VaporSafe™ Continuous Air Monitoring for a Sustainable Solution to the Vapor Intrusion Pathway at a Non-Residential Facility

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PRODUCE [PURPOSE] PIONEER

Overview

- Site Background/Site Conceptual Model
- Vapor Intrusion Investigation Objectives
- VaporSafe™ Technology
- Sampling Strategy – Round 1
- Round 1 Results
- Sampling Strategy – Round 2
- Round 2 Results
- Next Steps
- Cost Savings/Business Value Added

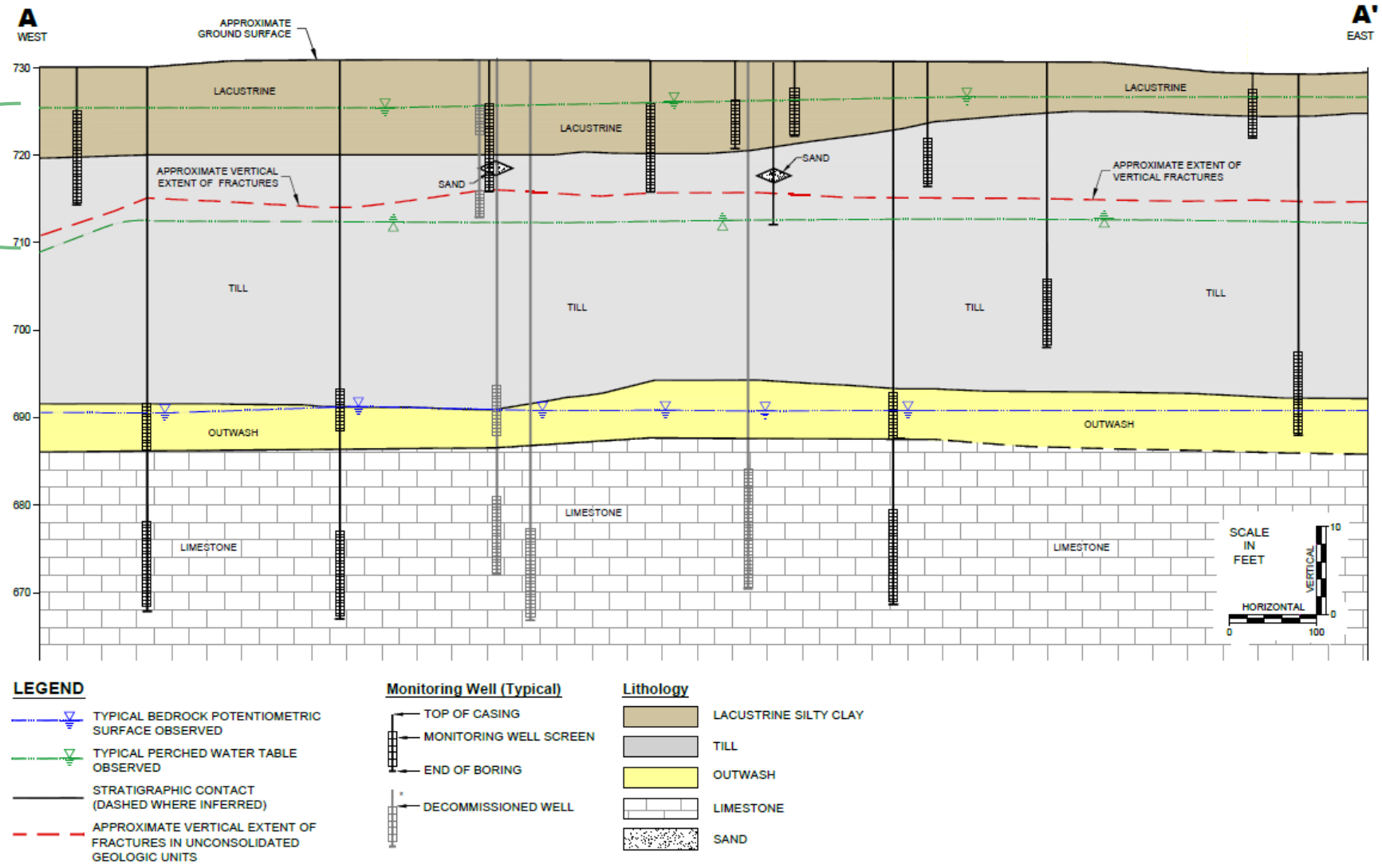
Site Background

- Former Parts Manufacturer
- Trichloroethylene (TCE) is the primary constituent of concern
- USEPA RCRA Corrective Action Site
- Property sold; Environmental Restrictive Covenant limits property use
- Corrective Action (per Final Decision) is largely complete
- New remediation goals established (2016) based upon updated TCE toxicity values (IRIS 2011)
- Portion of building still restricted from use (ERC) until industrial indoor air clean-up levels and concerns with short-term exposure

Site Conceptual Model

Shallow groundwater, limited to fracture network

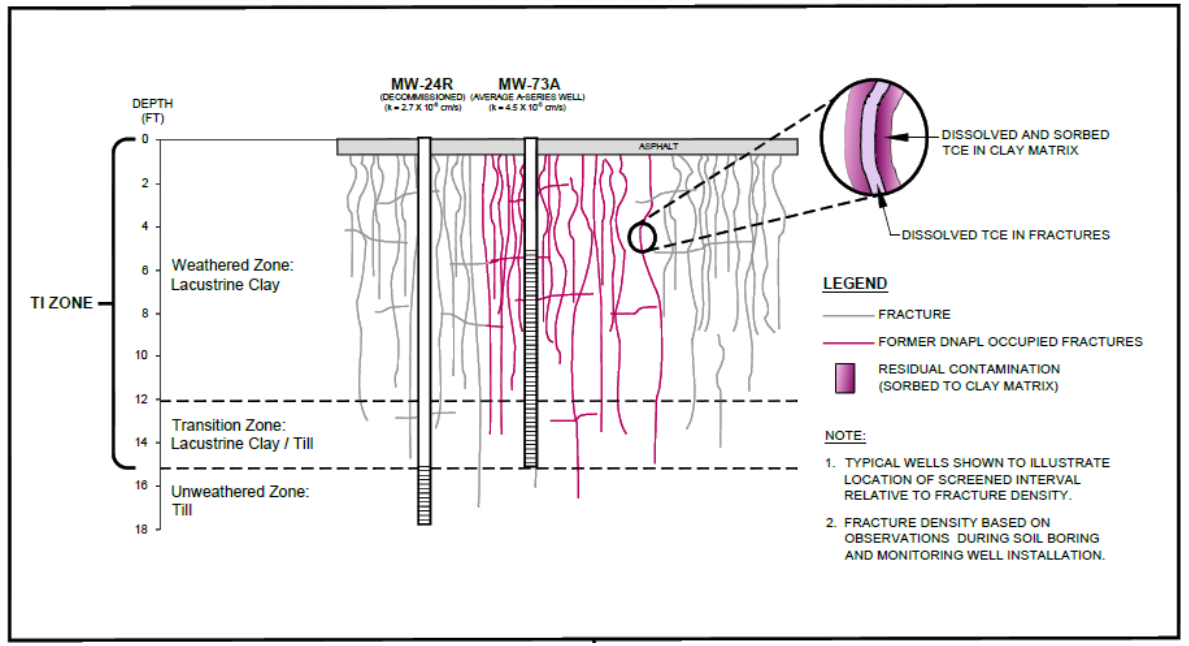
~40 feet of clay



Lacustrine Clay Remediation Challenges

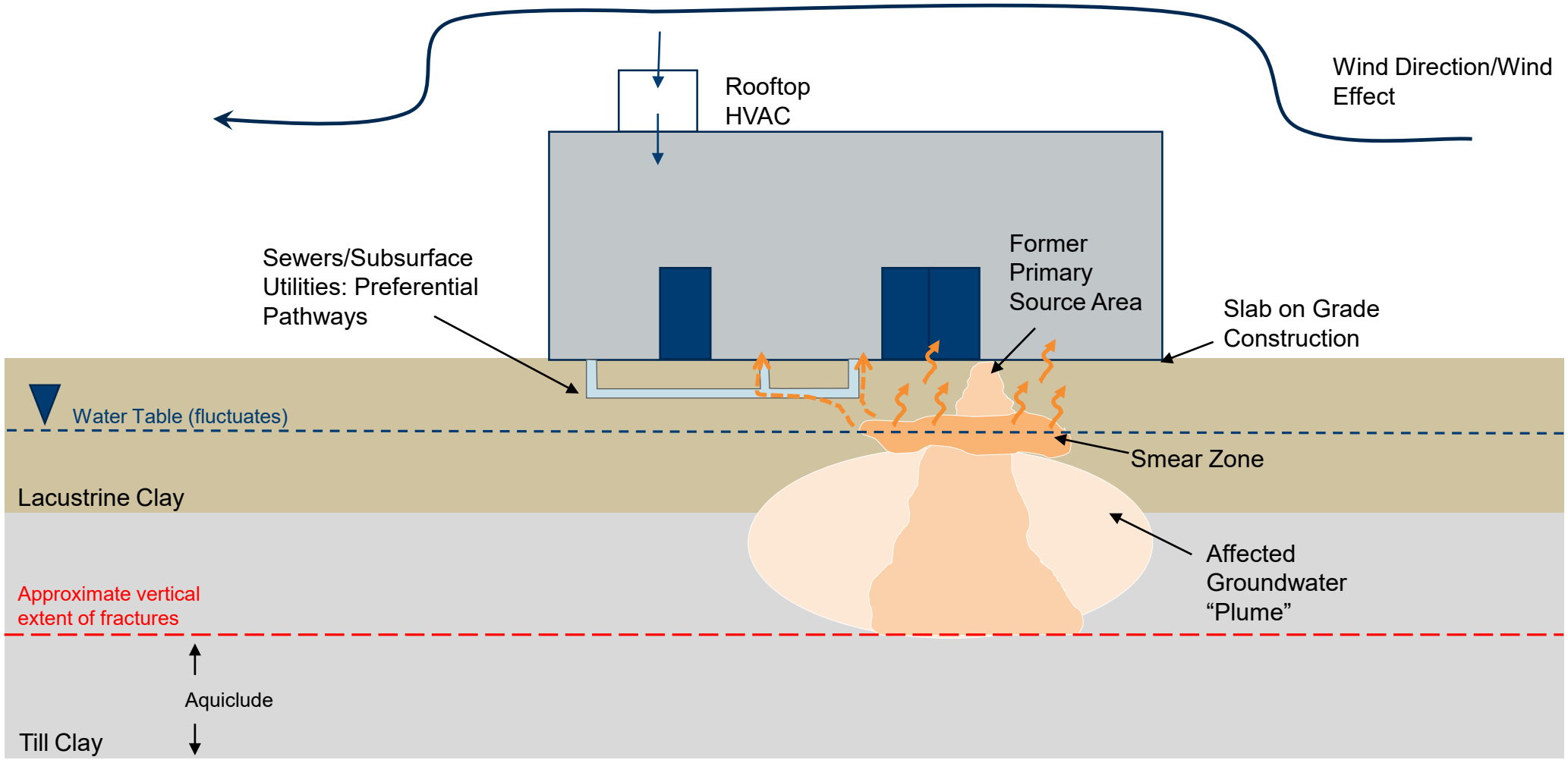
- SVE-based technologies ineffective
  - Diffusion limited mass transfer
- Injection-based technologies ineffective
  - e.g., ISCO, ERD
  - Severely limited ROI (a few feet)
  - Highly susceptible to short-circuiting
- Soil blending with ISCO was effective
  - Not practical beneath a building

CONCEPTUAL MODEL OF THE LACUSTRINE CLAY GEOLOGY



- In Situ Thermal Desorption system operated for approximately 14 months
  - Soil concentrations protective of groundwater were achieved
  - Initial indoor air testing appeared favorable…until TCE remedial goals were revised

Vapor Intrusion Pathway



Vapor Intrusion Sampling

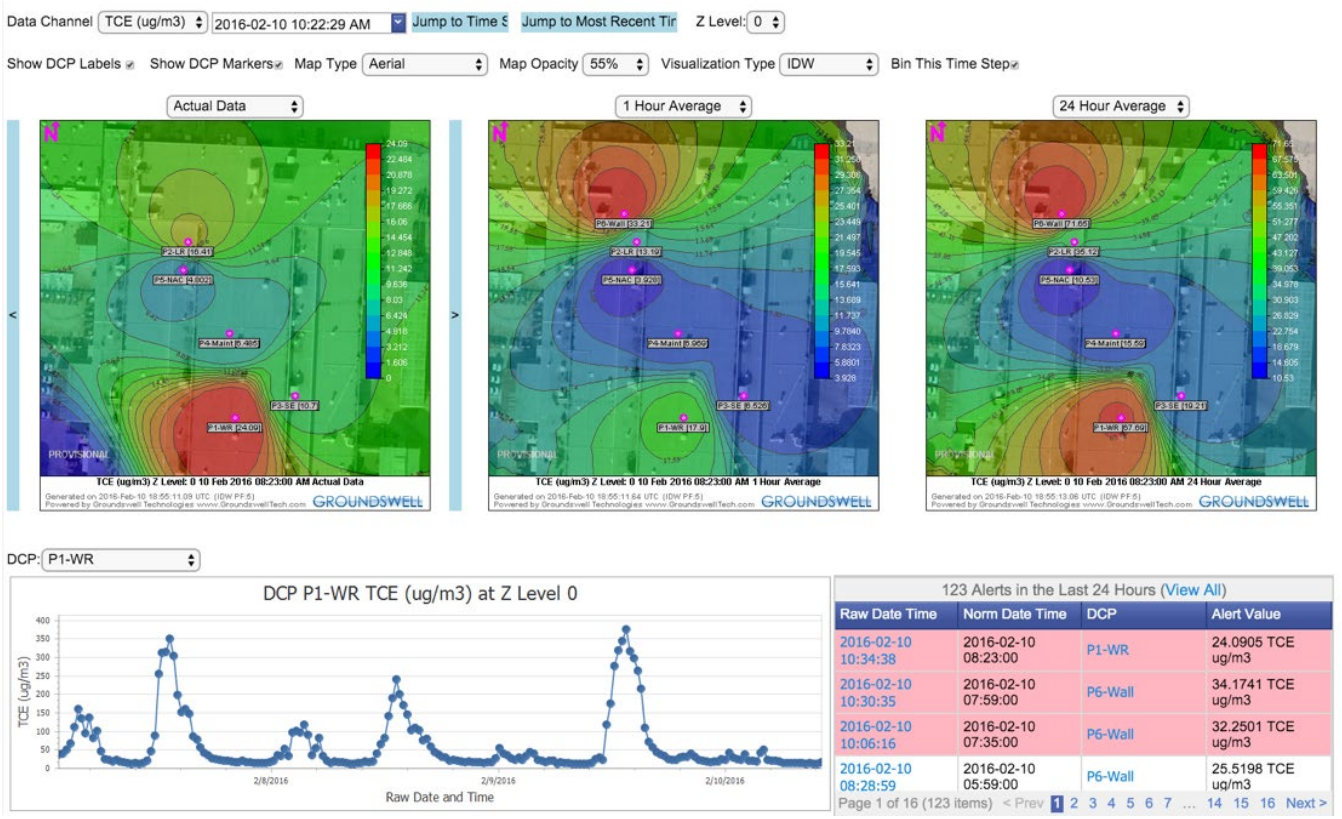
- Passive sub-slab ventilation system installed in July 2016
- Favorable results (TCE <8.8 ug/m^3) in Dec 2016 and Feb 2017
  - Traditional 8-hr Summa canister
- Concerns with short term TCE exposure prompted further investigation
- Additional Vapor Intrusion Investigation Objectives
  - Capture extremes (*i.e.* heating season)
  - Identify and asses potential preferential pathways
  - Determine the best path forward for returning the building to full industrial use

VaporSafe™ Technology

VaporSafe™ VAPOR INTRUSION ASSESSMENT, MONITORING & RESPONSE SERVICES

TRC

- Fully Quantitative EPA Method TO-14
- Can Reach Ultra-Low Levels (<1 ug/m^3) for TCE, PCE, Vinyl Chloride & others
- <10 min Analysis Time for TCE & PCE
- Multiple Sample Locations (16 to 30)
- Very Stable - holds calibration for months
- Discrete Sampling Mode
- QA/QC: calibrated with validated gas standard
- Real-Time Data – Web-Based Dashboard



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VaporSafe™

VAPOR INTRUSION
ASSESSMENT, MONITORING & RESPONSE SERVICES

Sampling Strategy: Round 1 – February 2018

- Discrete sampling
  - Identify vapor encroachment locations
  - Confirm whether or not potential preferential pathways are a significant source
  - Select sample locations for continuous indoor air monitoring

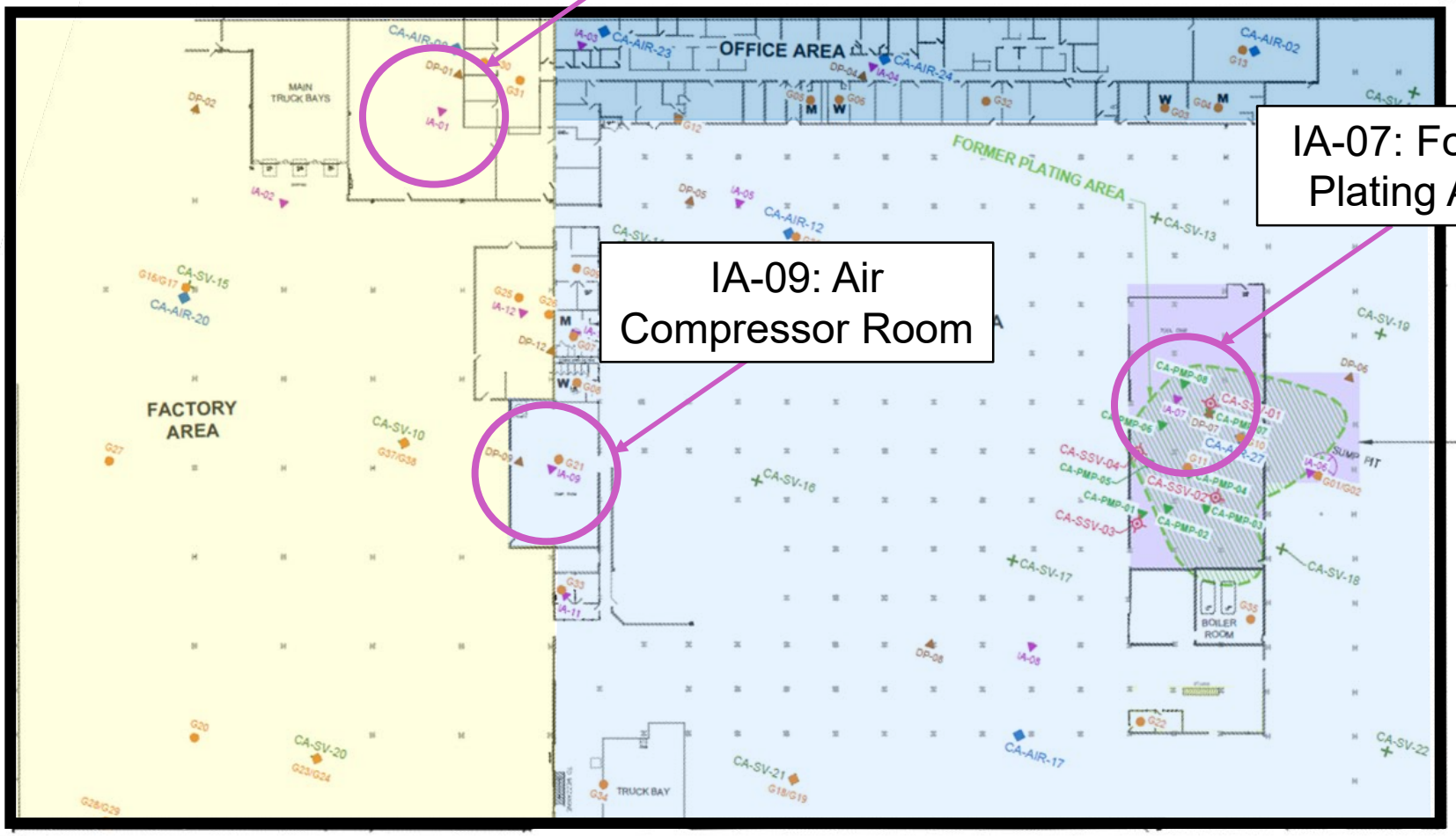
- Continuous Air Monitoring
  - 12 locations sampled over a 5 day period (~1 sample/location every 2 hours)
    - 7 locations near previous canister sampling locations
    - 5 locations based on current building use and results of discrete sampling

- Continuous Cross-Slab Pressure Monitoring
  - Differential pressure sensors installed at 9 locations

IA-01: Automotive Maintenance Area

IA-07: Former Plating Area

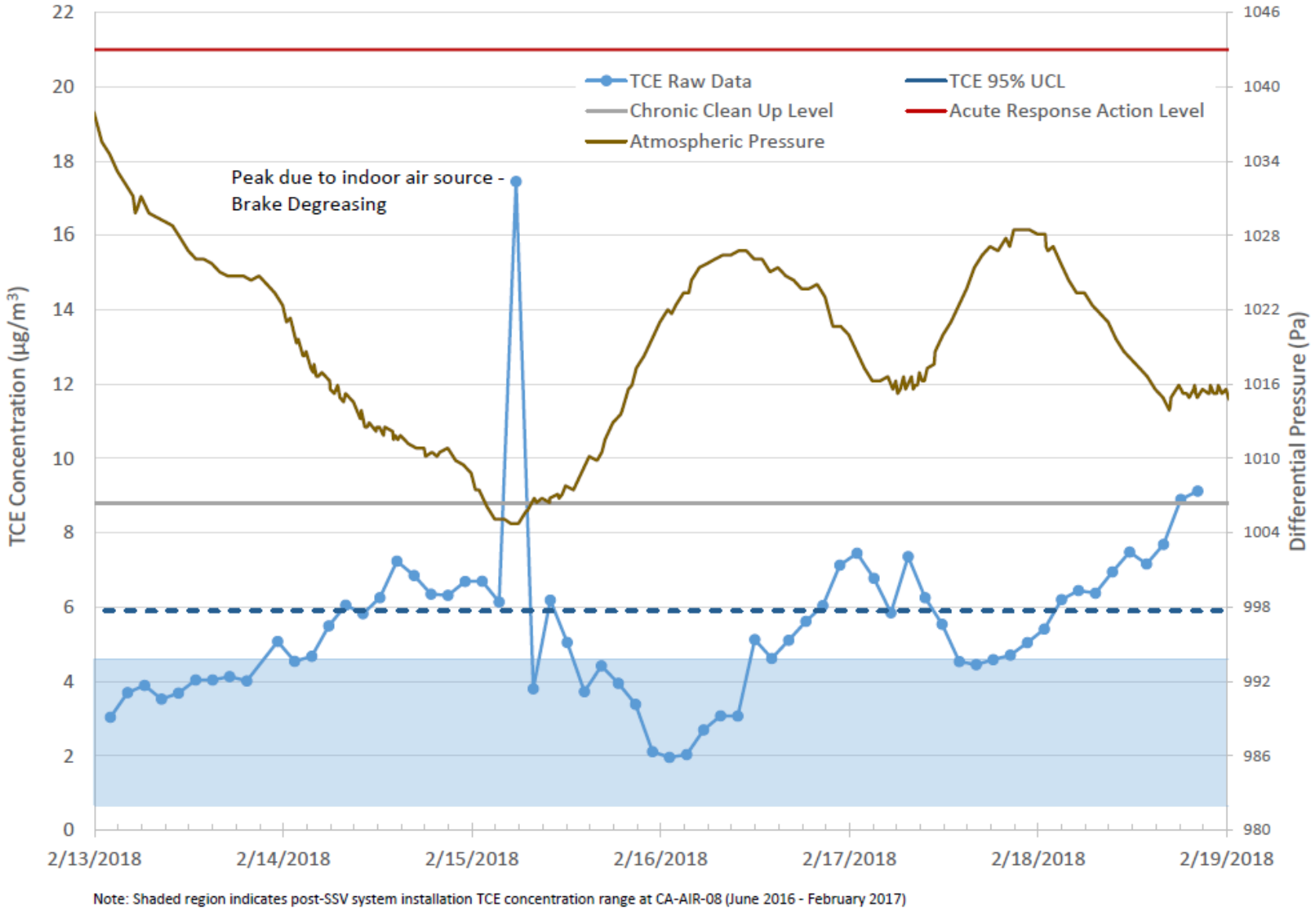
IA-09: Air Compressor Room



LEGEND

- CA-AIR-23 — INDOOR AIR SAMPLE LOCATION AND NUMBER
- CA-SV-19 — SOIL GAS SAMPLE LOCATION AND NUMBER
- CA-SSV-02 — SUB-SLAB VENTILATION WELL LOCATION AND NUMBER
- CA-PMP-04 — PRESSURE MONITORING POINT LOCATION AND NUMBER
- IA-01 — CONTINUOUS INDOOR AIR SAMPLE LOCATION AND NUMBER
- DP-05 — DIFFERENTIAL PRESSURE SENSOR LOCATION AND NUMBER
- G15 — GRAB INDOOR AIR SAMPLE LOCATION AND NUMBER
- LACUSTRINE TREATMENT AREA
- M — MENS RESTROOM
- W — WOMENS RESTROOM

Chart 10: IA-01



Note: Shaded region indicates post-SSV system installation TCE concentration range at CA-AIR-08 (June 2016 - February 2017)

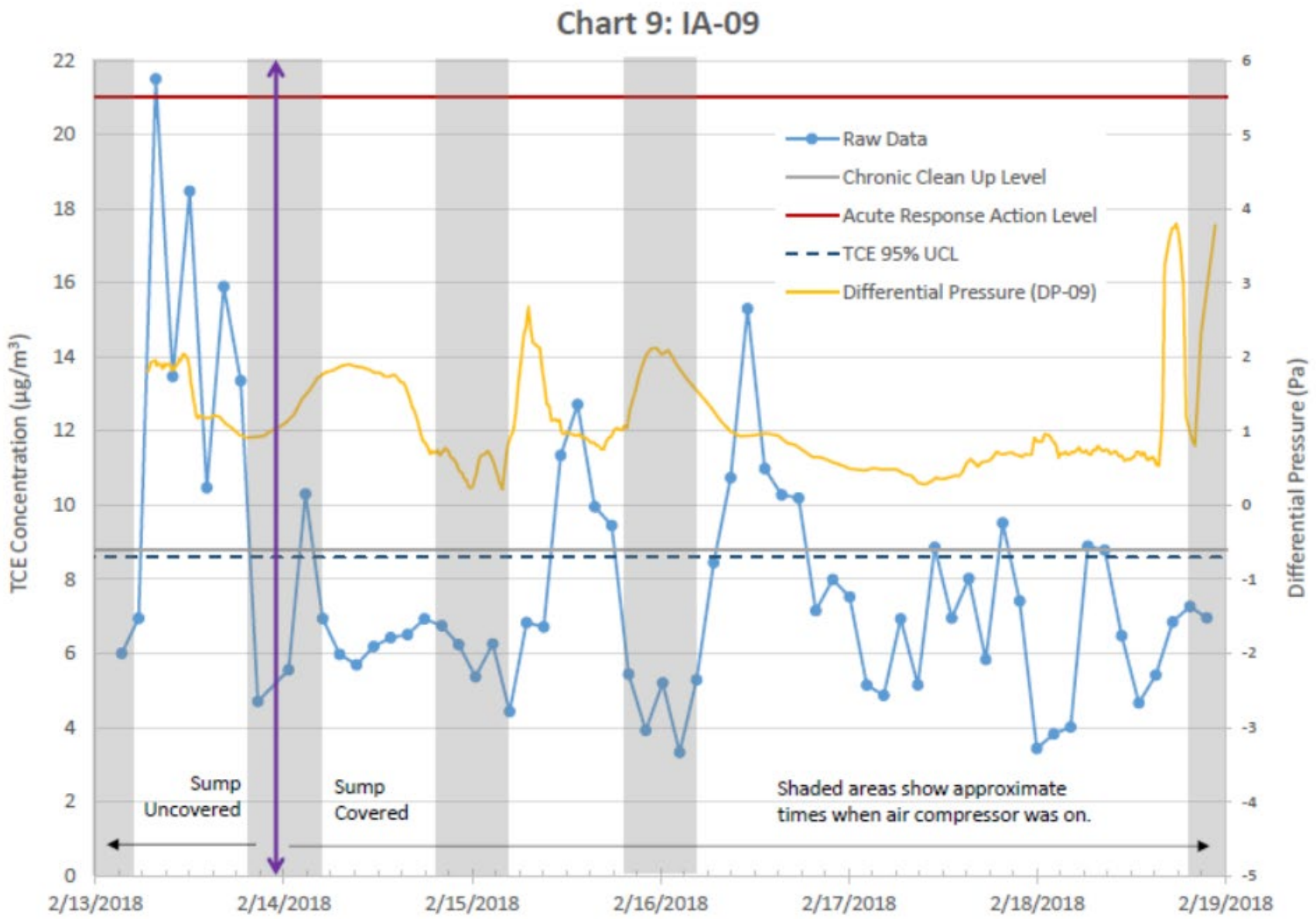
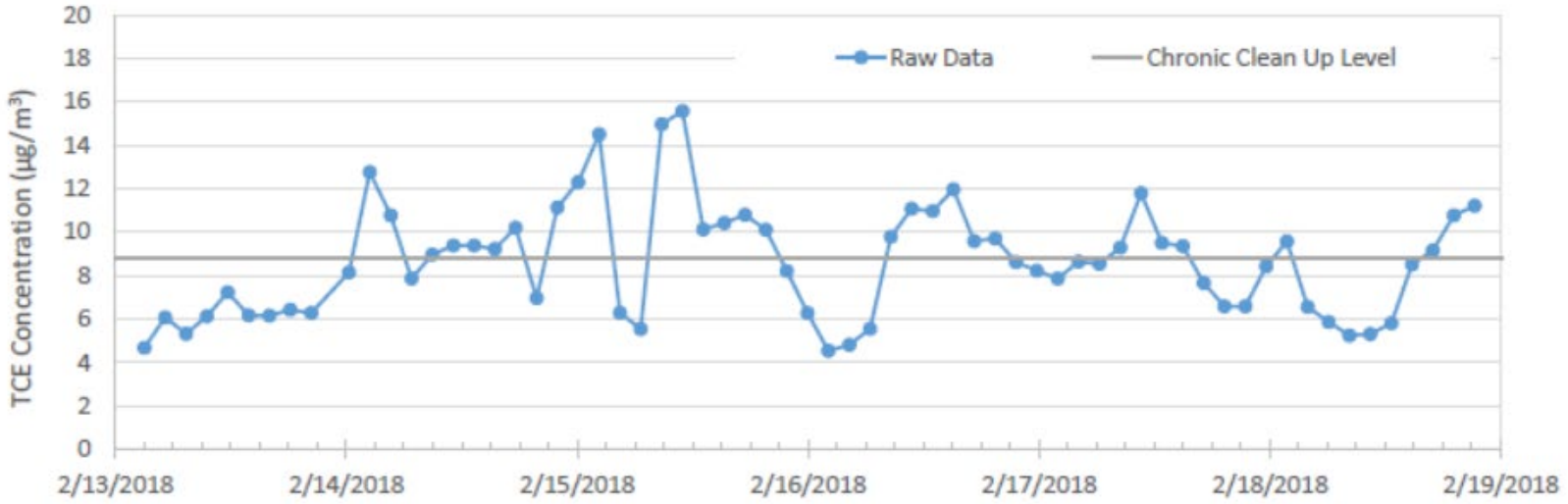
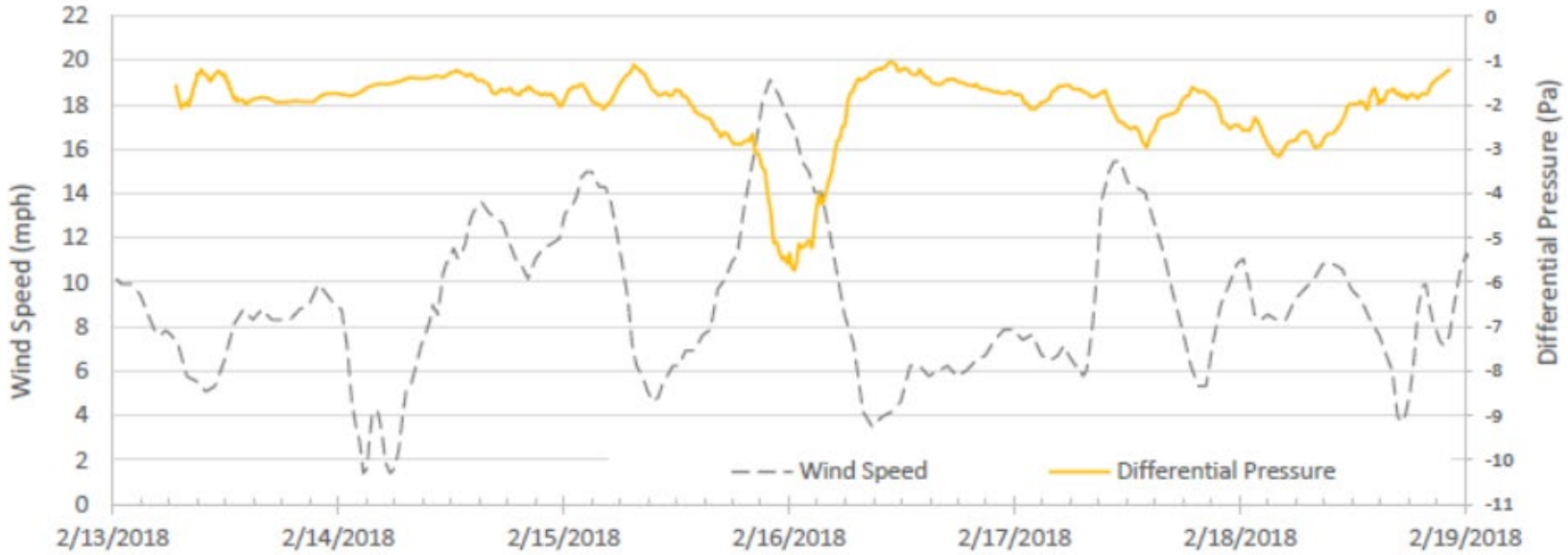


Chart 11: IA-07





Building Improvements/Sampling Round 2: October 2018 – January 2019

- TCE data from continuous indoor air sampling support:
  - No unacceptable risk due to chronic exposure within the building
  - No unacceptable risk due to short-term exposure within the office area and occupied factory area

- To further address concerns with short-term TCE exposure in the unoccupied factory area, recommended:
  - Further preferential pathway mitigation: seal sump near IA-09
  - SSV system improvements: install active fans

- Repeat continuous indoor air sampling in Q1 2019 to evaluate building improvement effectiveness

Results – Round 2

Active System Successful!

Much lower initial concentrations…

IA-07: Former Plating Area/SSV Area

Date	24-hr EPC (ug/m3)	Date	24-hr EPC (ug/m3)
2/14/2018	9.6	1/8/2019	5.4
2/15/2018	12	1/9/2019	5.1
2/16/2018	9.7	1/10/2019	4.6
2/17/2018	10	1/11/2019	7.1
2/18/2018	8.2	1/12/2019	8.2
		1/13/2019	8.2
		1/14/2019	8.5
		1/15/2019	7.6
All Data	**9.2**	**All Data**	**6.9**

Passive Sub-Slab System

Active Sub-Slab System

IA-10: Compressor Room/Sump Area

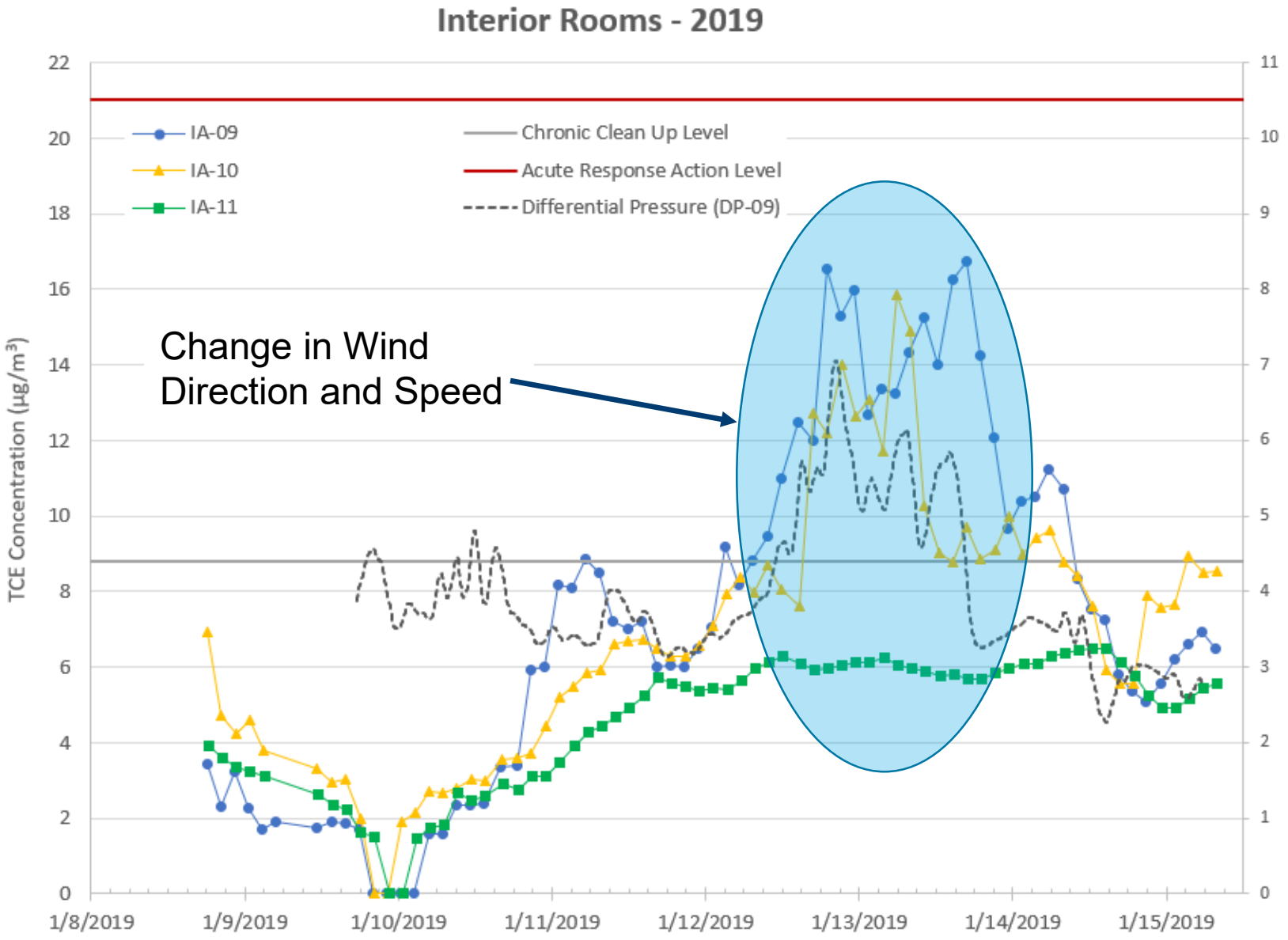
Date	24-hr EPC (ug/m3)	Date	24-hr EPC (ug/m3)
2/14/2018	12	1/8/2019	4.0
2/15/2018	7.6	1/9/2019	2.7
2/16/2018	10	1/10/2019	3.7
2/17/2018	8.9	1/11/2019	7.8
2/18/2018	7.8	1/12/2019	13
		1/13/2019	15
		1/14/2019	9.3
		1/15/2019	6.9
All Data	**8.6**	**All Data**	**8.3**

Sump Covered

Sump Sealed

Hmm….what happened??

*EPC = exposure point concentration (i.e. 95% upper confidence limit)



Next Steps

- Finalize round 2 report and petition to open office area to full use
  - Supported by several years of quarterly data (Summa canister)
  - Plus two continuous indoor air sampling events

- Almost there…
  - Additional differential pressure testing during different wind conditions
  - Evaluate feasibility of additional fan in/near air compressor room (IA-09)

Cost Savings/Business Value

- Returning property to productive use sooner
- Targeted data collection effort
  - Can hone in on what drives the variability of data for targeted mitigation/additional sampling
- Truncation of monitoring
  - No exit ramp with quarterly canister monitoring
- Targeted mitigation effort
  - Mitigation and two one-week continuous air monitoring events cost approximately $150,000 followed by an anticipated annual energy use of ~3,000 kW-hr

  -- OR --

  - Retro-coat coat entire floor: over 250,000 ft^2 = $$$
  - Depressurize entire slab: >$1 million; anticipated annual energy use >50,000 kW-hr

Thank You

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