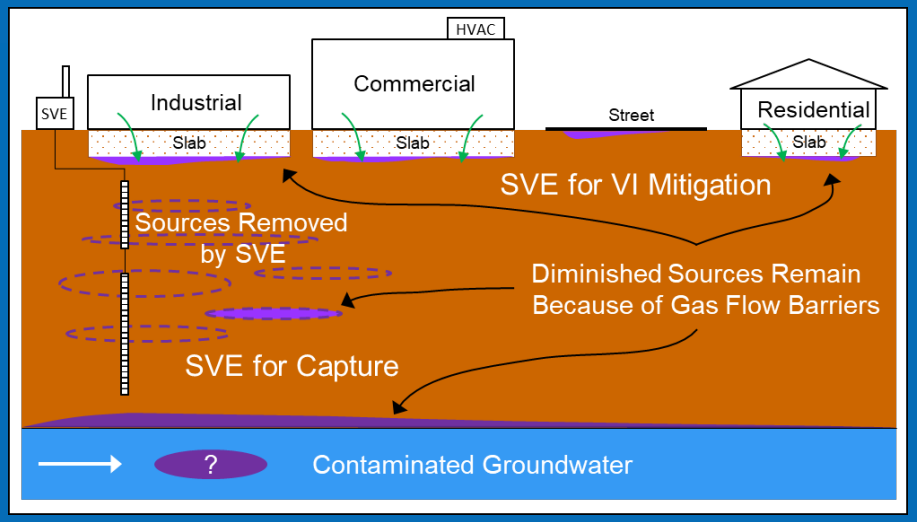
Chris Lutes, Jacobs

[1] funding organization; [2] presenters





March 15, 2022

Collaborators –

- *EPA Sponsors/Leads*
  - Brian Schumacher, John H. Zimmerman, U.S. EPA Office of Research and Development, Center for Environmental Measurement and Modeling
  - Rebecca Connell and Rusty Harris-Bishop, U.S. EPA Region 9
- *Expert Contractors*
  - *Soil vapor extraction (SVE):* Bo Stewart, Praxis
  - *Vapor intrusion (VI), indoor air*: Chris Lutes, Jacobs
  - *Project management:* Robert Truesdale, RTI
  - *On-site support:* Jose De Loera, OTIE (now with Apex)

SVE to Mitigate VI - Background

- SVE typically focuses on VOC mass removal. However, SVE may be useful for a "double benefit":
  1. *Remove soil gas containing VOC vapors to "clean" soil*
  2. *Create subslab depressurization (SSD) and/or intercept vapors prior to reaching subslab to control VI*
- Problem: Can SVE operation mitigate VI by capturing VOC vapors prior to subslab contact and/or maintain a negative pressure below the slab?

Objectives: VI Mitigation by SVE

- applicable to Soil Gas Safe Communities

Install and operate SVE for cleanup & VI control to:

1. Monitor area-wide ***effectiveness***
2. Assess ***cost effectiveness***
3. Develop ***preliminary design concepts*** for VI control

Pilot Test Site Map

Suspected Surface Release Points

Suspected Groundwater Source Mass (Plume)

? = uncertainties

Pilot Test Operations & Timeline

Infrastructure & Monitoring:

- Five, 3-level SVE wells; 20 HP blower (360-400 scfm)
- Numerous soil gas monitoring points, multilevel and subslab
- Monitoring VOCs indoor and subslab using several methods in seven surrounding buildings

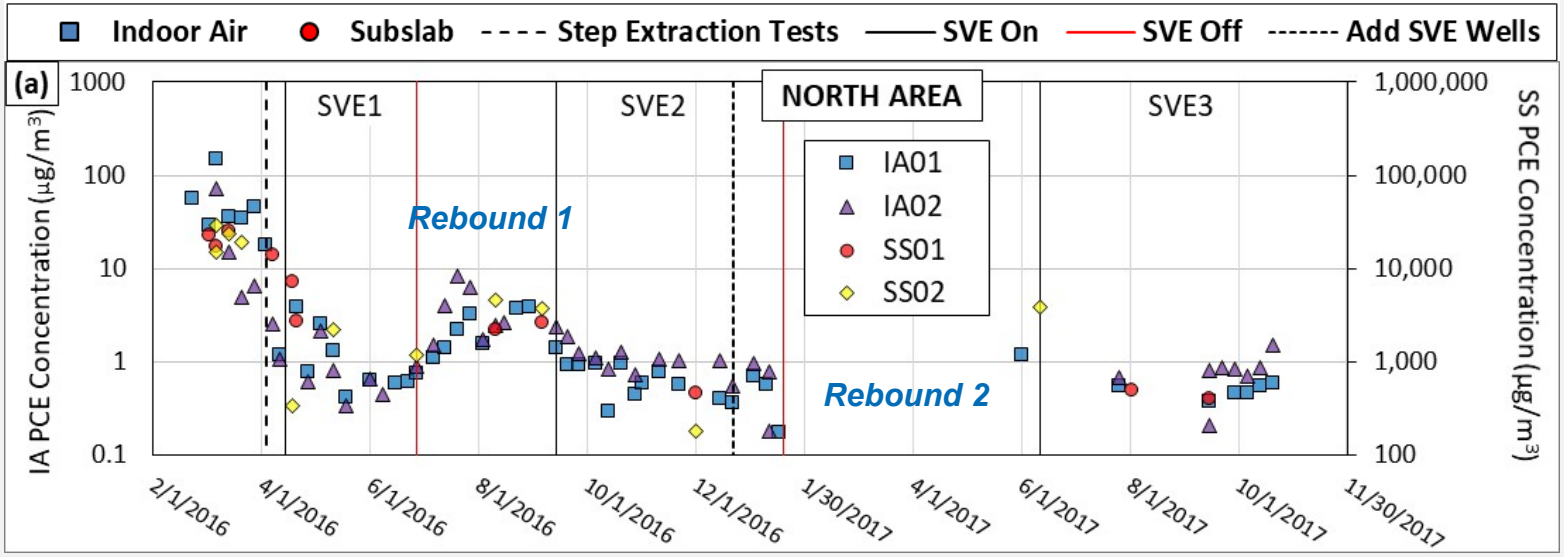
SVE Operation Timeline:		*days*
SVE 1	(Apr 16 – Jun 16)	81
Rebound 1	(Jun 16 – Sep 16)	78
SVE 2	(Sep 16 – Jan 17)	127
Rebound 2	(Jan 17 – Jun 17)	144
SVE 3	(Jun 17 – Mar 18)	262
Rebound 3	(Mar 18 – …)	

Multiple Rebounds: Identify problem areas, track cleanup progress, collect vertical mass flux data

Results Summary (Objective 1)

Monitor area-wide effectiveness

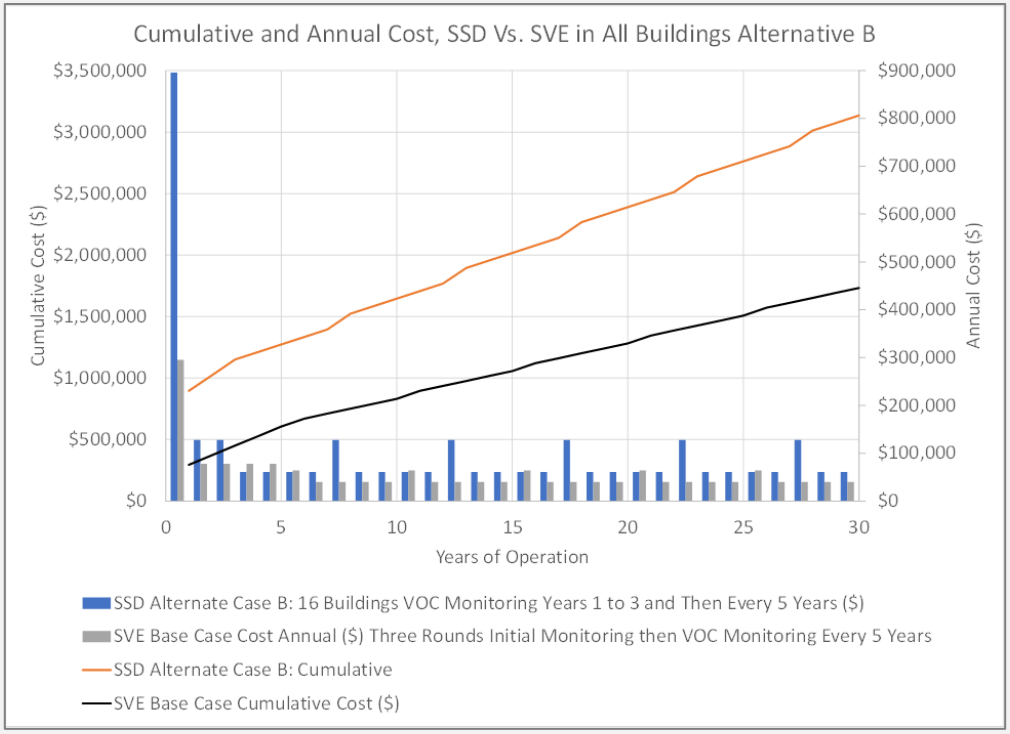
"***Field Study of Soil Vapor Extraction for Reducing Off-Site Vapor Intrusion***", Groundwater Monitoring & Remediation, January 2020, https://doi.org/10.1111/gwmr.12359



Results Summary (Objective 2)

Assess cost effectiveness

"***Cost Comparison of Soil Vapor Extraction and Subslab Depressurization for Vapor Intrusion Mitigation***", GWM&R, Spring 2022, https://doi.org/10.1111/gwmr.12510



Results Summary (Objective 3)

Provide preliminary design concepts for VI control in Soil Gas Safe Communities

"***Evaluation of VI Mass Flux from Transient Vertical Vapor Concentration Profiles***", Manuscript in Preparation

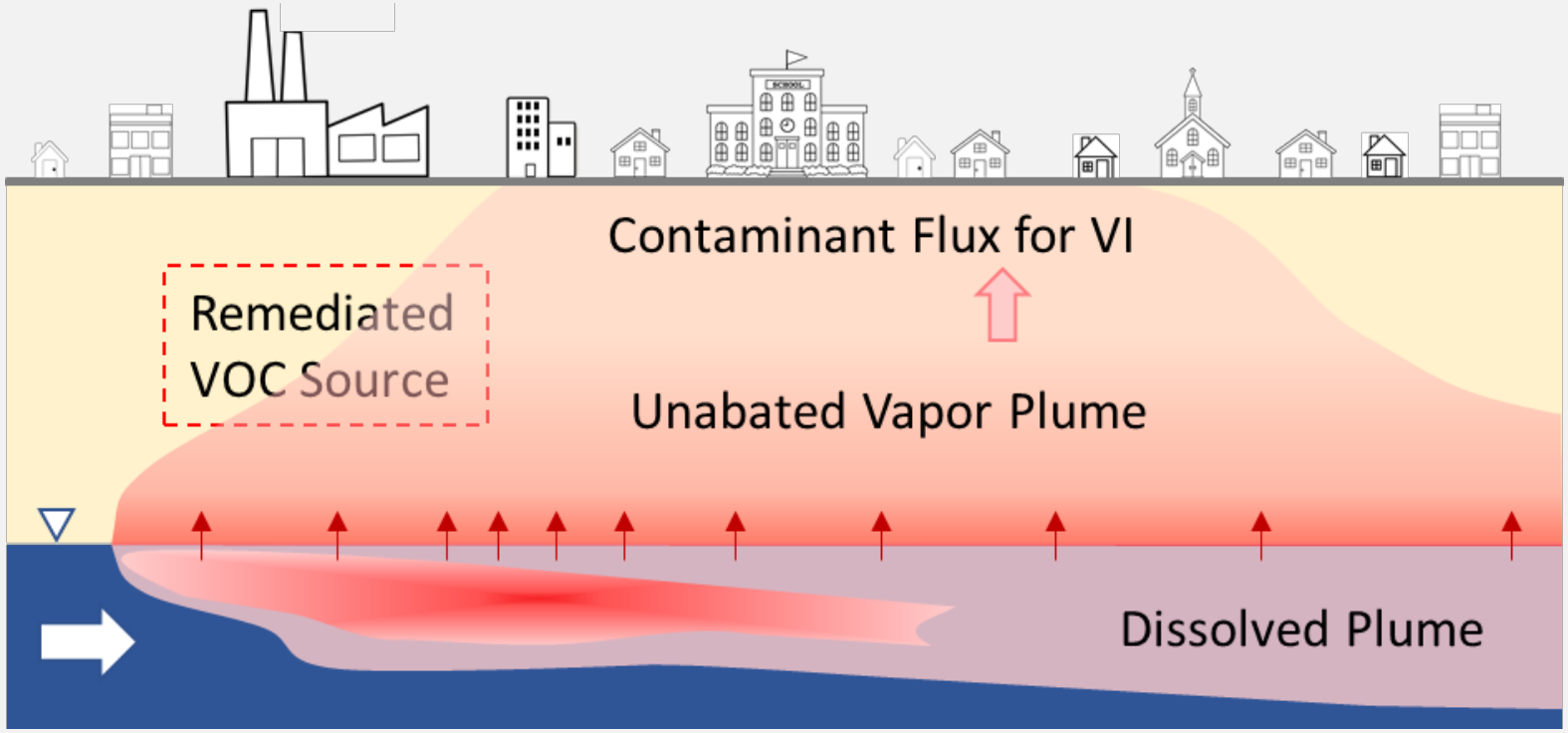
- AEHS East Presentation slides available

"***Analytical Solutions for Steady-State Gas Flow in Layered Soils with Field Applications***", Groundwater Monitoring & Remediation, January 2022, https://doi.org/10.1111/gwmr.12496

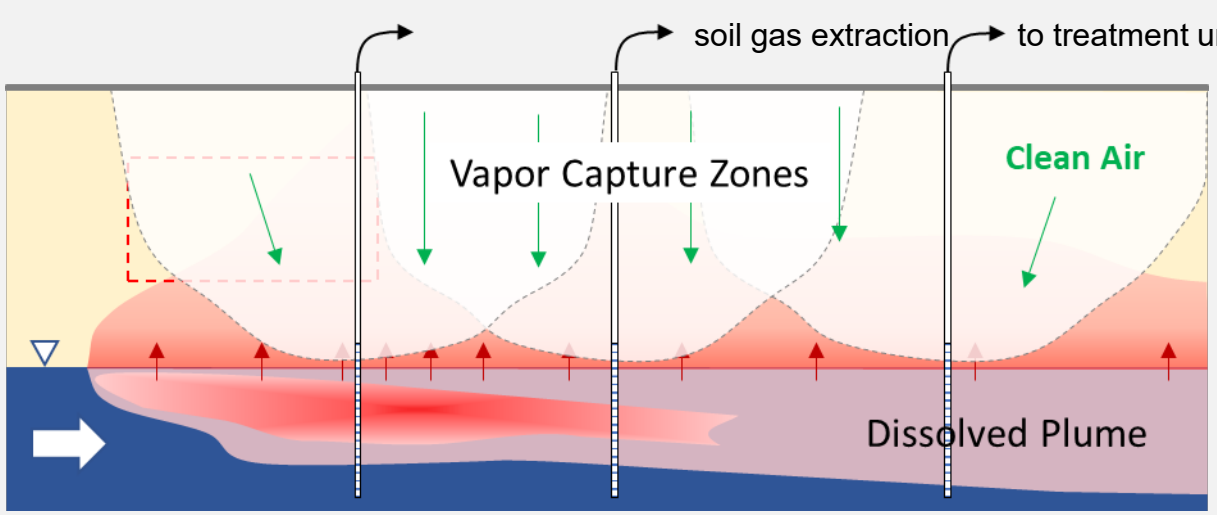
"***Development and Testing of New Design and Operational Concepts for VI Mitigation with SVE***", Manuscript in Preparation

Design and Operational Concepts for VI Mitigation with SVE

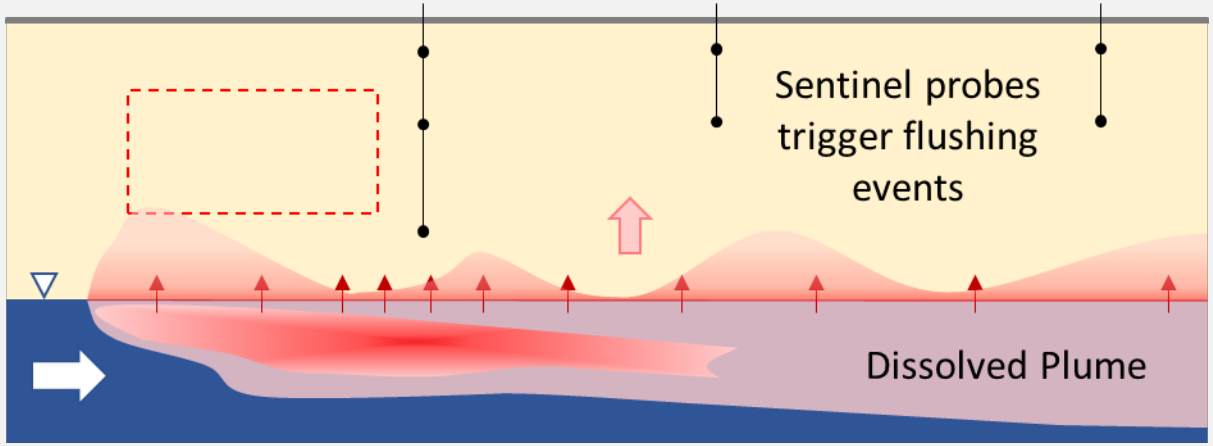
Contaminated groundwater produces persistent mass flux for VI



Design and Operational Concepts for VI Mitigation with SVE



Flushing several soil gas pore volumes suppresses the vapor plume, TEMPORARILY



Periodic monitoring of sentinel probes until a threshold concentration is detected; triggers flushing event

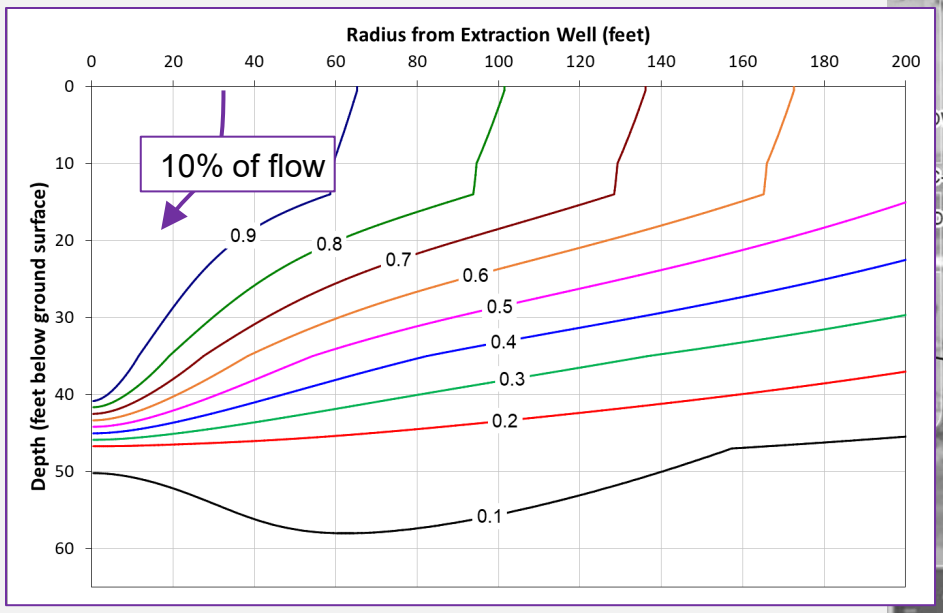
Design and Operational Concepts for VI Mitigation with SVE

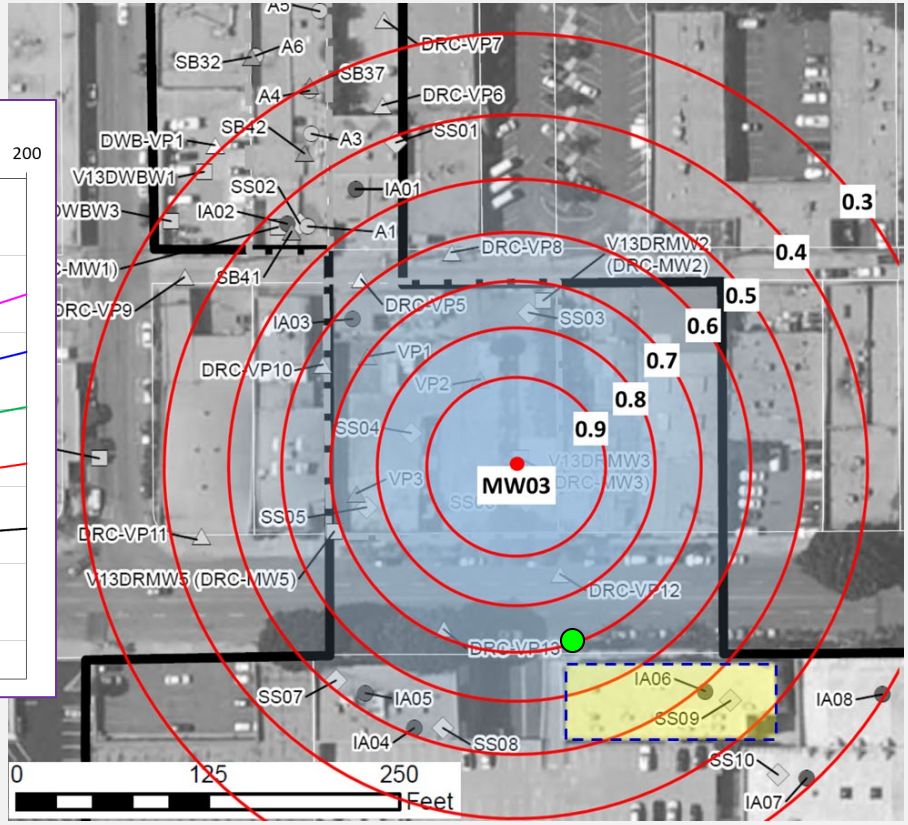
[SVE Sweep Rate] > [Vertical Mass Transport Rate] = [No opportunity for VI]

Design Issues:

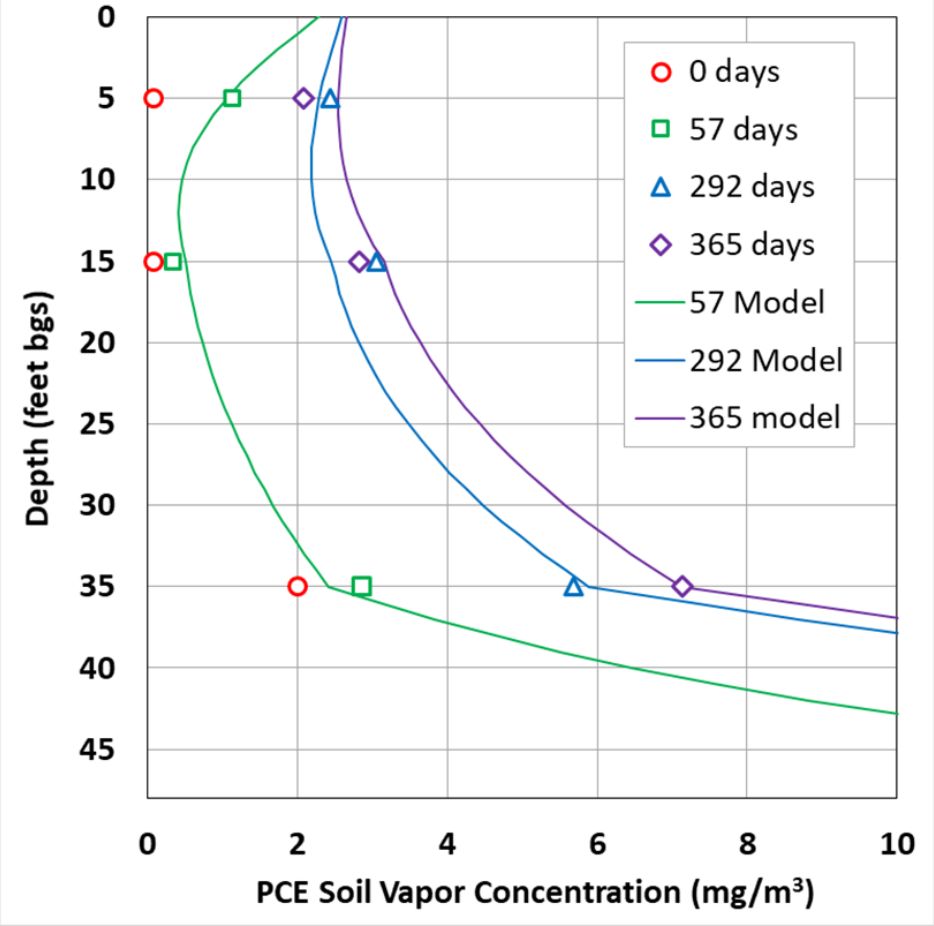
- How far does SVE reach laterally?
- What flow rate and duration provide adequate flush?
- What are appropriate “trigger” depths and concentrations?
- How frequently does the zone require flushing?

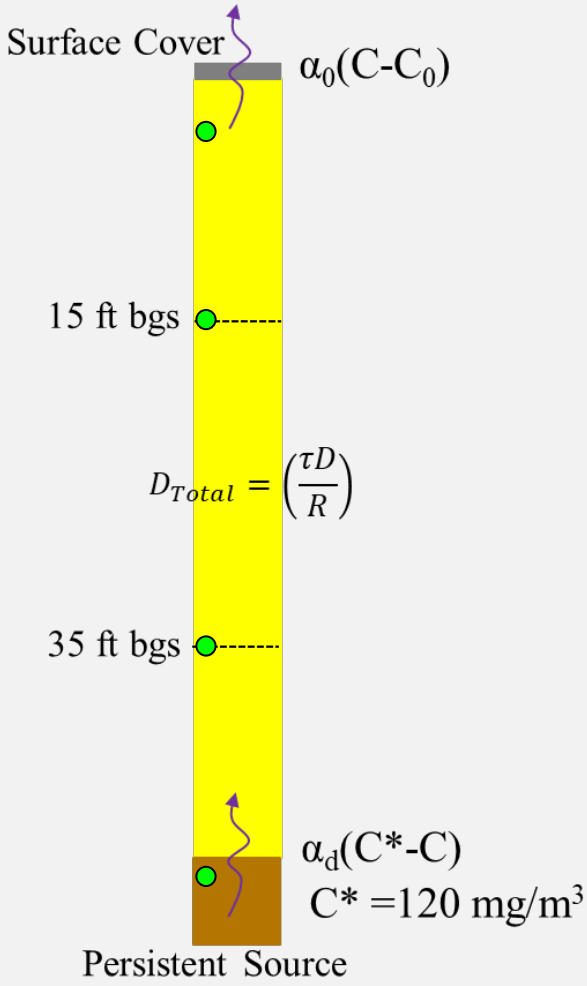
Design and Operational Concepts for VI Mitigation with SVE



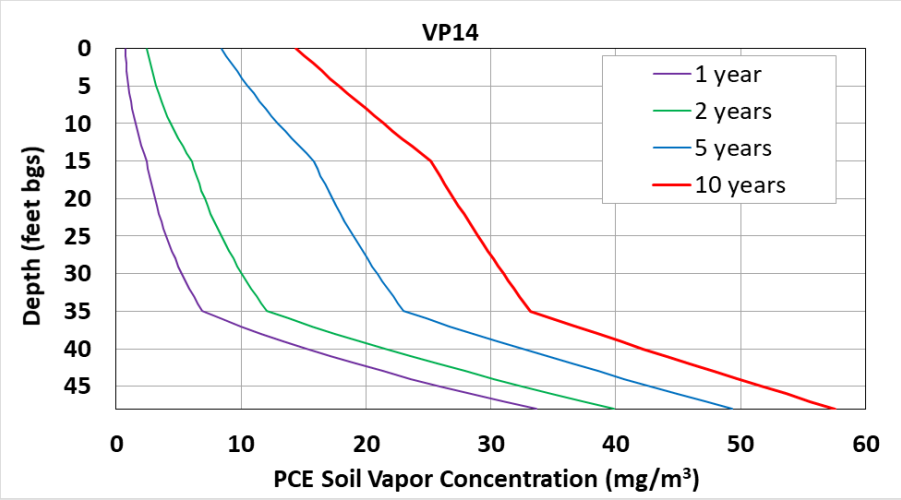


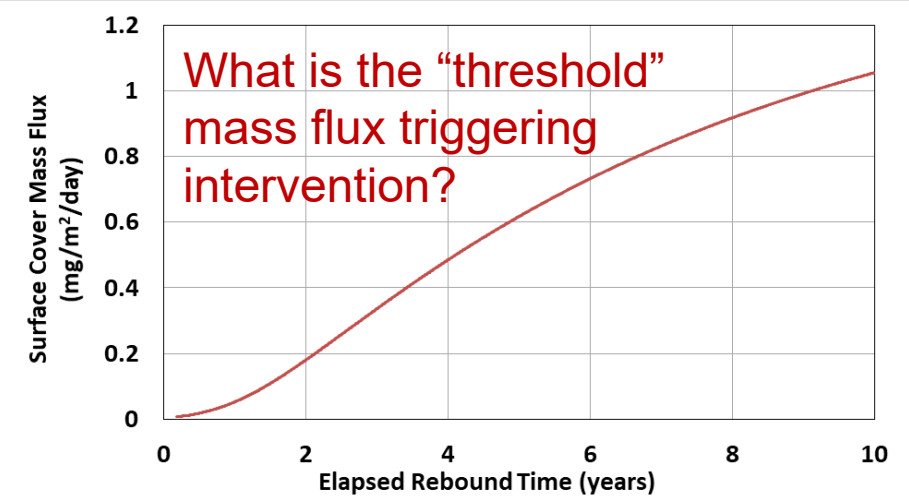
Design and Operational Concepts for VI Mitigation with SVE

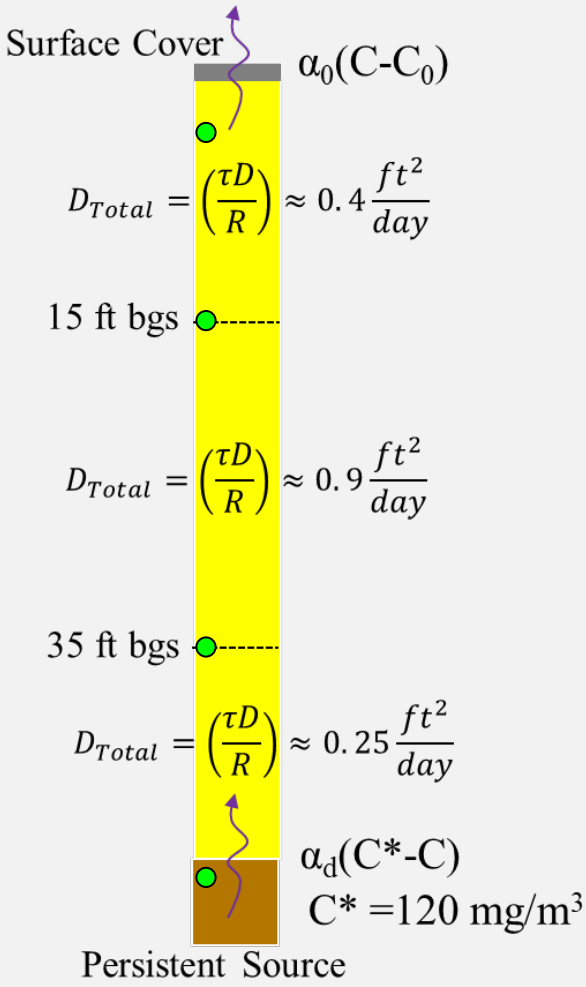




Design and Operational Concepts for VI Mitigation with SVE







More Information

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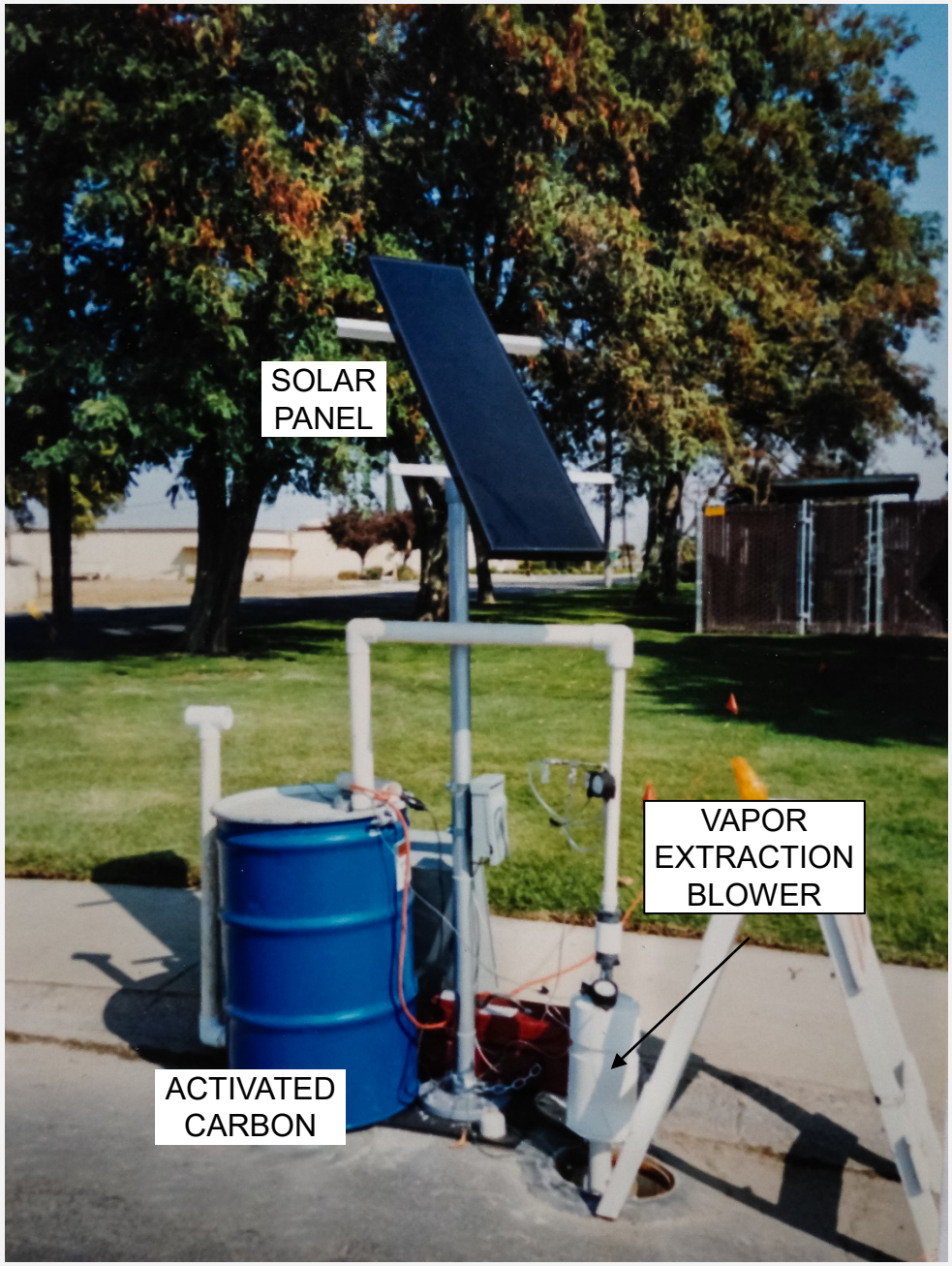
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