PVI Conceptual Model

"If I had more time I would write a shorter letter": Mark Twain

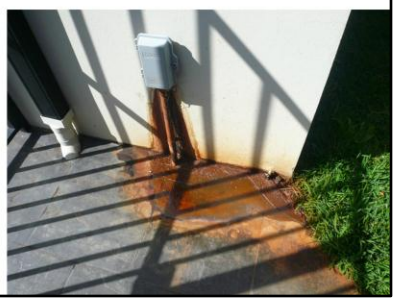
Keep it Simple

Model Validated: Lab, Field, Data Bases

Practical Application

PVI Problem Sites Understandable

Clear Distinction: PVI vs CVI Sites



PVI vs CVI Conceptual Models

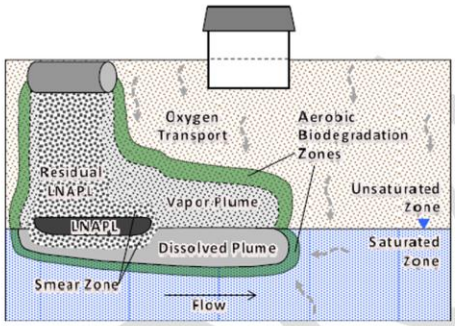


Figure 1. Typical petroleum hydrocarbon transport scenario

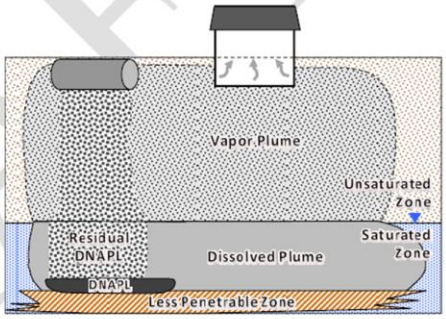
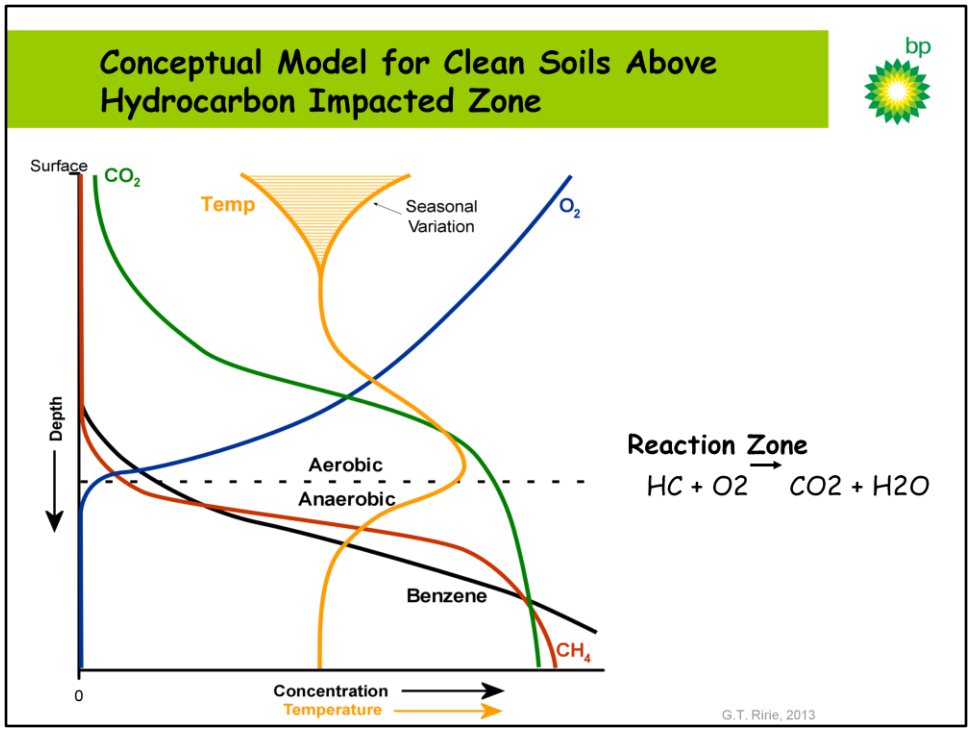


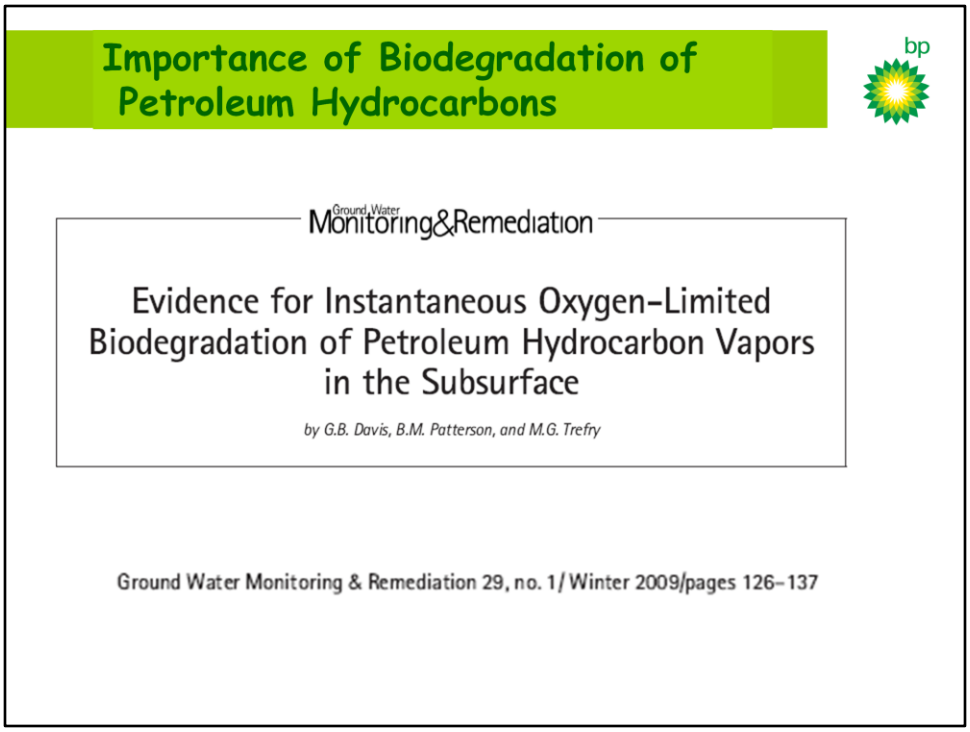
Figure 2. Typical chlorinated solvent transport scenario

From EPA OUST Document



Conceptual model for clean soils shows that above the hydrocarbon reaction zone there is no more hydrocarbon vapor migration if there is oxygen present. The key to identifying if sites are clean or dirty is to determine if there is sufficient oxygen present in the vadose zone over an interval of several feet.

Importance of Biodegradation of Petroleum Hydrocarbons



Recent publication covering effect of oxygen on biodegradation of petroleum hydrocarbons based on field work in Australia.

Oxygen versus Petroleum Hydrocarbon Plots

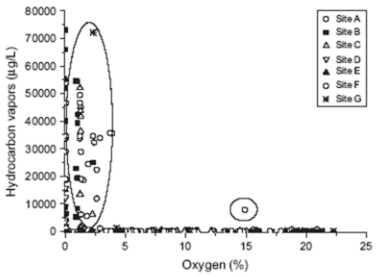


Figure 2. Total petroleum hydrocarbon vapor concentrations compared to oxygen concentrations for Sites A-G. Circled are data from sites where at the same sampling port both oxygen and hydrocarbon vapors were above detection levels.

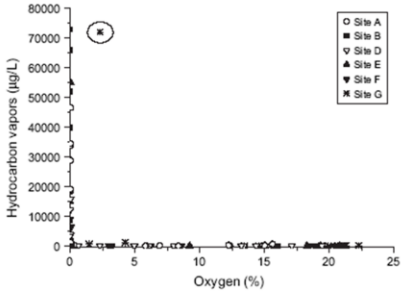


Figure 4. Total petroleum hydrocarbon vapor concentrations compared to oxygen concentrations; data from in situ oxygen and VOC probes for all available sites.

Manual collected O2 data: Leakage of O2 into syringe

In situ O2 data

From Davis et al., 2009

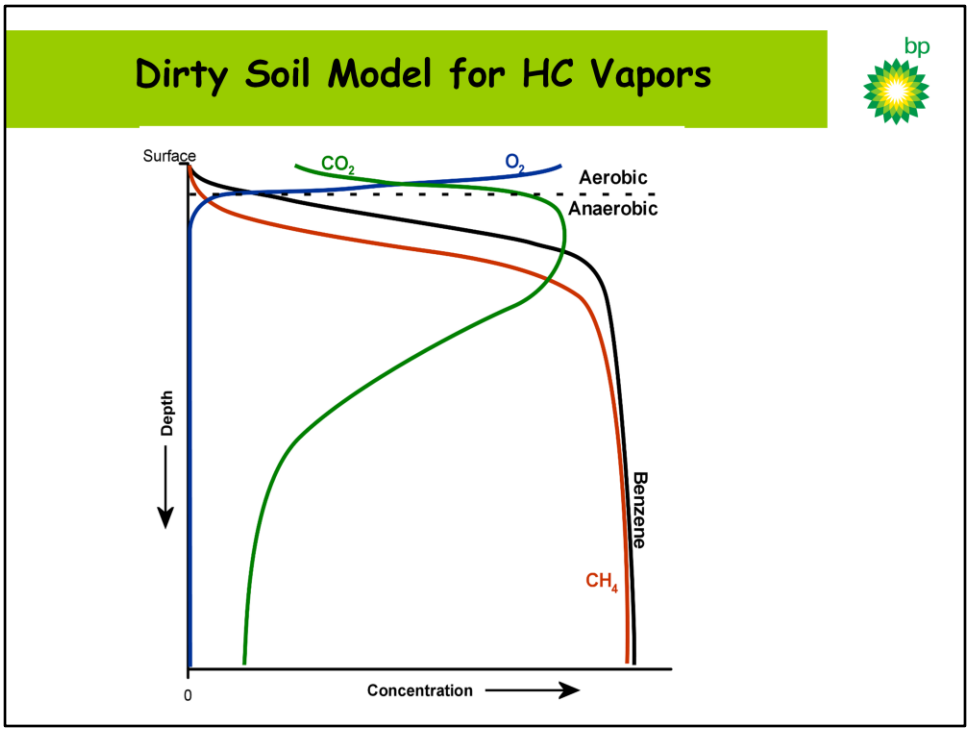
Notice that the when oxygen is present most of the petroleum hydrocarbon vapors are limited; however there were some outliers in the syringe data. However, once dedicated sample probes were installed (in situ data) the outliers disappeared. This is attributed to some leakage of oxygen into the samples collected in the field into syringes. Take away message is that once oxygen is present in measurable amounts the hydrocarbon vapors are no longer present.

Is There Enough Oxygen?

- Aerobic Biodegradation
  - Hydrocarbon to Oxygen use ratio: 1 : 3 (kg/kg)
  - Atmospheric air (21% Oxygen; 275 g/m3 oxygen) provides the capacity to degrade 92 g/m3 hydrocarbon vapors (92,000,000 ug/m3)

George DeVaull
george.devaull@shell.com

- Oxygen below a Foundation: can it get there?
  - Through the foundation
    - Cracks; concrete does have permeability to air
  - Around the foundation edges (bonus)
    - Oxygen has been found in sufficiently high quantities under most buildings
    - Large buildings or buildings built over dirty soils can be areas of low oxygen concentration



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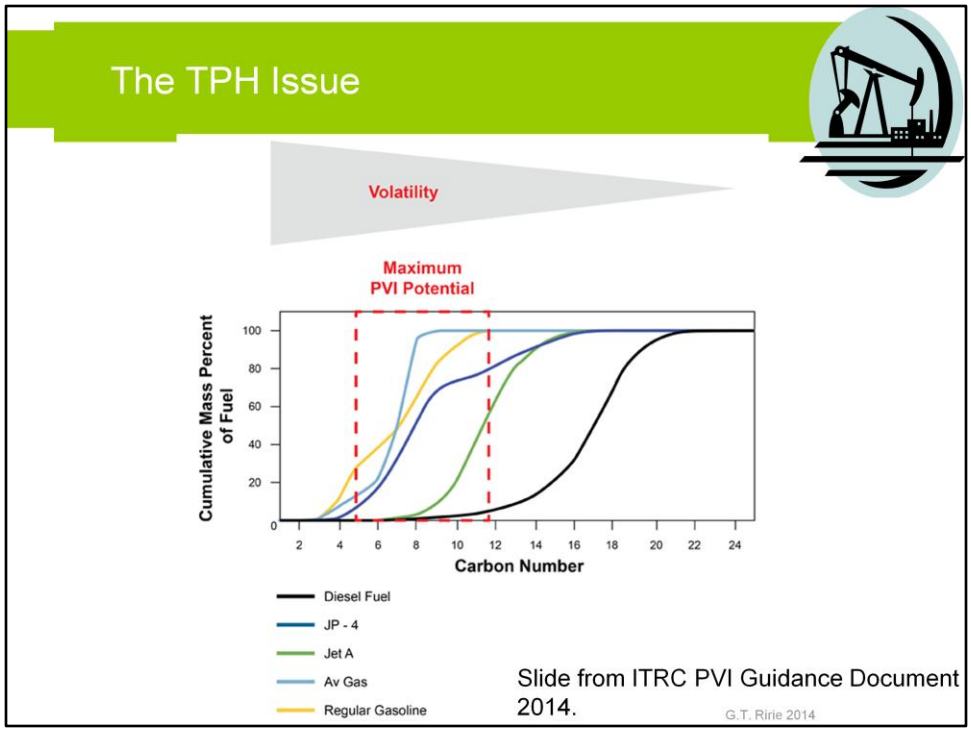

The TPH issue is a good example of one of the “hot topics” that generated much discussion before being addressed nicely with this new figure showing the relationship between carbon number, volatility, and potential for PVI. Note that diesel posed little risk as a PVI issue while gasoline has a much higher risk. The EPA data base included sites with diesel and there was little to no evidence for any PVI risk issues within the data evaluated. Here is the ITRC disclaimer:This material was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof and no official endorsement should be inferred.

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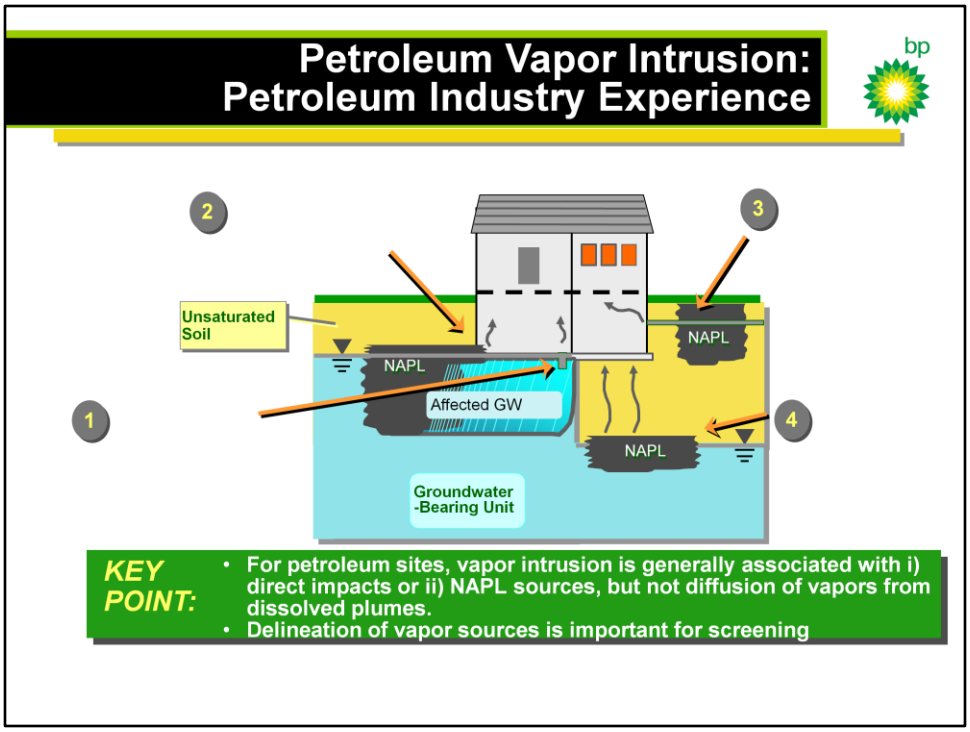

Based on industry experience, petroleum vapor intrusion impacts are generally associated with:

1) Direct NAPL impacts on a building foundation
2) NAPL or dissolved hydrocarbon impact on building sump
3) NAPL impact on preferential flow pathway or
4) Diffusion of vapors from subsurface NAPL source

Key Points:

Current USEPA VI guidance provides GW screening concentrations for benzene and other petroleum hydrocarbons in the low ug/L range (i.e., 5 ug/L for benzene). These low screening concentrations are not consistent with industry experience that vapor intrusion impacts are not associated with low concentrations of petroleum hydrocarbons dissolved in groundwater.

We believe that the science available today is sufficient to support the development of separate attenuation factors and screening criteria for petroleum and chlorinated VOCs