Modernizing Source Water Management by following a Data Driven Approach

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Agenda

1. Intro
2. Validation Study
3. Summary of Current Sampling Practices
4. TCM Case Studies
5. Suggested Improvements
6. Funding and Regulation
7. Questions?

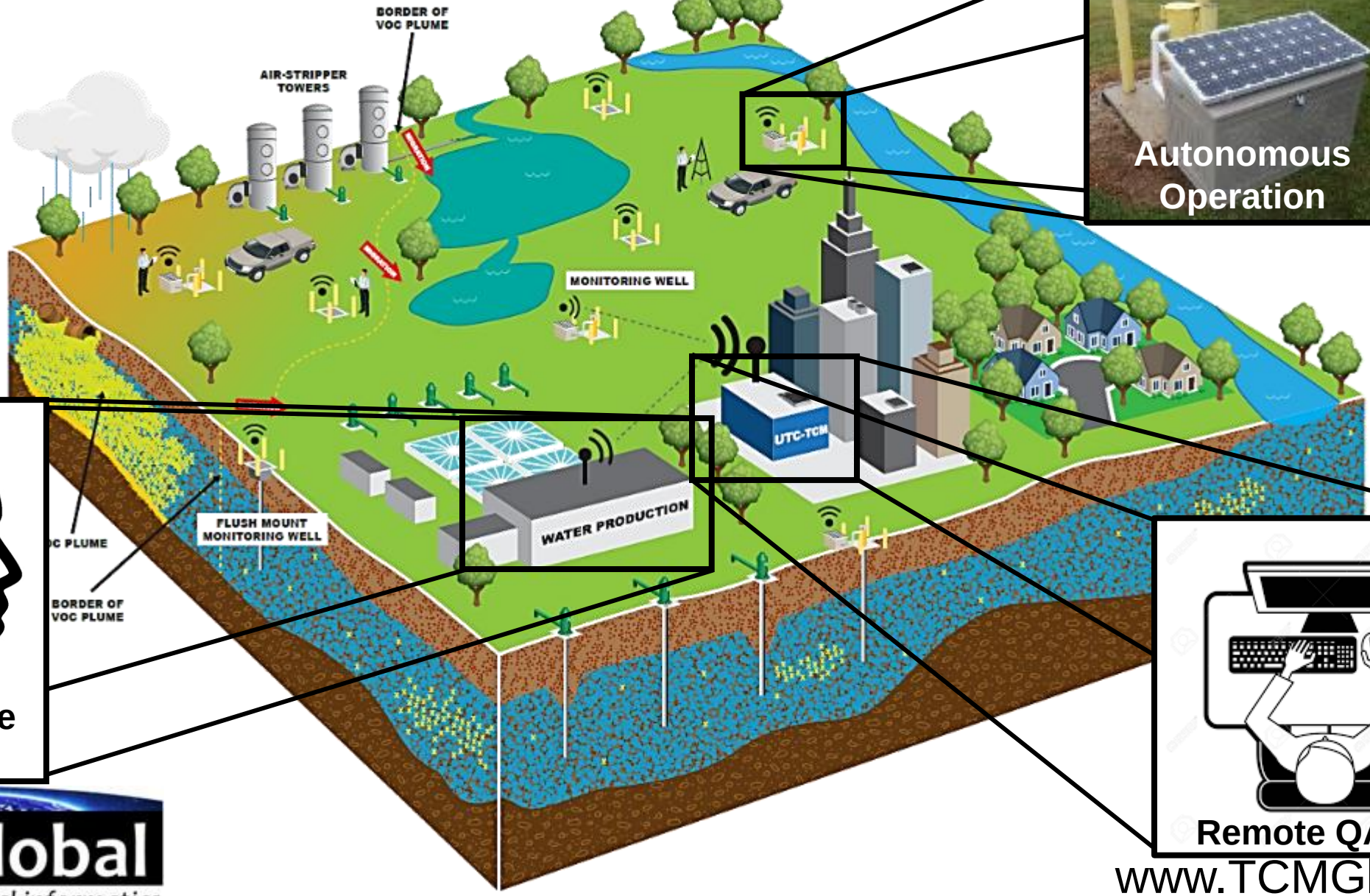
A Little about Me

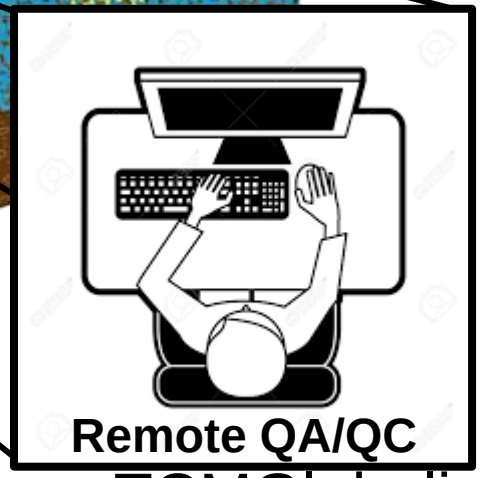
- Director at Targeted Compound Monitoring
- B.S. in Chemical Engineering from the University of Dayton
  - Graduated in 2020
- Leads TCM's efforts in groundwater sampling and monitoring through a variety of roles
  - Day to day operational management
  - Data processing
  - Customer outreach
  - QA/QC
- One of the two investigators in TCM's groundbreaking microGC validation study
- Main operator in a VOC study at the UC Groundwater Observatory on the banks of the Great Miami River

TCM

- Targeted Compound Monitoring
  - It's in the name
  - Primarily look for VOCs (volatile organic compounds) in groundwater
    - i.e. chlorinated compounds, BTEX, etc.
- Fully automated, remote, field Gas Chromatographs
  - Solar powered
  - Pump groundwater via low flow bladder pumps
  - Simultaneously used for geothermal heating/cooling as well as for sample analysis
  - Remote, so no human interaction is required for sampling
- We provide the data so you don't have to!
  - GCs used for multiple applications including:
    - Plume monitoring and tracking
    - Early warning monitoring (pipeline leakage or chemical spill)

Complete Solution: Automation, Remote QA/QC





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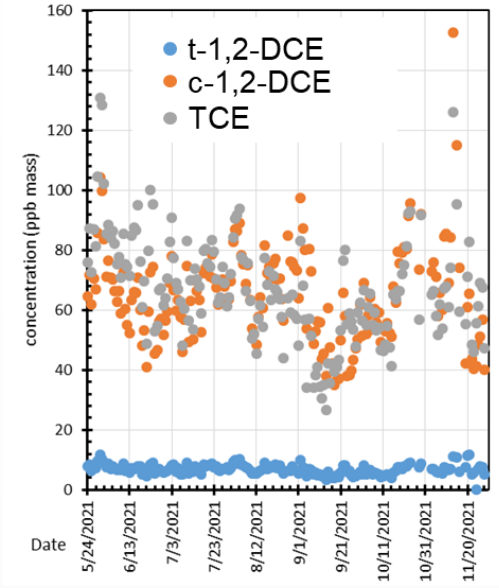
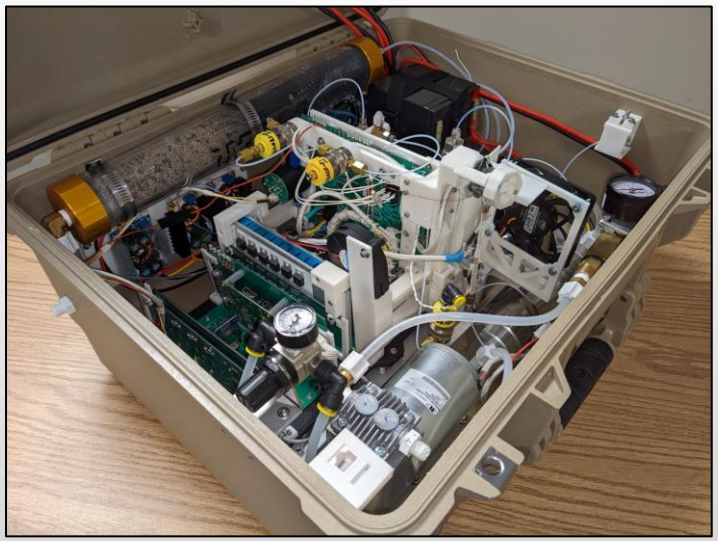
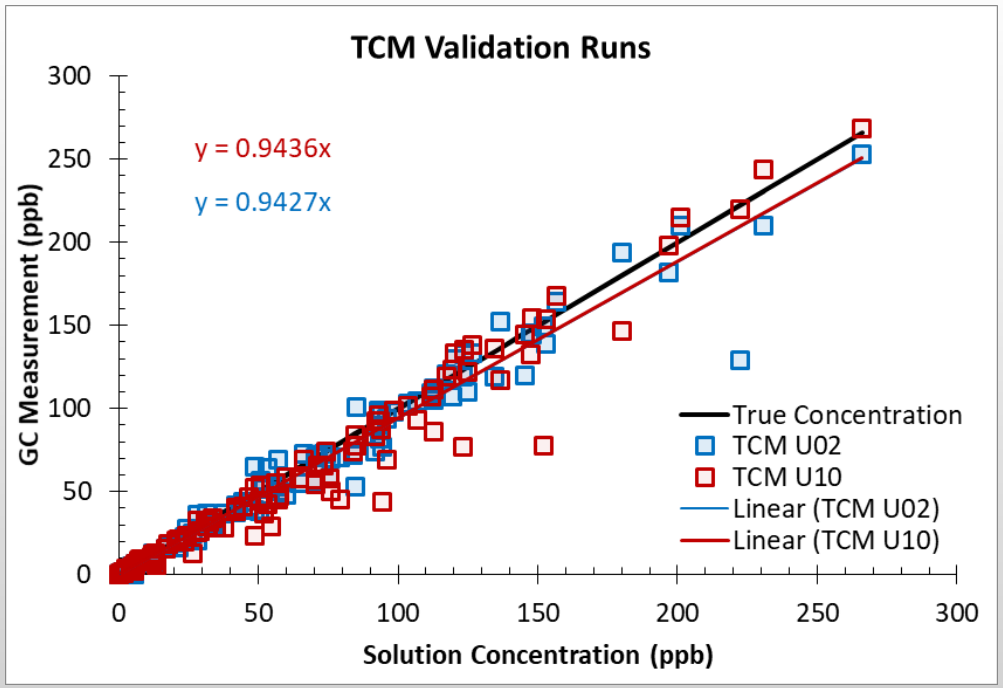
Double Blind GC Validation Study (2019)

- 2 TCM DELCD MicroGCs vs. laboratory purge-and-trap GC-MS
- Random large volume groundwater samples spiked to known analyte level
  - 7 samples per day for 5 days
- Concentrations from 0 ppb to ~270 ppb
  - Analytes: t-1,2-DCE | c-1,2-DCE | TCE
- Randomized and double-blinded for a non-biased study
- Validated against laboratory purge-and-trap GC-MS
  - Average of 94% accuracy
  - Outperformed laboratory purge-and-trap GC-MS in accuracy and dynamic range







Tested Sample Concentrations

Sample ID	t-1,2-DCE	c-1,2-DCE	TCE
1D	48.9	70.6	5.6
1A	1.6	5.0	13.4
1C	12.5	12.1	1.7
1G	123.1	41.9	79.3
1E	71.2	103.6	152.2
1B	6.1	1.0	54.8
1F	96.0	145.3	75.7
2A	0.0	0.0	1.4
2B	5.7	4.3	44.4
2C	12.5	12.3	4.8
2E	75.9	112.6	32.3
2F	94.5	28.1	73.5
2D	52.0	84.7	7.8
2G	26.5	57.6	92.0
3A	6.2	119.6	48.6
3F	106.9	152.9	136.7
3B	13.3	124.9	94.1
3E	98.4	266.0	85.2
3D	64.5	222.2	57.2
3G	42.0	196.9	180.1
3C	21.4	134.6	53.4
4A	0.8	13.2	28.3
4F	70.5	34.9	93.1
4B	5.3	16.9	66.4
4E	56.2	92.1	50.9
4D	38.0	74.1	33.7
4G	23.5	60.0	117.2
4C	12.1	21.5	31.6
5A	2.5	20.6	120.1
5B	7.1	24.3	156.8
5C	17.7	29.0	123.5
5G	31.4	111.8	230.9
5F	112.9	50.6	201.1
5D	46.6	93.7	126.6
5E	84.0	147.3	147.9

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Are Current Sampling Practices Outdated?

Decisions, Decisions, Decisions

- A few questions come to mind…
  - What are current pumping strategies used by different water departments?
  - What data are decisions based off of when pumping from an aquifer to add to an existing public water supply?
  - Are current sampling practices enough to give confidence that the correct decisions are being made?
  - Is enough money allocated to allow for monitoring and the safety of the public when consuming water that comes primarily from groundwater sources?

Current Day Industry Sampling Practices

- Sampling and data collection vary from water department to water department
  - Ranges from monthly to quarterly to annually
  - Consumer confidence reports usually have a phrase like:
    - "Some of our data, although it may be more than a year old, remains accurate."
    - Is this really true?
  - One water department I talked to with active plumes samples:
    - Productions wells once monthly
    - Monitoring wells once yearly
  - Another samples quite differently
    - Production wells are annually
    - Monitoring wells range from quarterly to monthly (plume dependent)

Current Day Industry Sampling Practices

- Once a year minimum in most cases if water is clean
  - Can be more frequent based on VOC plume distances from production wells
- Ohio law states that sampling must occur quarterly if contamination at a site is detected (3745-81-24)
- Does this make sense from a pumping strategy or safety perspective?
    - Can you really know where a plume is if you are only sampling monitoring wells quarterly or annually?
    - Will you actually find new plumes that are unknown with infrequent sampling?
    - Why is the standard for VOCs one sample per year during the compliance period for sampling frequency?
  - Accidents can and do happen!
- Less data can lead to a false sense of security

Potential Consequences of Limited Sampling

- Trivial to drastic
  - At best, nothing goes wrong
  - Medium
    - Plumes get moved due to lack of knowledge about real time ground water status, doesn't affect anything if it doesn't get pulled into water supply
  - Worst case
    - Woburn, Massachusetts – extremely elevated levels of TCE in municipal wells in the '70s
    - Many children ended up getting leukemia and eventually dying

Real Life Scenarios

TCM's Experience-Groundwater is Volatile

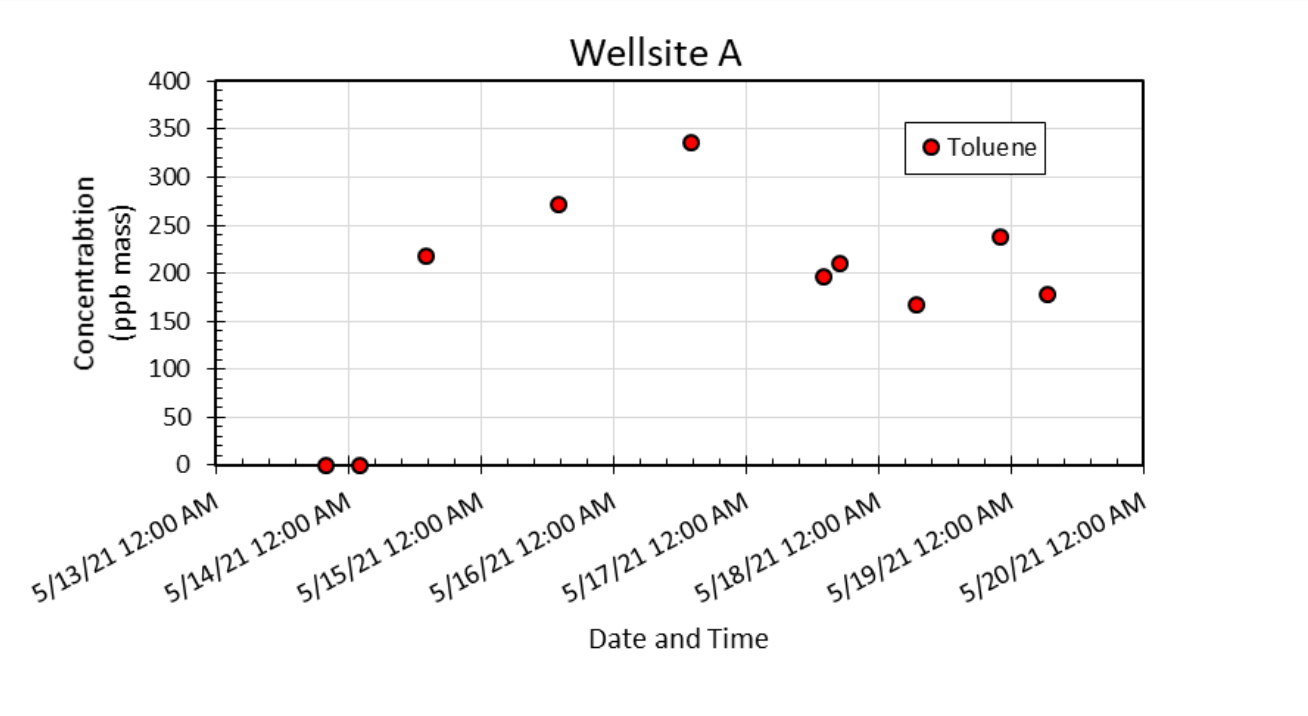
- 1 to 4 VOC data points a year do not tell the story 99% of the time
- We have collected loads of data sampling for customers
- The results are often surprising, to say the least

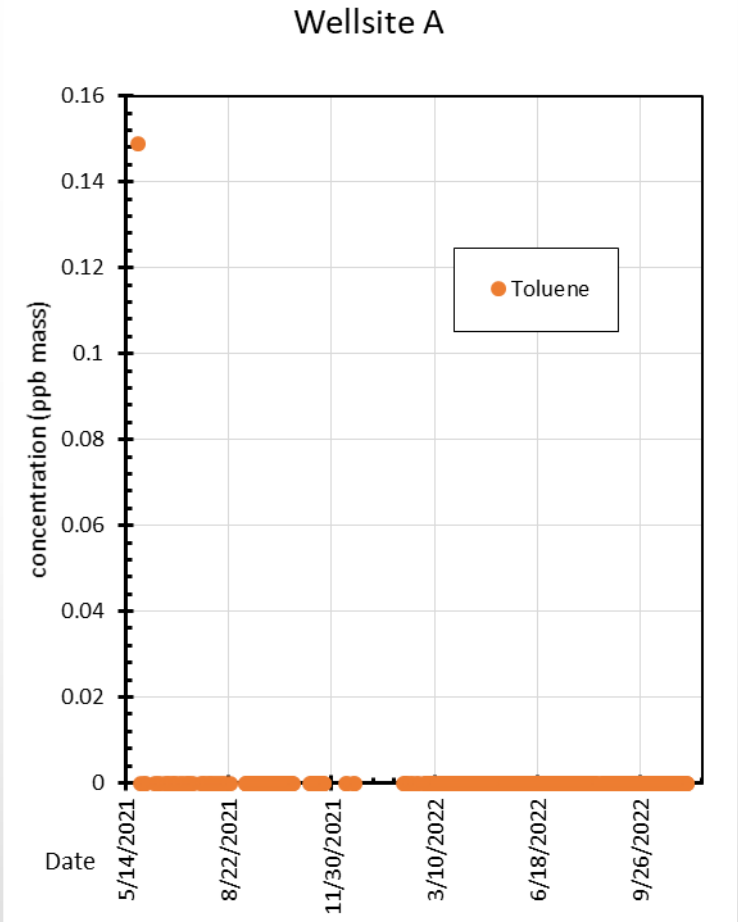
- On the following slides, we will go through some case studies that demonstrate the volatility of groundwater and why it is imperative that sampling practices change in favor of more data collection for enhanced decision making and decreasing risk of pumping incidents

Wellsite A – Very Clean to Excess Toluene

- The GC at this site was installed in early May and the data was showing clean water at this site
  - Note: this monitoring well is historically clean, but is situated close to a petroleum pipe line
- On May 15th, Toluene levels spiked to ~210 ppb
- Levels continued to climb, reaching a maximum concentration of ~340 ppb
- From this point on, concentrations gradually fell until May 21st, when the readings were clear (samples run in the lab on multiple GCs for confirmation)

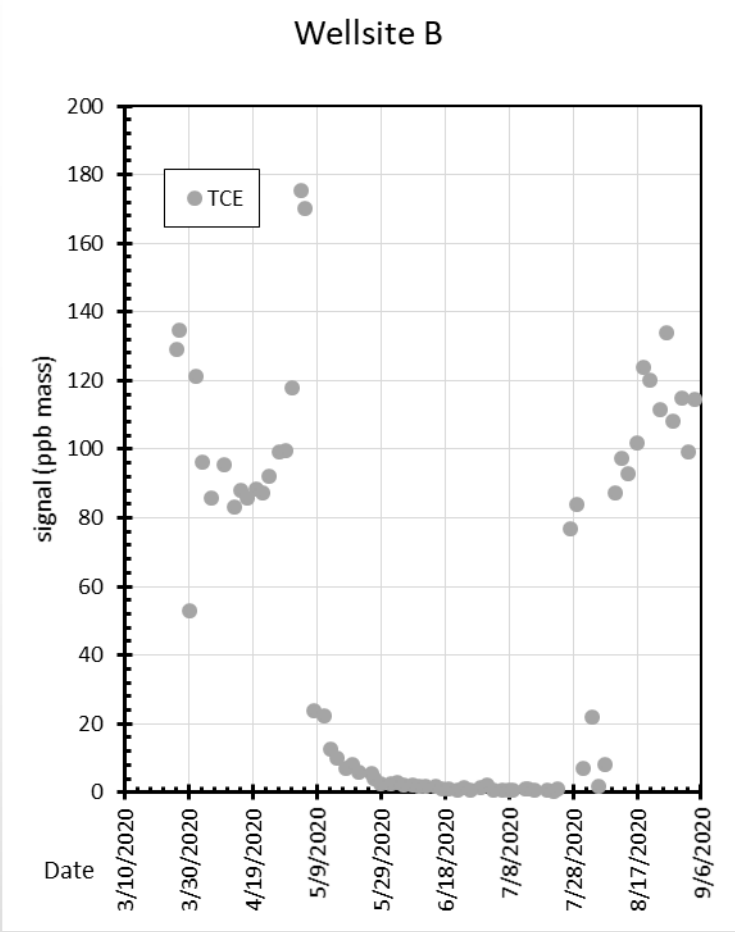
Wellsite A – Very Clean to Excess Toluene





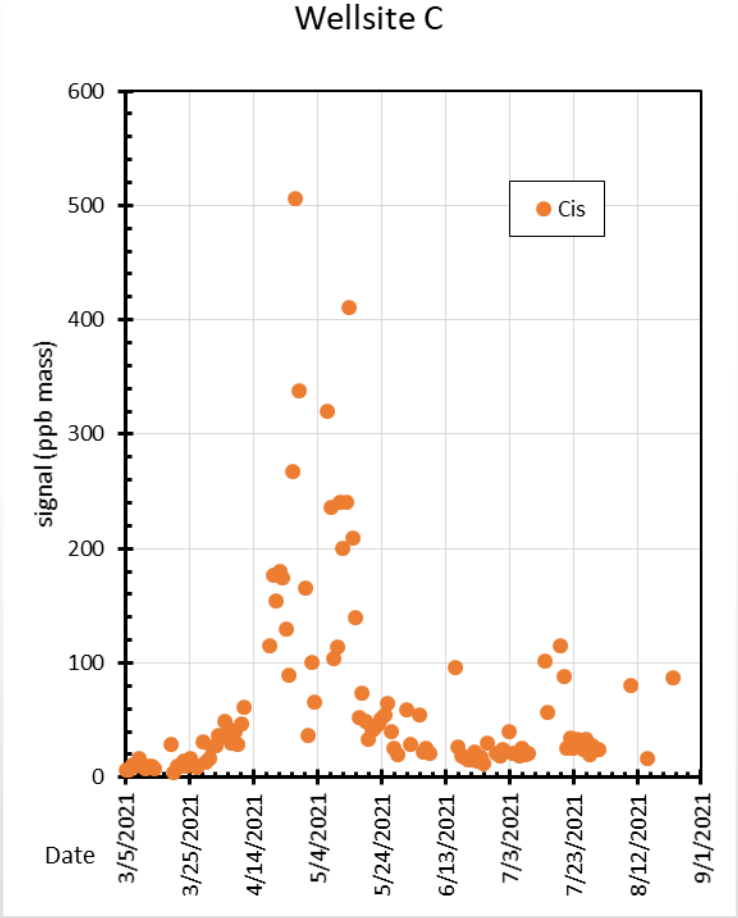
Wellsite B – TCE Plume Migration

- Historical data shows TCE concentrations between 80-140 ppb at this monitoring well
- For a period of almost three months, concentrations dropped to almost 0 ppb
- One day, concentrations spiked back to historical norms
- Plume migration can be assumed from this data and other monitoring well spikes during this time
- This most likely would have been missed if using conventional sample timing



Wellsite C – cis-1,2-dichloroethylene Variations

- Historical norms at this site are ~100 ppb of cis-1,2-DCE prior to the start of the graph
- Concentrations dropped to roughly 20 ppb and then spiked to upwards of 500 ppb over a months time and back down again
- Short term spikes indicating plume migration are often missed



What can be Done to Improve Groundwater Management Practices?

More Sampling → More Active Data Acquisition → Better Management

- The easy (and not so easy) answer is more sampling
  - PFAS in the news and more public awareness up the importance
- More data lends to better management practices
  - Proactive pumping strategies
    - Redirect flow to move plumes away from production
  - A chance to think about remediation before it is too late in severe circumstances
- You might just find something in the water that you did not know was there
- More sampling comes with a very obvious increased cost and a genuine mindset shift… how do we fix that?

More Data Collection → More Funding

- More sampling means more money needed and more employees to handle the increased workload
- The EPA and Ohio EPA offer generous resources for water departments big and small
  - OEPA: Drinking Water Assistance Fund (DWAF)
    - https://dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/29/documents/ofa/DWAF-PMP-2024.pdf
  - Federal EPA: Bipartisan Infrastructure Law (BIL)
    - $43 billion in state and local funding across the country
    - Specifically for water infrastructure from 2022-2026

Challenge Preconceived Notions!

- Just because sampling has been done a certain way for an extended period of time does not mean it has to continue that way
- “Some of our data, although it may be more than a year old, remains accurate.”
  - Limited sampling makes this statement seem true in most cases
  - More extensive sampling often proves this statement false
- Evolve!
  - Just like acceptable PFAS levels are changing for public water supply, frequency of sampling can change too
  - Results may be surprising and possibly uncomfortable, but public safety will be better off because of this

Standards and Regulations

- It may be time to look at regulations as a whole
- Currently, sampling is approached on a case by case basis when there is contamination
- Even once a month is better than once a year for normal circumstances
- Be proactive!
  - Sample more before there is contamination, not after it has already been confirmed
- Remember, we are in the business of safety
  - Lots of lives depend on us

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Thanks!

Questions and/or discussion?