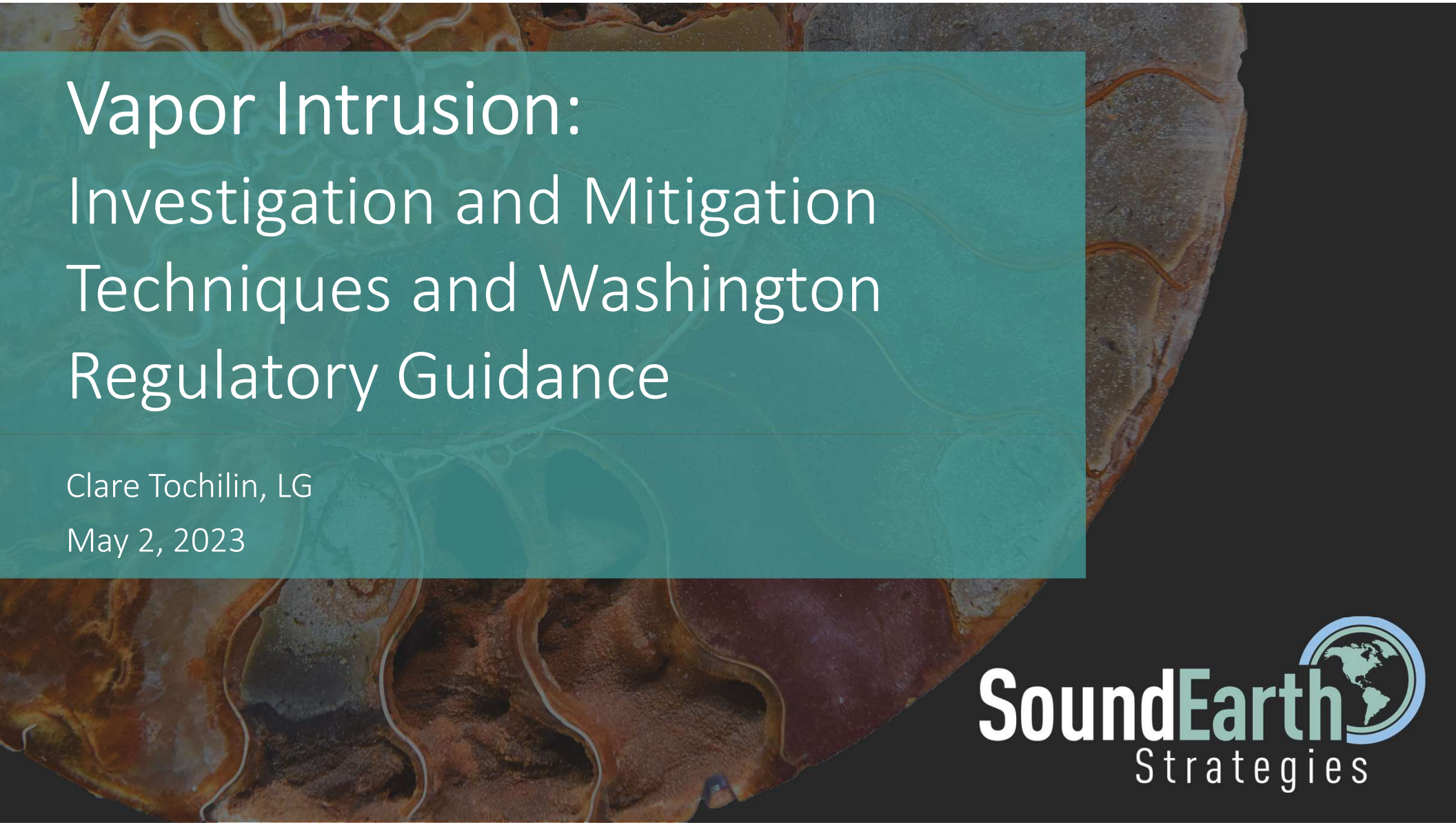

Vapor Intrusion:
Investigation and Mitigation Techniques and Washington Regulatory Guidance

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May 2, 2023

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Presentation Outline

- Overview of Current Ecology Vapor Intrusion Guidance
- Vapor Intrusion Assessment Approach
- MTCA Screening and Cleanup Levels for Vapor Intrusion
- Vapor Intrusion Sampling Methods, Considerations, and Project Examples
- Vapor Intrusion Mitigation Methods and Project Examples

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Current Ecology Vapor Intrusion Guidance

- Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action (Finalized March 2022)
  - Incorporates 5 previous guidance documents:
    - Ecology's 2009 Draft VI Guidance
    - Implementation Memo 14 – Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion
    - Implementation Memo 18 – Petroleum Vapor Intrusion (PVI): Updated Screening Levels, Cleanup Levels, and Assessing PVI Threats to Future Buildings
    - Implementation Memo 21 – Frequently Asked Questions (FAQs) Regarding Vapor Intrusion (VI) and Ecology's 2009 Draft VI Guidance
    - Implementation Memo 22 – Vapor Intrusion (VI) Investigations and Short-Term Trichloroethene (TCE) Toxicity
- Vapor Intrusion Screening Levels for Workers (July 2022)

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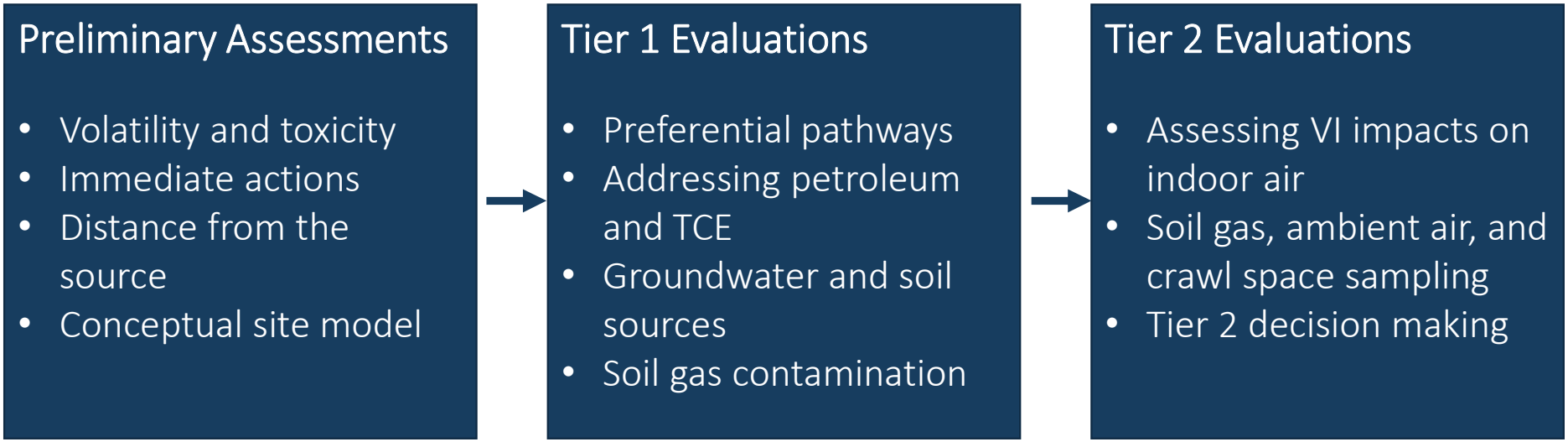
Tiered Vapor Intrusion Assessment Approach



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Vapor Intrusion Screening and Cleanup Levels

- Cleanup levels established for indoor air
- Screening levels protective of indoor air are established for groundwater and soil gas
- Appropriate cleanup and screening levels should be selected based on land use scenario:
  - Method B – unrestricted (residential)
  - Method C - industrial

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Soil Gas and Groundwater Screening Levels

- Soil gas and groundwater screening levels determined based on default attenuation factors:

Media	Screening Level Attenuation Factor
Groundwater	0.001
Soil Gas	0.03

- Deep soil gas screening levels have been eliminated
- Updated TPH Cleanup and Screening Levels

Indoor Air Cleanup Level ($\mu g/m^3$)	Soil Gas Screening Level ($\mu g/m^3$)
46	1,500

- Attenuation factors may be overly conservative for petroleum hydrocarbon sites due to enhanced attenuation from aerobic biodegradation
- Site-specific TPH cleanup and screening levels may also be established

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Soil Screening Levels

- For sites with only petroleum hydrocarbon contamination, Ecology guidance allows for the use of soil screening levels

Media	Benzene	TPH	Vertical Separation Distance (feet)*
Soil (mg/Kg)	≤10	≤ 100 (unweathered gasoline), or ≤ 250 (weathered gasoline, diesel)	6
Soil (mg/Kg)	>10 (LNAPL)	> 100 (unweathered gasoline) >250 (weathered gasoline, diesel)	15
Groundwater (mg/L)	≤5	≤30	6
Groundwater (mg/L)	>5 (LNAPL)	>30 (LNAPL)	15

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Vapor Intrusion Screening Levels for Workers

- Ecology provided default VI risk-based indoor air levels and soil/groundwater screening levels that are protective of indoor air for adult workers in July 2022

- May be used at sites where indoor adult workers are the primary potential receptors

- VI may be a concern if land use changes in the future

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TCE Short-Term Action and Screening Levels

- Ecology provides short-term indoor air action levels protective of short-term exposures to TCE, as well as groundwater and soil gas screening levels that are protective of the short-term indoor air TCE action levels
- Applicable for three-week average concentrations for women of childbearing age

TCE Short-Term Action or Screening Level	Concentration
Indoor Air Action Level – Unrestricted	2.0 µg/m^3
Indoor Air Action Level – Commercial or Industrial	7.5 µg/m^3
Groundwater Screening Level – Unrestricted	8 µg/L
Groundwater Screening Level – Commercial or Industrial	31 µg/L
Soil Gas Screening Level – Unrestricted	67 µg/m^3
Soil Gas Screening Level – Commercial or Industrial	250 µg/m^3

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Vapor Intrusion Sampling and Analysis

- SUMMA Canisters
- Sorbent Tubes
- Tedlar Bags
- Passive Samplers

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Soil Gas Sampling

- Sampling of soil gas from beyond the footprint of the building of concern or where there are no buildings
- Should be collected laterally close to the building of concern
- May be collected at different depths, ideally greater than 5 feet below ground surface
- Tracer should be used to verify that atmospheric air has not been drawn into the sample point

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Sub-Slab Soil Gas Sampling

- Sampling of soil gas immediately below a building's basement floor or floor slab
- Should not be collected in the immediate vicinity of sub-slab utilities, drains, or floor cracks
- Ideally collected while building is depressurized relative to the subsurface
- Tracer should be used to verify that ambient air within the building has not been drawn into the sample point

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Indoor Air Sampling

- Conducted when a Tier I screening fails to lead to a vapor intrusion assessment off-ramp for an existing building
- A pre-sampling site survey should be conducted to evaluate potential background sources of VOCs within the building, and any identified sources should be removed
- Outdoor ambient air samples collected simultaneously to account for ambient air conditions
- Analyte list should include those VOCs detected in the subsurface in the vicinity of the building
- Sampling may need to be conducted more than once to improve confidence that VOC levels are consistently acceptable

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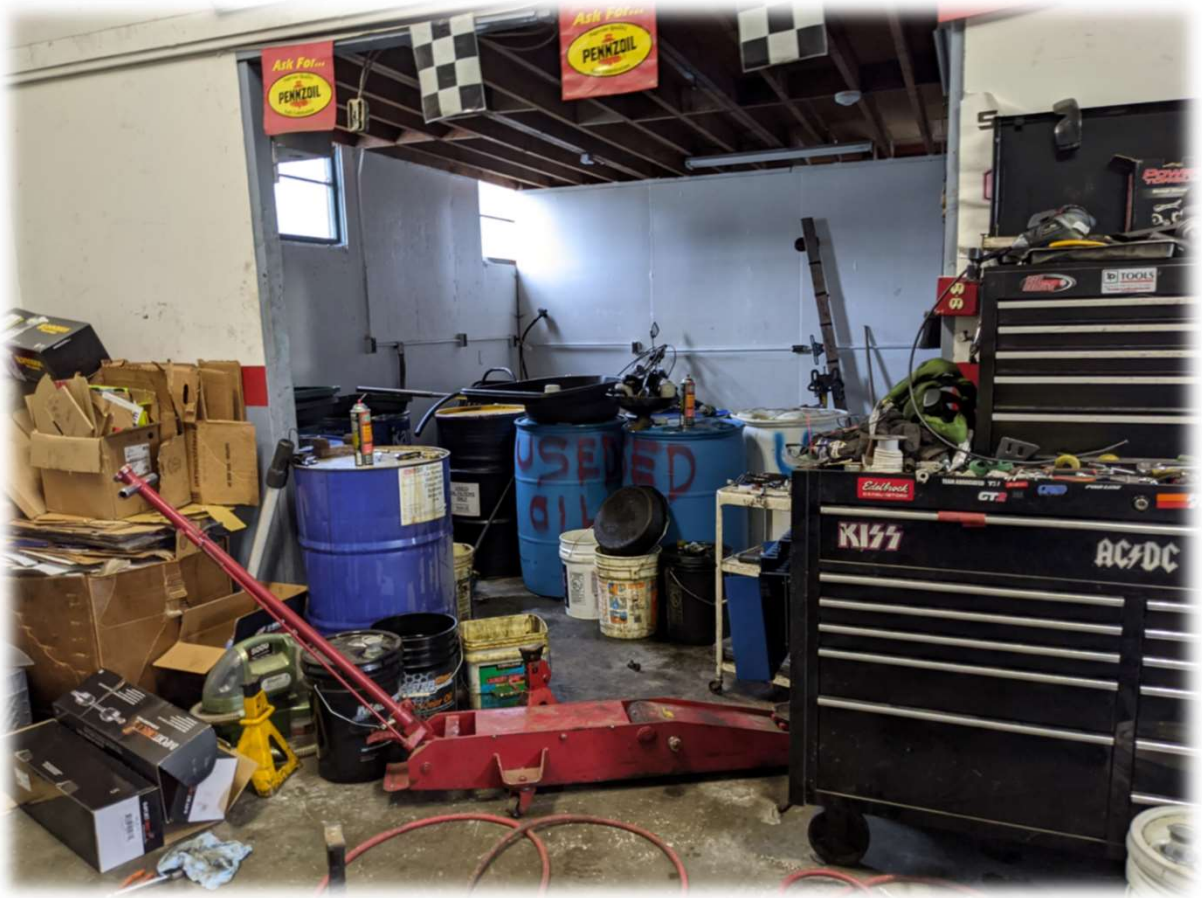
Indoor Air Sampling Considerations

- Use or storage of materials containing COCs within the building



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Indoor Air Sampling Considerations

- Use of materials within the building that can interfere with APH analytical results

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Indoor Air Sampling Considerations

- Building materials known to contain VOCs

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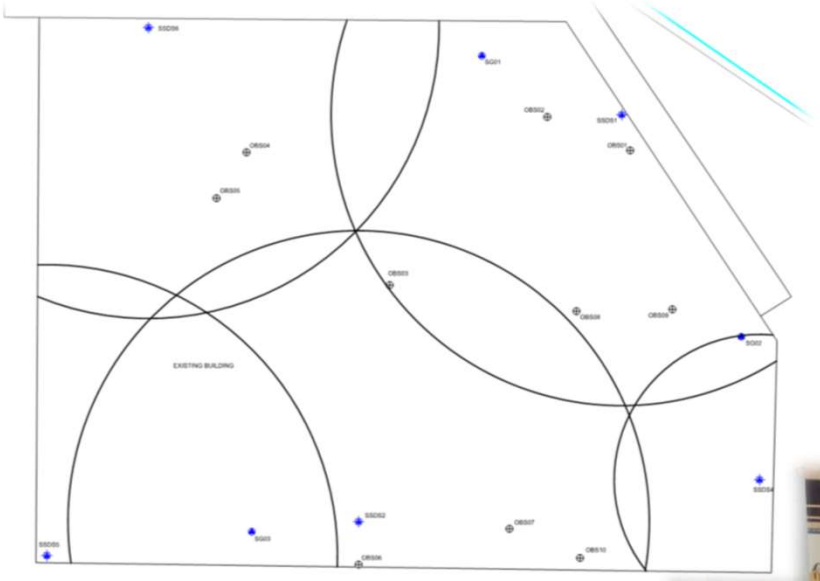
Vapor Intrusion Mitigation

- Sub-Slab Depressurization System
  - Applies a negative pressure beneath the building slab
  - Can be installed beneath existing building or during new building construction
- HVAC installation or modification to apply positive pressure or to improve ventilation by increasing air exchange rate



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Vapor Intrusion Mitigation

- Physical Barriers
  - Installation of a vapor barrier during new building construction
  - Application of epoxy floor coating within existing building

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Takeaways

- Stay informed on updates to state and federal vapor intrusion guidance
- Evaluate potential interior and exterior sources of contaminants while conducting vapor intrusion assessments to ensure that data is representative of conditions associated with vapor intrusion
- Design and implement vapor intrusion assessments and mitigative actions with site-specific conditions, current/future land use scenarios, and regulatory requirements in mind

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