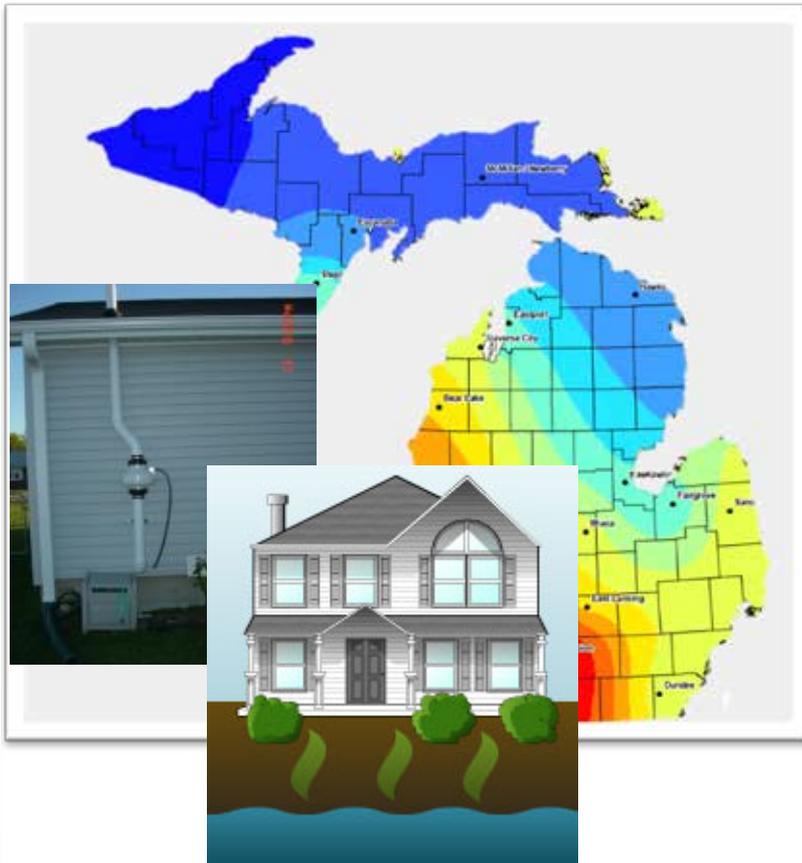


Mitigation and Vapor Intrusion

Differences between VI, PVI, and Radon when considering Mitigation Strategies



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Vapor Intrusion (VI) Conceptual Site Model

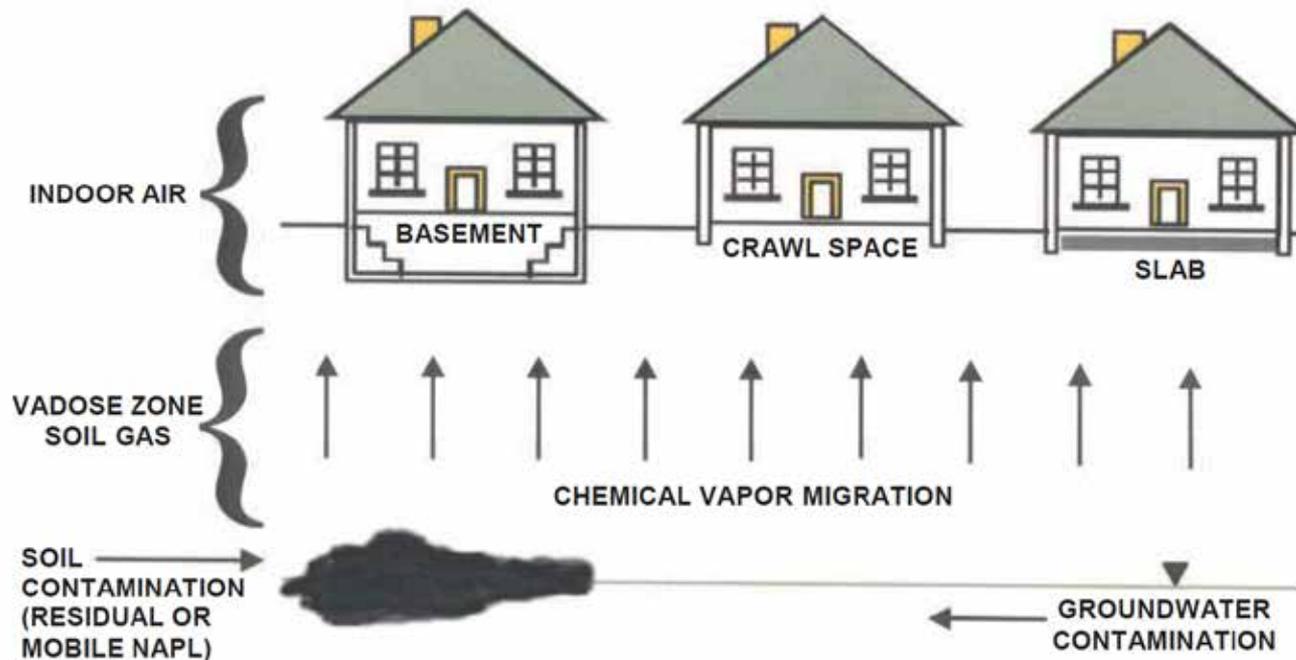


Figure 1-1. Generalized diagram of vapor intrusion in a residential setting from a groundwater source (based on Johnson 2002).

Types of Vapor Intrusion

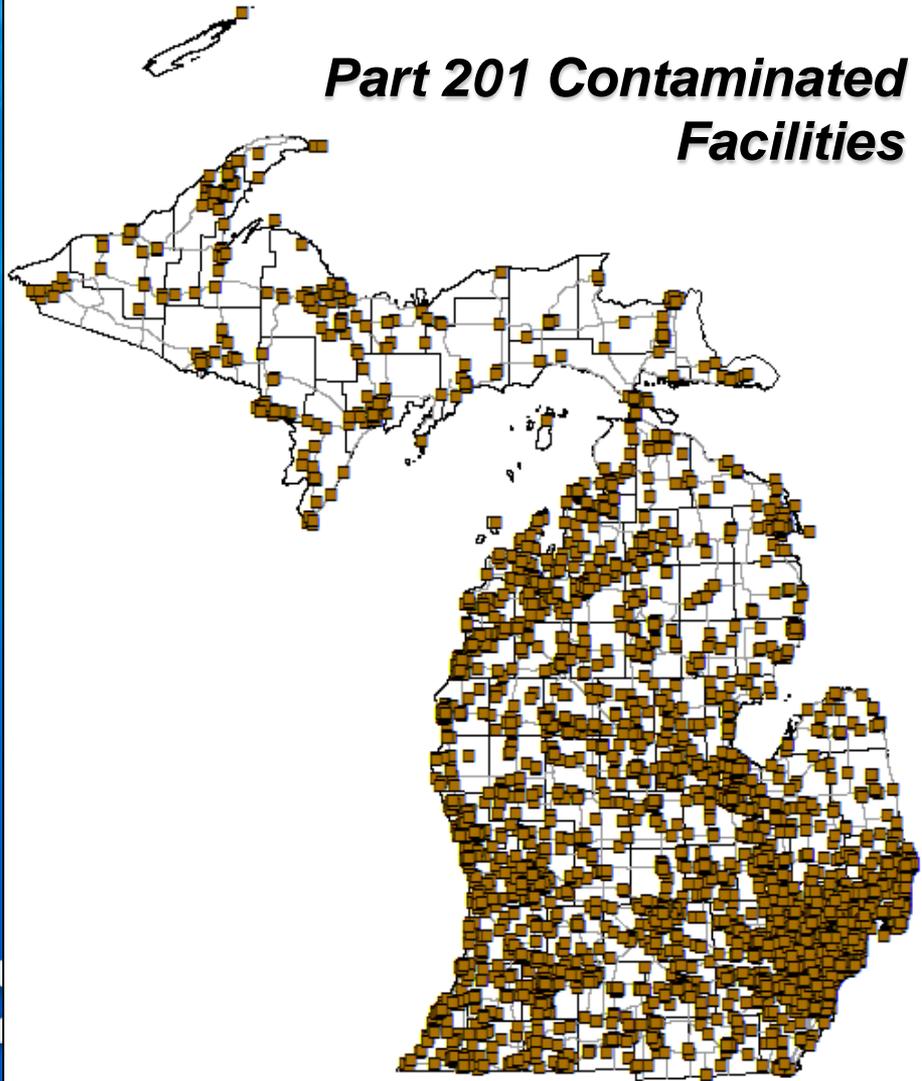
- Vapor intrusion (VI)
 - Broad term, all encompassing
- Chlorinated vapor intrusion (CVI)
 - Subset of chlorinated hazardous substances like PCE and TCE
- Petroleum vapor intrusion (PVI)
 - Subset of petroleum-contaminated soil, groundwater, and light nonaqueous phase liquid (LNAPL)
- Methane(?)

What's the appropriate indoor air standard?

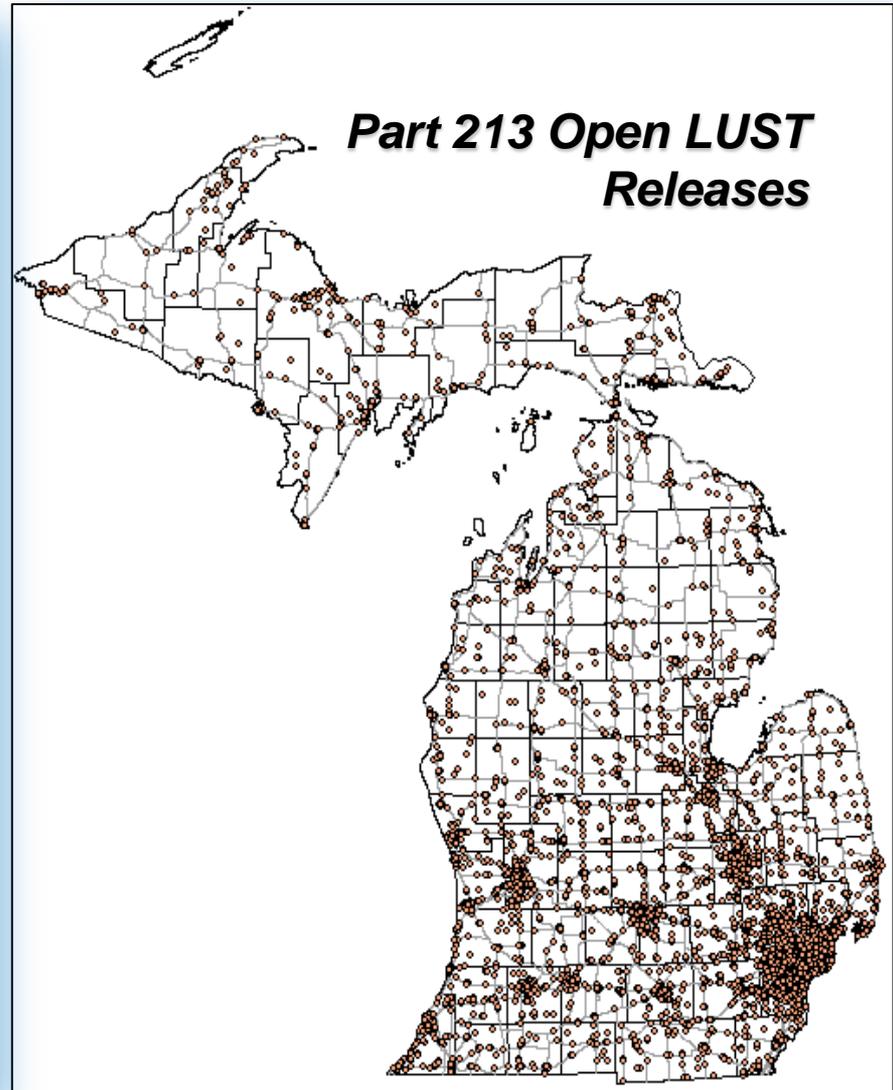
- OSHA PELs
 - Not updated, old standards
 - EPA doesn't use for vapor intrusion
- Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs)
- Part 201 Acceptable Air Values
- Other(s)

What is the magnitude of the problem?

Part 201 Contaminated Facilities



Part 213 Open LUST Releases



Similarities to Radon

Simplified

- Can cause an unacceptable risk to human health
 - Radon – carcinogenic risk
 - VI – carcinogenic risks and more
- Sub-slab depressurization (SSD) systems is an accepted mitigation strategy
 - Also called active soil depressurization
 - Widely recommended
- Others/more . . .

Differences to Radon

- Main challenge – It is NOT radon
 - System components are basically the same, but volatile organic compounds (VOCs) present a specific set of circumstances that need to be understood
- Not naturally occurring
 - Someone is liable
 - Property owner may have a legal obligations to address the risk
 - More...

Differences to Radon (*cont*)

- Explosive conditions are possible
 - Methane
 - High levels of petroleum compounds
 - Other?
- May pose an unacceptable ***acute*** health risk at low levels
 - Requires a far greater efficiency
- May require permits/pretreatment for discharge

Differences to Radon (*cont*)

- Testing is expensive
 - TO-15 runs between \$200 - \$450 each
 - Requires monitoring during sampling
 - Experience counts
 - Short vs long sampling duration questions
- Indoor air sampling requires experience and knowledge
 - Multiple sampling methods
 - Toxic endpoints

Design Considerations

Background Air Concentrations

- 2011 EPA Report
 - Measured background in thousands of residences between 1990 and 2005
 - Assumed to NOT be associated with VI
 - The VOCs most commonly detected in indoor air due to background sources *included petroleum compounds*
- May be influenced by more than VI



Indoor Air

Background Air Concentrations



PCE > 95% by weight

Can also include:

- TCE
- Toluene
- Acetone
- More. . .



- PCE



Can include:

- TCE
- Toluene
- Acetone
- More. . .

Indoor Air

“Hidden” Sources



Contains:

- Naphthalene (31 mg/m³)
- 1,4 Dioxane (2,100 mg/m³)
- Toluene (120 mg/m³)
- Ethanol (600,000 mg/m³)
- And a bunch of others . . .



Contains:

- 1,2 DCA



Contains:

- Ethylbenzene (3,400 mg/m³)
- Toluene (660 mg/m³)
- TPH (390,000 mg/m³)
- And more . . .



Contains:

- Acetone
- MEK

Design Considerations

Biodegradation

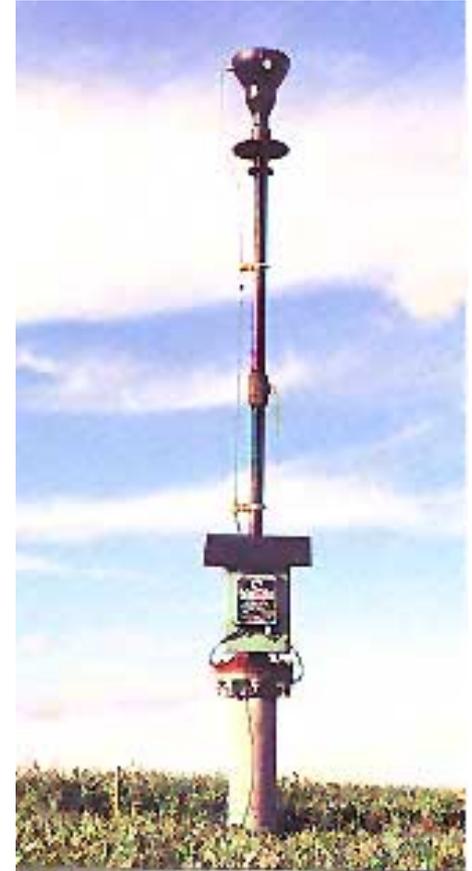
- PVI sites will eventually reduce the concentrations of volatile petroleum compounds in soil or groundwater to values that are protective of human health.



Design Considerations

Risk of Explosion

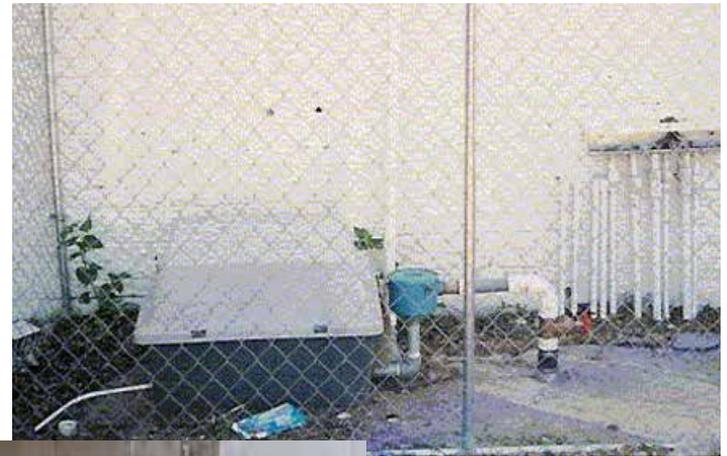
- Does it require intrinsically-safe equipment?
- Methane
 - Landfills, dumps, etc.
 - Byproduct of biodegradation
- Explosive levels of hazardous chemicals



Design Considerations

Air Discharge

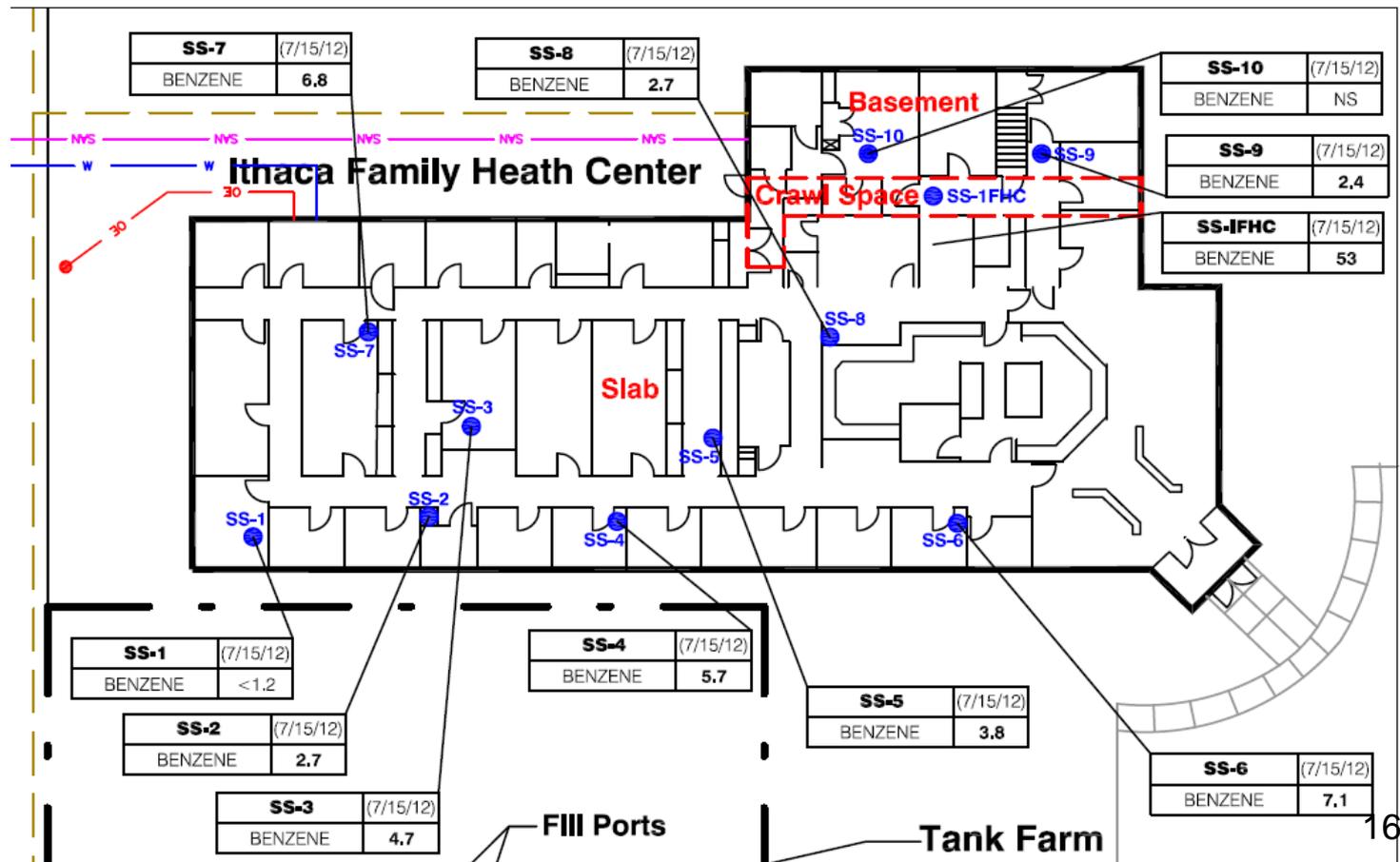
- Permit to install required?
 - *May not be exempt*
- Pretreatment required?



Design Considerations

Extent of Contamination

- Entire structure or only part?



Design Considerations

Areal Extent of Contamination



Design Considerations

Products Used in the Design

- Off-gassing of products may impact indoor air measurements
 - What's in your glues, cement, foams, sealants and more?



Design Considerations

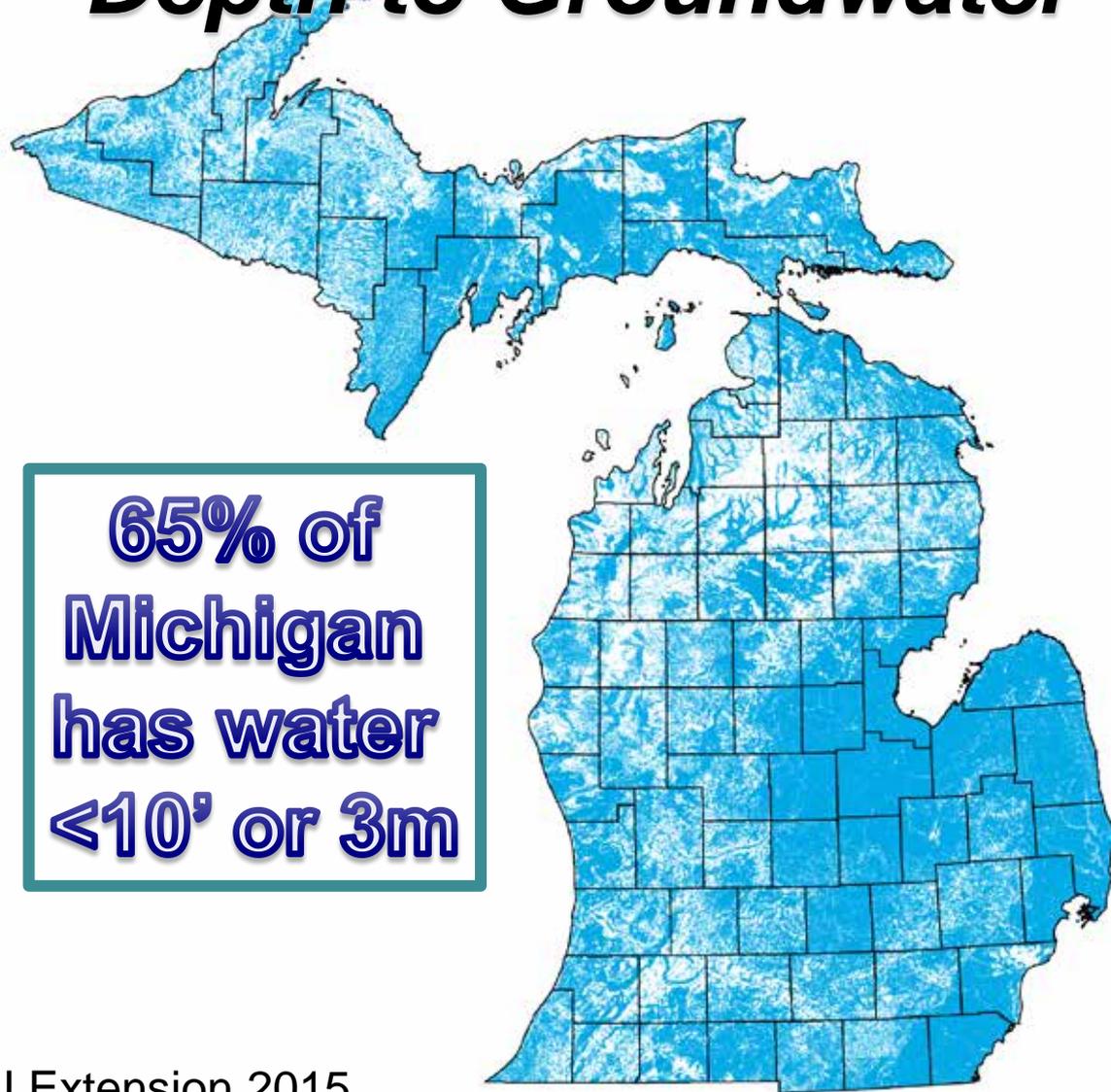
Short Term Risks

- ATSDR
- Short term exposures have the potential to impact:
 - PCE – color vision
 - TCE – immune system and fetal heart development
- May require continued operation



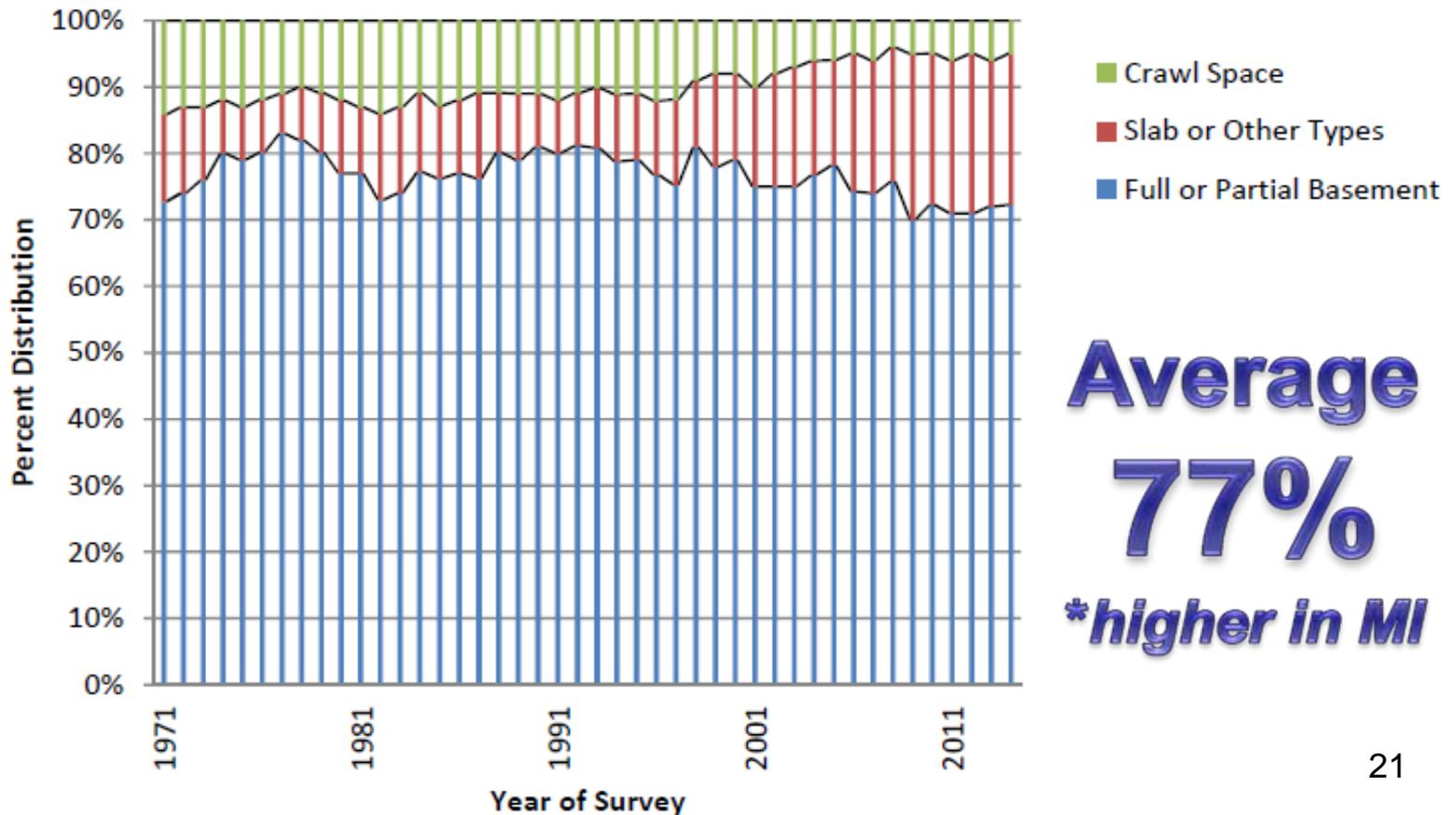
Design Considerations

Depth to Groundwater



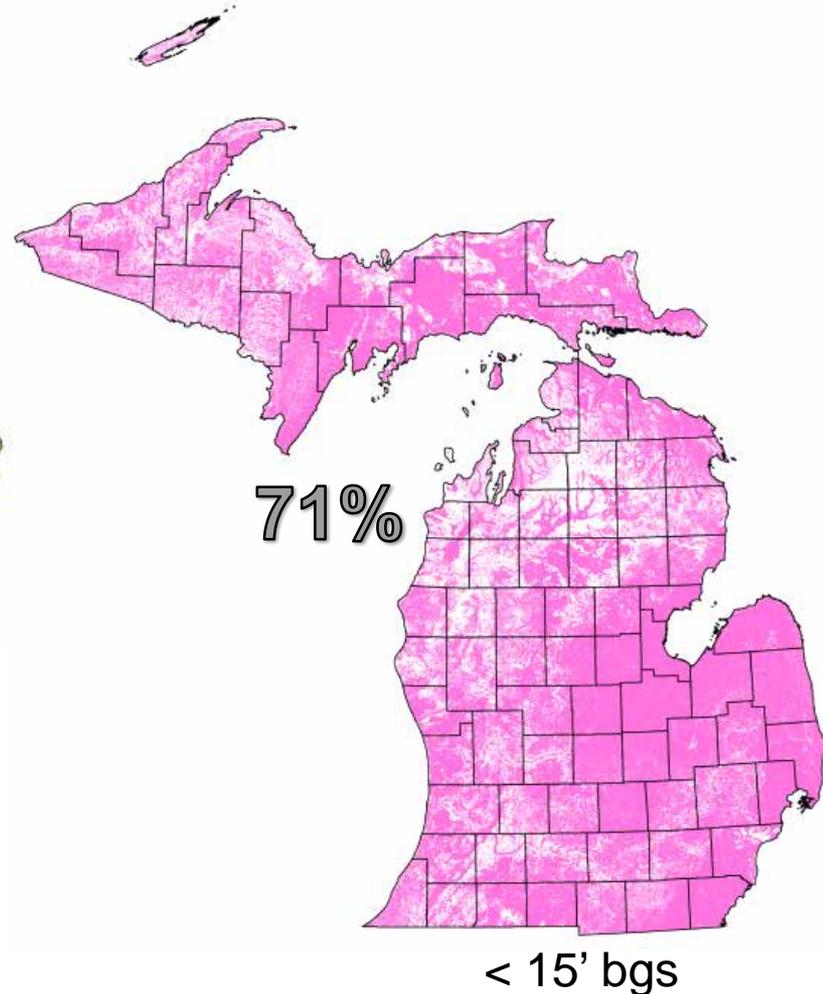
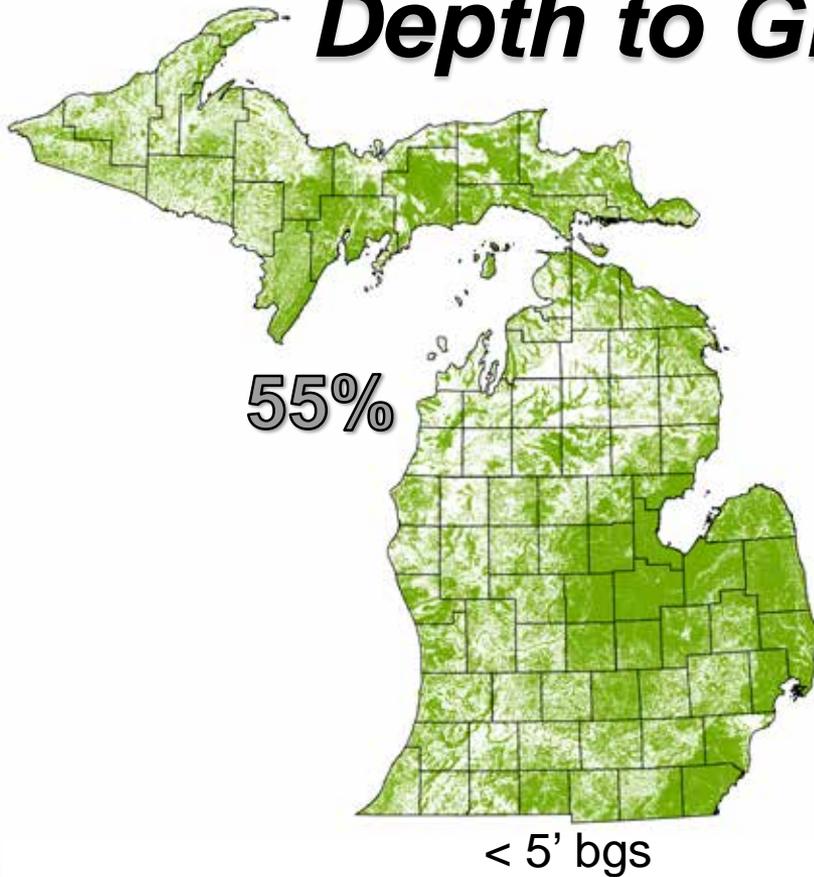
Foundations in the Midwest

Type of Foundations Single Family – Midwest



Design Considerations

Depth to Groundwater



*MSU Extension 2015

Design Considerations

Operation and Maintenance

- How long can the system be down?
- How will demonstrate compliance?
 - Indoor air
 - Pressure gradients
 - Energy usage
 - Others?
- How easy is it to access?
- Signage requirements?

Design Considerations

System Decommissioning

- Is there the potential to decommission the system in the near future?
 - Is there clean-up occurring?
 - PVI or CVI?

Mitigation Strategies

Others *Commonly Implemented*

- SSD/SMD
- Passive systems with chemical resistant liners
- Remediation technology – SVE



- Aerated floors
- Other(s)

Mitigation Strategies

Hard to Implement

- Passive system
 - Requires significant data and lots of monitoring
- Positive pressure building
 - High energy requirements, not long term reliable
- Sealing cracks
 - Doesn't prevent diffusion thru concrete
- Indoor air cleaners
- Others

RMS-SF ANS/AARST 201X

- Available at:

http://aarst-nrpp.com/wp/wp-content/uploads/2016/07/SGM-SF_PubReview_07-2016.pdf



Questions?

