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Fall PD Workshop

November 7, 2024

This meeting is being conducted from the traditional, ancestral, and unceded territory of the Coast Salish peoples, including Squamish, Tsleil-Waututh, and Musqueam

Welcome

- Andrew Sorensen, P.Eng., Thurber Engineering
  CSAP President

- David Mitchell, P.Eng., Active Earth Engineering
  Chair, Professional Development Committee

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Performance Assessment Committee Lessons Learned

Jason Christensen, P.Eng., Keystone Environmental
Chair, CSAP Performance Assessment Committee

Lessons Learned using Kahoot

- 20 multiple choice questions
- There will be 3 prizes awarded at the end for the winner and 1st and 2nd runner up.

Ground rules:

- The Lessons Learned should always be taken with a grain of Sodium and Chloride Ion.
- What you hear is not formal regulatory policy.
- Your situation may be different or unique.
- Do your own due diligence (DYODD).
- Consider Lessons Learned as a starting point, not end point.
- Consider consulting ENV or your colleagues.
- Things change. What's allowed today might not be tomorrow.

Kahoot Instructions

- Join Kahoot at **www.kahoot.it**
- Enter game pin
- Enter your name / nickname
- You have 20 seconds to answer each question. Answer the question by choosing the shape(s) on that correspond with the correct answer.
- There will be a variety of questions, some with one correct answer only, some with multiple correct answers, and true or false questions.

Kahoot Instructions

- After each question, a leaderboard will show the top 5 players.
- Points are awarded based on the speed you answer. The quicker you answer the question, the more points you get!
- You score higher points as you answer each question correct consecutively.

Note: Correct answers are highlighted in yellow.

In which situations is TG2 statistical analysis permitted?

a) Stockpile Evaluation
b) A single stratigraphic unit in-situ
c) Remediation confirmation sampling (select situations)
d) From a Fill unit and Underlying Native Soil

During a Stage 2 PSI investigation, where should the monitoring wells be installed?

a) At the location with the potential to intecept the highest concentrations
b) At the property boundary for off-Site APECs
c) Whatever is accessible
d) Perimeter of existing buildings

What are possible PCOCs associated an in-ground hoist at an auto-repair facility?

a) LEPH
b) HEPH
c) PCB
d) PAH

What is the expected lifespan of ethylene glycol in an anaerobic soil environment?

a) 1 month
b) 6 months
c) 1 year
d) It depends

Which are examples of precluding conditions for an SLRA?

a) Soil contamination within the upper 1 m of soil
b) Stable Groundwater contamination that extends beyond the source parcel
c) Fractured Bedrock
d) Deep rooting vegetation at RL_{HD}

Which of the following are items expected to be part of a Remediation Plan? month

a) Remediation Alternatives Considered
b) Schedule with dates for remediation
c) Details for Data Gap Investigation
d) Confirmation of Remediation Sampling Program Details

Which of the following are required to use PAAD for a Risk Based CoC?

a) A sealed statement of assurance from a professional engineer
b) Ambient Air Sampling results
c) Building Mechanical Drawings
d) Statement by AP that ventilation system will mitigate risk

What are examples when TEL is not required to be analyzed as a PCOC at Fuel Dispensing Facility?

a) VPH results are less than standard in groundwater
b) Fuelling activities ceased greater than 30 years ago
c) Fuelling started after 1987
d) Fuel tanks smaller than 5000 L

Can you apply for an AiP without any substances listed on Schedule C of the certification document?

a) Unequivocally Yes
b) Unequivocally No
c) Maybe. Consult with ENV prior to making the submission.
d) The preference would be to apply for a Release

A Performance Verification Plan is required for Type 2 Sites?

a) True
b) False

What are examples of Type 1 sites that do not require a PVP.

a) No Trespassing Signage
b) Deep Soil Contamination
c) Vapour mitigation with PAAD
d) Contamination under Municipal Roadway

When developing Schedule B conditions for off-site Parcels, items to keep in mind

a) Keep the conditions simple and easy to understand
b) Develop them only for current use
c) Develop the conditions with the greatest flexibility for future use
d) Use very specific conditions

Trend analysis is required to show stability of the contaminant plume in a SLRA with minimum 2 years of data?

a) True
b) False

If TG2 statistics are used as part of the application, which documents should the details be provided within?

a) Summary of Site Condition
b) Detailed Risk Assessment
c) Screening Level Risk Assessment
d) Detailed Site Investigation

A septic drainage field at a residential meth lab is a potential APEC?

a) True
b) False

AiP Schedule B condition specifies that a Land Title restriction will be in place. When should the covenant be in place?

a) Prior to the AiP issuance
b) Prior to the CoC issuance
c) Prior to occupancy
d) Not that important

Protocol 28 lead TRV is 0.6 for children and 1.3 µg/kg bw/d for adults. HC TRV is 0.5 µg/kg bw/d. What is toddler TRV?

a) The Protocol 28 TRV of 0.6 ug/kg bw/day
b) The Protocol 28 TRV of 1.3 ug/kg bw/day
c) The Health Canada TRV of 0.5 ug/kg bw/day
d) Either A or C, based on best professional judgement

HHERA and COC included risk control barrier next to off-site MA. MA didn't have contamination. Is PVP required?

a) Precautionary Risk Control should be included and no PVP required
b) Risk Control and PVP not required
c) Type 1 Site, Risk Control Required but no PVP required
d) As Risk Control Listed, PVP is Required

100 m^2 sediment found with concentration>P11, WSA required for access (~9 months). What is process for P6 submission?

a) Remediate sediment, SRC submitted at time of NIR initiating, submit for CoC
b) Updated SRC sent when data >P11 received, preapproaval for P6 submission
c) Remediate sediment, SRC submitted at time of NIR complete, submit for CoC
d) Remediate sediment, SRC submitted at time of CoC

During Stage 1 Findings "Additional Information Required" may be requested under which of the following?

a) A report includes documentation errors
b) The level of investigation is insufficient
c) Conclusion that doesn't affect certification document appears to be wrong
d) Calculations are missing

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Updated Continuing Professional Development Hours for CSAP

Mandeep Purewal, MET, R.P.Bio., P.Ag., AtkinsRéalis
Chair, CSAP Membership Committee

CPD Revisions starting in 2025

Background and Objective

- Simplify CSAP Membership Guidelines for Continuing Professional Development (CPD) while maintaining the intent of the requirement to maintain continued competency and professional development.

CPD Revisions starting in 2025

Overview of changes

- The new CPD categories are being re-grouped and renamed as follows:
  - **NEW** CPD Category 1: Review and Recommendation
    - 1A: Certification Documents and 1B: Quality Assurance Activities
  - **NEW** CPD Category 2: Contaminated Sites Professional Development
    - 2A: Organized Activities and 2B: Informal Self-Directed Study
- Caps have been removed from several areas.
- Easier to track and enter CPD hours.
- Requirement for 1 submission every renewal cycle (3 years) remains.

CPD Revisions starting in 2025

CPD Requirements	Details
Minimum PDH per year	• 30
Minimum PDH per 3 years	• **120** (including 30 hours in Category 1)
Carry forward allowance (if > 30 PDH/year)	• 2 years from **year** of activity
Activity in Categories	• Participation in 3 sub-categories over 3-year term
Submissions*	• 1 in 3-year term for area of specialty

CPD Revisions starting in 2025

CPD Requirements	Details
Category 1: Review and Recommendations	*This category accounts for CPD conducted acting as a CSAP. These activities earn 1 PDH per hour of activity.* ***Maximum of 50 hours per year.***
Category 1A: Certification Documents	Submission of advice and recommendation to the Ministry respecting issuance of a certification document defined under the CSR; this is not limited to CSAP submissions but includes, for example: • submissions respecting certification documents through the CSAP process; • work completed under direct Ministry contract or submissions for certification documents made directly to the Ministry for their review; • participation in a performance assessment (PA) as the member whose submission is being assessed; and • all work requiring a CSAP signature.
Category 1B: Quality Assurance Activities	Participation in CSAP quality assurance activities including: • conducting detailed screening (DS) of submissions received by CSAP Society; • participation in a PA as a member of a PA panel; and • conducting review of reports received by CSAP Society's Review Services Committee.

CPD Revisions starting in 2025

CPD Requirements	Details
Category 2: Contaminated Sites Professional Development (comprising Category 2A and 2B)	*This category captures CPD that directly relates to the field of **contaminated sites**. These activities **earn 1 PDH per hour of activity**.*
• **Category 2A: Contaminated Sites Professional Development: Organized Activities**	• Organized Activities: such as service on public bodies or volunteer organizations; CSAP Society committee work and PD Workshop preparation; presentations ; and contributions to knowledge: • Informal Activities: such as attendance at industry trade shows; attendance at meetings of technical, professional or managerial associations or societies; structured discussion of technical or professional issues with peers; and acting as a mentor to a less experienced or potential member of the CSAP Society.
Category 2B: Contaminated Sites Professional Development: Self-Directed Study	Informal self-directed study and mentoring. A **maximum of 15 PDHs** per year may be claimed for Category 2B, with an opportunity to roll over surplus hours into the next year.

CPD Revisions starting in 2025

- CPD Reporting remains as is for the 2024 renewal.
- Changes will take into effect for next year's reporting (2025).
- The Members' Portal will be updated to reflect changes and updated requirements for CPD logging.
- Updated Membership Guidelines will be posted in early 2025.

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Groundwater Contamination Plume Stability: A Review of Assessment Methods

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WSP

Groundwater Contamination Plume Stability

A Review of Assessment Methods

Prepared for CSAP Society Technical Review Committee

7 November 2024

Presentation Outline

- **Introduction to Plume Stability**
- **General Considerations for Plume Stability Assessments**
- **Overview of Plume Stability Assessment Methods**
- **Example Conceptual Site Models**
  - Petroleum Hydrocarbon Site
  - Chlorinated Solvent Site
- **Considerations for Sites in British Columbia**
- **Questions**

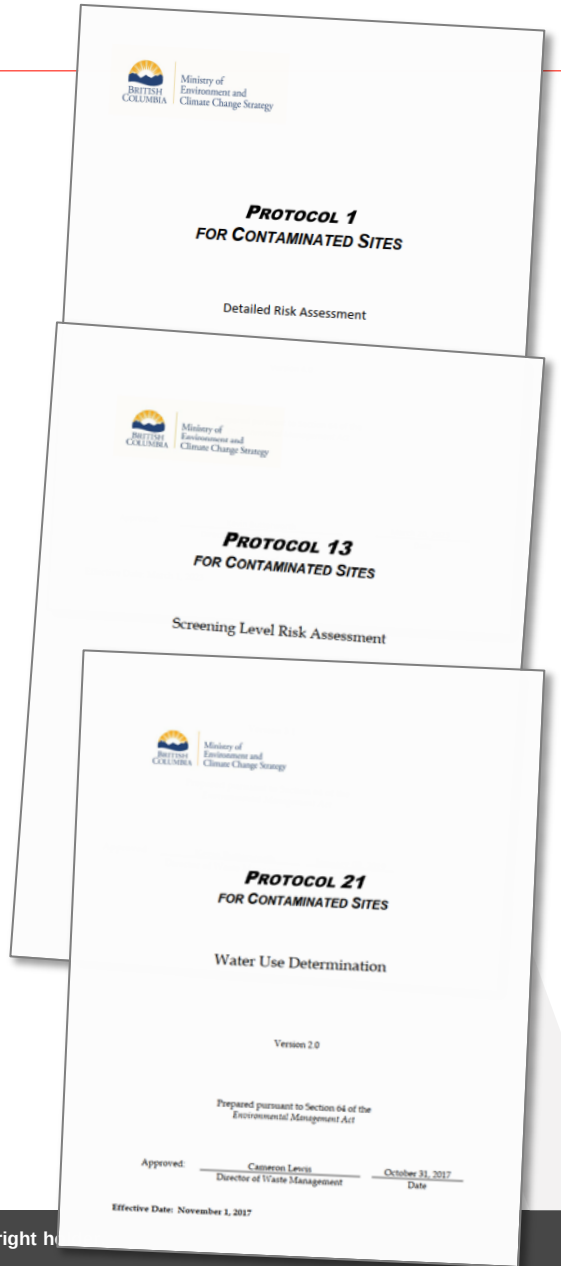
Introduction to Plume Stability

- **Definition – A simple definition of plume stability is a condition in which a groundwater contaminant plume is not increasing (physical dimension and/or mass) and the plume footprint is not moving in an undesirable direction.**

- **For a plume that is not stable, the rate of contaminant mass into the plume is greater than (increasing plume) or less than (decreasing plume) to the rate of chemical mass lost from the plume.**

Introduction to Plume Stability

- **Demonstrating plume stability is a requirement of the BC Contaminated Sites regulatory framework**
  - Prescribed in Protocol 1, Section 2.4 as pre-requisite for detailed risk assessment
  - Key component of Screening Level Risk Assessment, Protocol 13, Section 6.0.
  - Relevant in water use determination, Protocol 21, where contaminant plume migration potential must be assessed, e.g. relative to aquatic receiving environment 500 m setback boundary.



Introduction to Plume Stability

- **Regulatory expectations for data:**

  "The demonstration of stable or decreasing contaminant plumes must include the evaluation of groundwater conditions within and at the margins of contaminant plumes and…

  …provide evidence of both stable or decreasing substance concentrations throughout and no additional vertical or lateral migration or rebound effects.

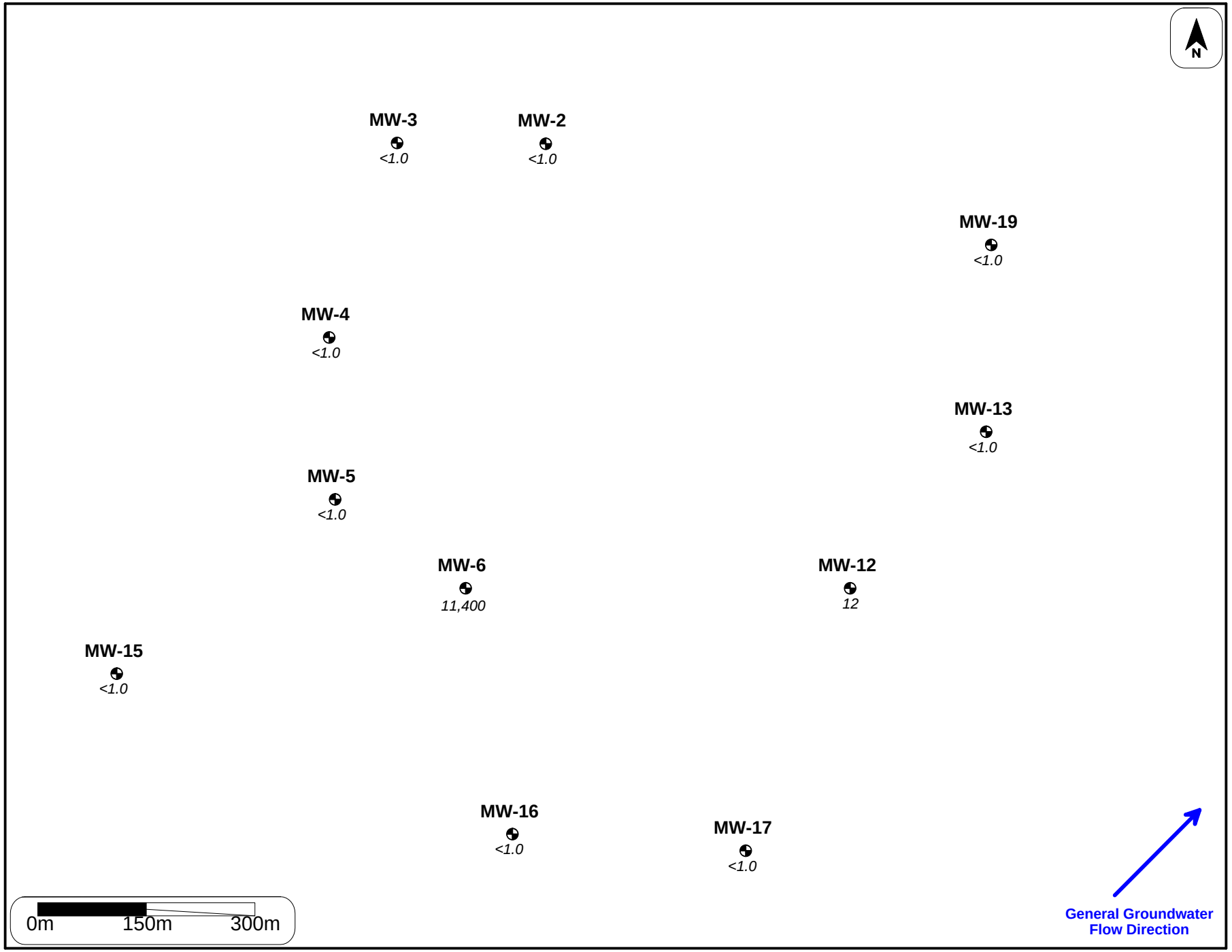
  A minimum of two years of groundwater monitoring and geochemical data (including seasonal variations over a two- year period) demonstrating stable or decreasing groundwater concentrations and conditions is necessary." – Screening Level Risk Assessment Protocol 13

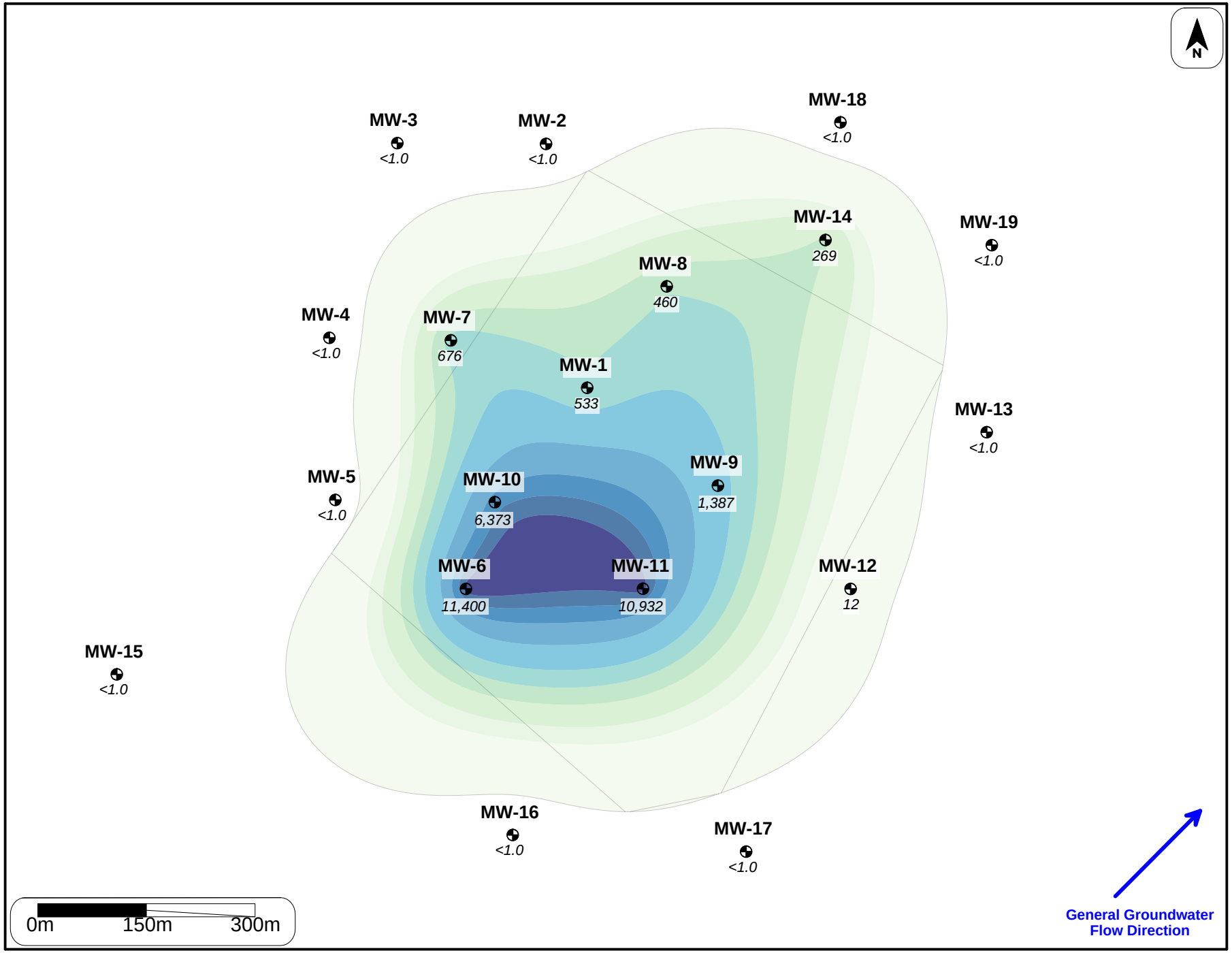
  "A minimum of one year of quarterly groundwater monitoring and geochemical data…coupled with other methods of evaluation" – TG08

- **Trend analysis methods**
  - Mann-Kendall test is provided as an example in technical guidance for Groundwater Investigation and Characterization (TG08)
  - Other methods are available, and this presentation provides an overview of the options

General Considerations for Plume Stability Assessments

- **Established network**
- **Quantity of data (time, events)**
- **Consistent sampling**
- **Handling of Non-Detects**


N
MW-3
<1.0
MW-2
<1.0
MW-19
<1.0
MW-4
<1.0
MW-13
<1.0
MW-5
<1.0
MW-6
11,400
MW-12
12
MW-15
<1.0
MW-16
<1.0
MW-17
<1.0
0m
150m
300m
General Groundwater
Flow Direction


N
MW-3
<1.0
MW-2
<1.0
MW-18
<1.0
MW-14
269
MW-19
<1.0
MW-8
460
MW-4
<1.0
MW-7
676
MW-1
533
MW-13
<1.0
MW-5
<1.0
MW-10
6,373
MW-9
1,387
MW-6
11,400
MW-11
10,932
MW-12
12
MW-15
<1.0
MW-16
<1.0
MW-17
<1.0
0m
150m
300m
General Groundwater
Flow Direction

General Considerations for Plume Stability Assessments

- **Established network**
- **Quantity of data (time, events)**
- **Consistent sampling**
- **Handling of Non-Detects**

Quantity of Data

- **Number of sampling events**
  - A minimum of four data points are required to conduct a Mann-Kendall trend test
  - More events provide stronger statistical analyses

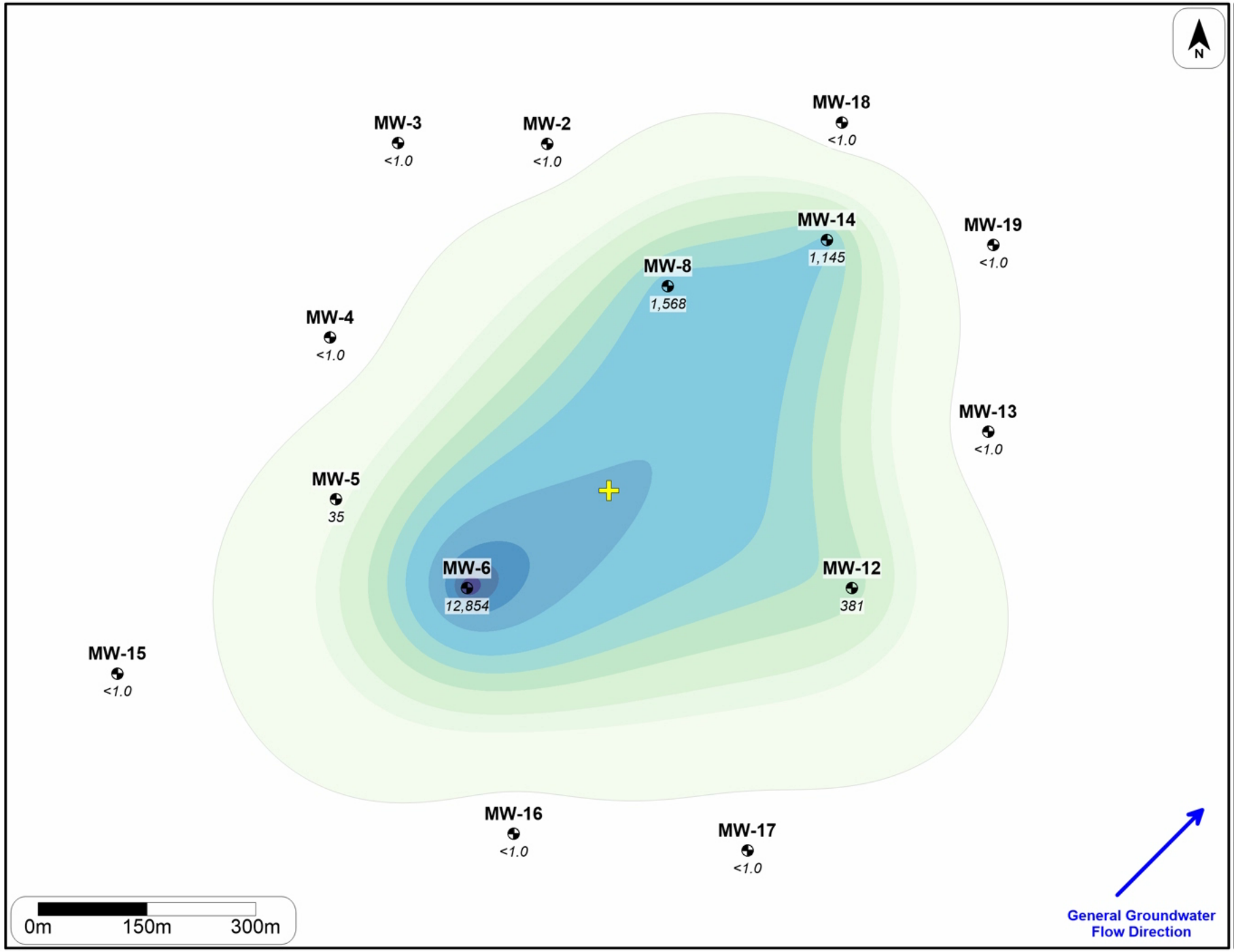
- **Period covered by data**
  - Four annual events > four quarterly events > four weekly events > four daily events
  - Longer time periods provide a better assessment of rates of change over time
  - Eight quarterly events is a good starting point
  - Emphasis should be placed on recent data

General Considerations for Plume Stability Assessments

- **Established network**
- **Quantity of data (time, events)**
- **Consistent sampling**
- **Handling of Non-Detects**

Consistent Sampling

Well	Benzene Monitoring Data (µg/l)							
	Feb-20	Aug-20	Feb-21	Aug-21	Feb-22	Aug-22	Feb-23	Aug-23
MW-1	NS	NS	NS	1,042	895	661	NS	NS
MW-2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5	35	204	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6	12,854	14,143	11,786	11,845	NS	11,895	NS	NS
MW-7	NS	NS	NS	643	592	758	697	676
MW-8	1,568	1,139	681	927	770	595	484	460
MW-9	NS	NS	NS	2,414	803	1,511	NS	NS
MW-10	NS	NS	NS	5,838	NS	3,749	NS	NS
MW-11	NS	NS	NS	7,247	9,650	15,529	NS	NS
MW-12	381	635	688	395	423	751	13	12
MW-13	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-14	1,145	1,014	477	807	585	387	266	269
MW-15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-16	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-17	<1.0	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0
MW-18	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-19	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0



Benzene

Feb-2020

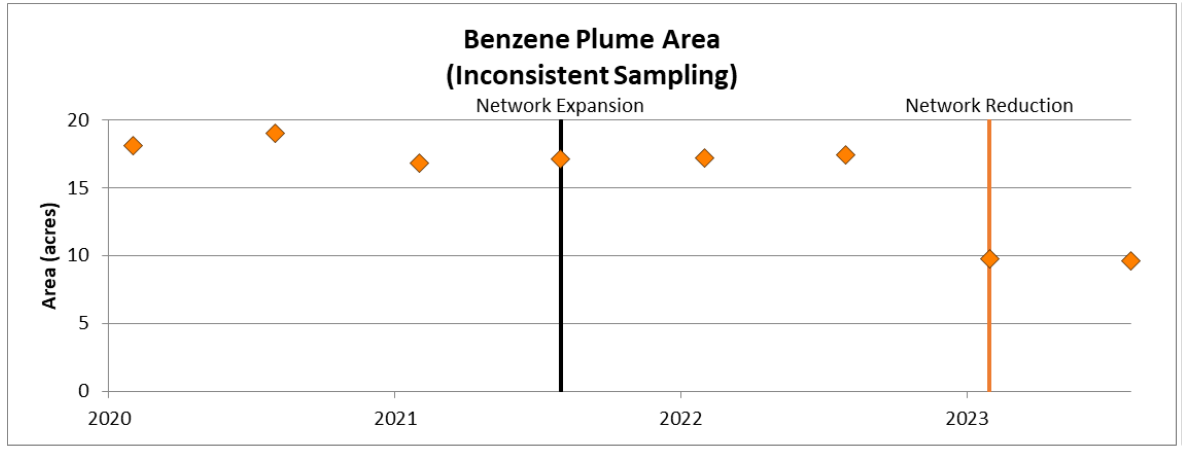
Concentration (µg/L)

5 50 100 250 500 1,000 2,500 5,000 7,500 10,000

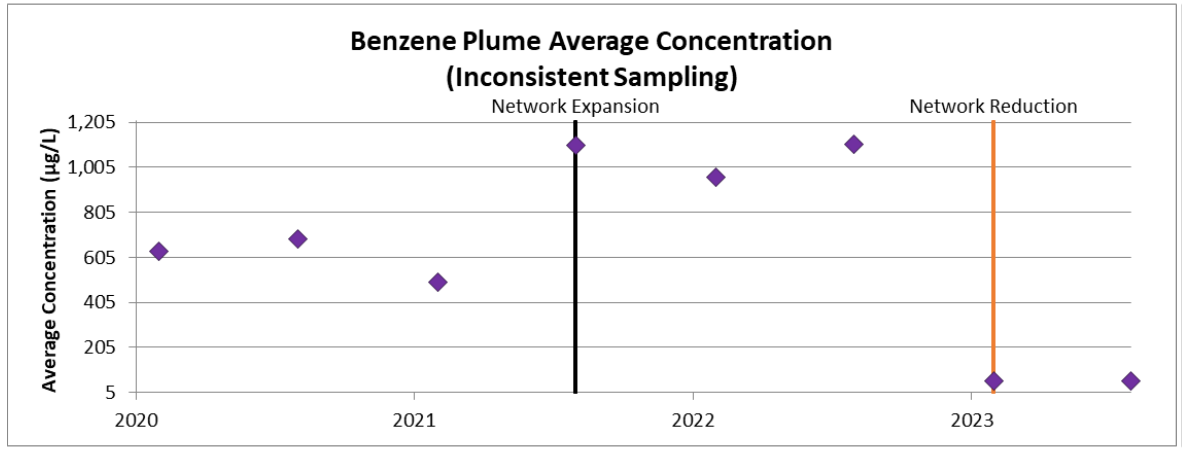
Plume Characteristics

Plume Area: **18.1 acres**
Plume Average Concentration: **632 µg/L**
Plume Mass Indicator: **93.5 lbs**

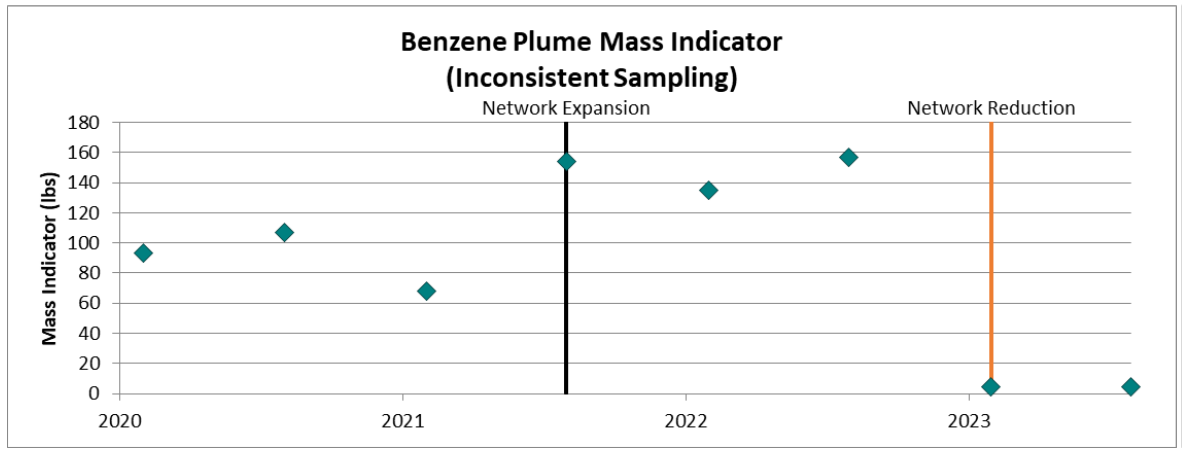
MW-1	Monitoring Well
	Hanging Well
112	Concentration (µg/L)
NS (146)	Well Not Sampled (Assigned Value Shown)
	Centre of Mass



Trendline NA



Trendline NA



Trendline NA

General Considerations for Plume Stability Assessments

- **Established network**
- **Quantity of data (time, events)**
- **Consistent sampling**
- **Handling of Non-Detects**

Non-Detects

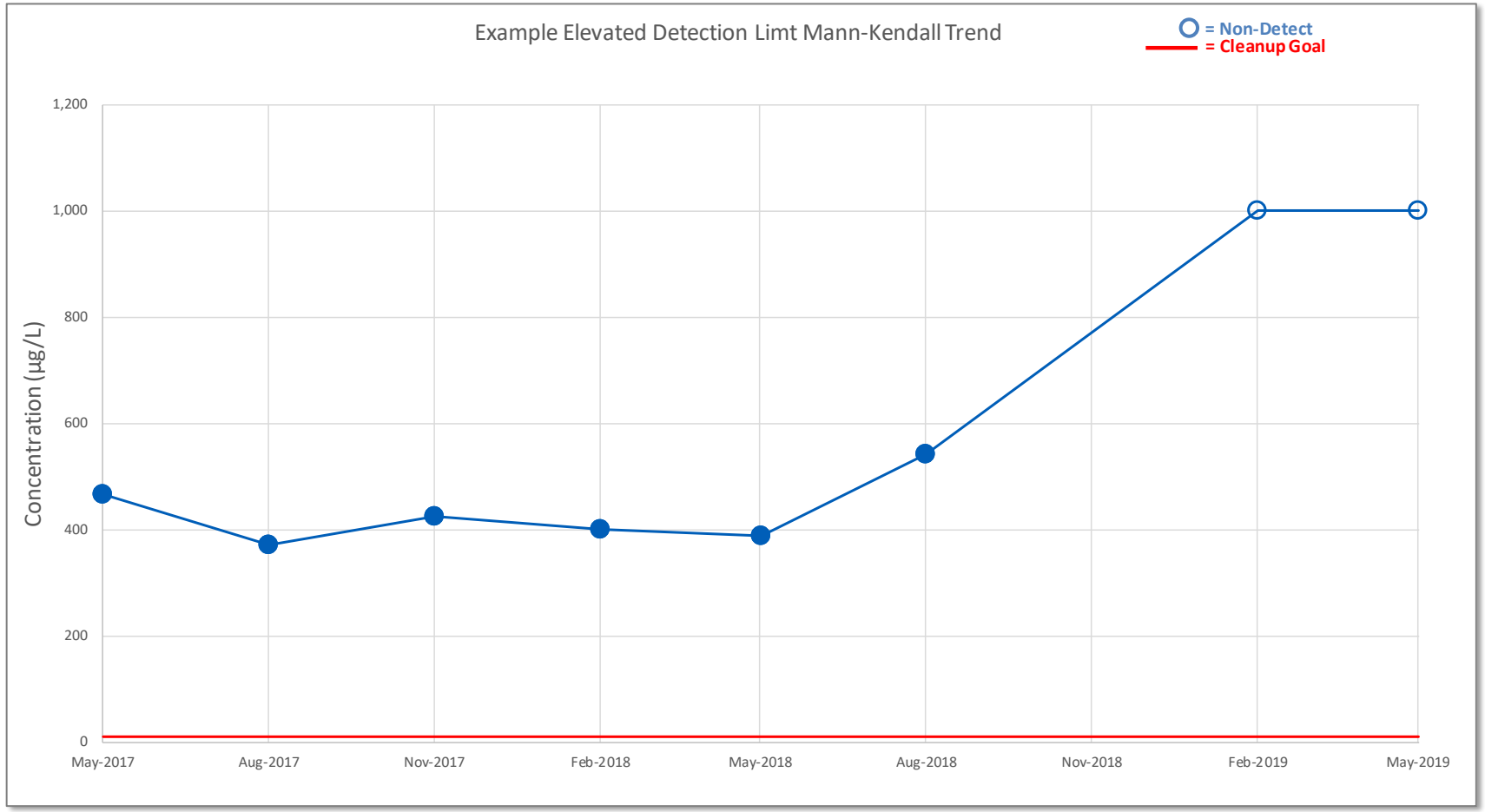
Benzene Results (µg/l)							
May-17	Aug-17	Nov-17	Feb-18	May-18	Aug-18	Feb-19	May-19
467	371	425	400	389	543	<1,000	<1,000

Data Set ID:	Example Elevated Detection Limt		
Units:	µg/L		
Event #	Date	Value	MK Value
1	05/01/2017	467	
2	08/01/2017	371	
3	11/01/2017	425	
4	02/01/2018	400	
5	05/01/2018	389	
6	08/01/2018	543	
7	02/01/2019	<1000	1,000
8	05/01/2019	<1000	1,000

Mann-Kendall Results	
n:	8
S:	13
SES:	8.02
Z:	1.50
Confidence Factor:	93%
Coefficient of Variation:	0.47
Conclusion:	**Increasing Trend**

Trend Threshold:	90%

Mann-Kendall Interpretation		
Mann-Kendall Statistic	**Statistical Confidence**	**Trend Conclusion**
S > 0	≥ 90%	Increasing
S > 0	< 90%	No Trend
S ≤ 0	< 90% and COV ≥ 1	No Trend
S ≤ 0	< 90% COV < 1	Stable
S < 0	≥ 90%	Decreasing

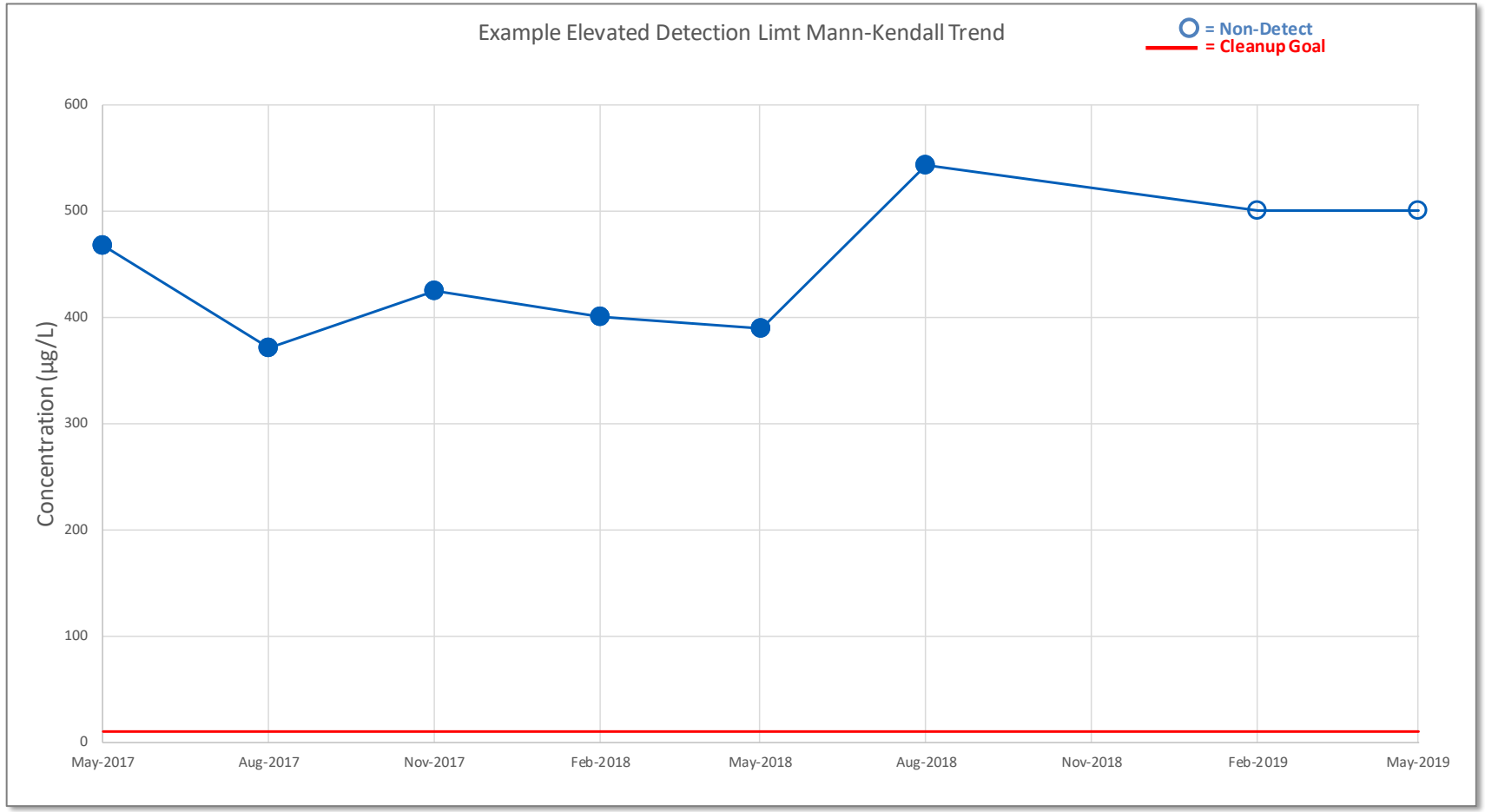


Data Set ID:	Example Elevated Detection Limt		
Units:	µg/L		
Event #	Date	Value	MK Value
1	05/01/2017	467	
2	08/01/2017	371	
3	11/01/2017	425	
4	02/01/2018	400	
5	05/01/2018	389	
6	08/01/2018	543	
7	02/01/2019	<1000	500
8	05/01/2019	<1000	500

Mann-Kendall Results	
n:	8
S:	9
SES:	8.02
Z:	1.00
Confidence Factor:	83%
Coefficient of Variation:	0.14
Conclusion:	**No Trend**

Trend Threshold:	90%

Mann-Kendall Interpretation		
Mann-Kendall Statistic	**Statistical Confidence**	**Trend Conclusion**
S > 0	≥ 90%	Increasing
S > 0	< 90%	No Trend
S ≤ 0	< 90% and COV ≥ 1	No Trend
S ≤ 0	< 90% COV < 1	Stable
S < 0	≥ 90%	Decreasing

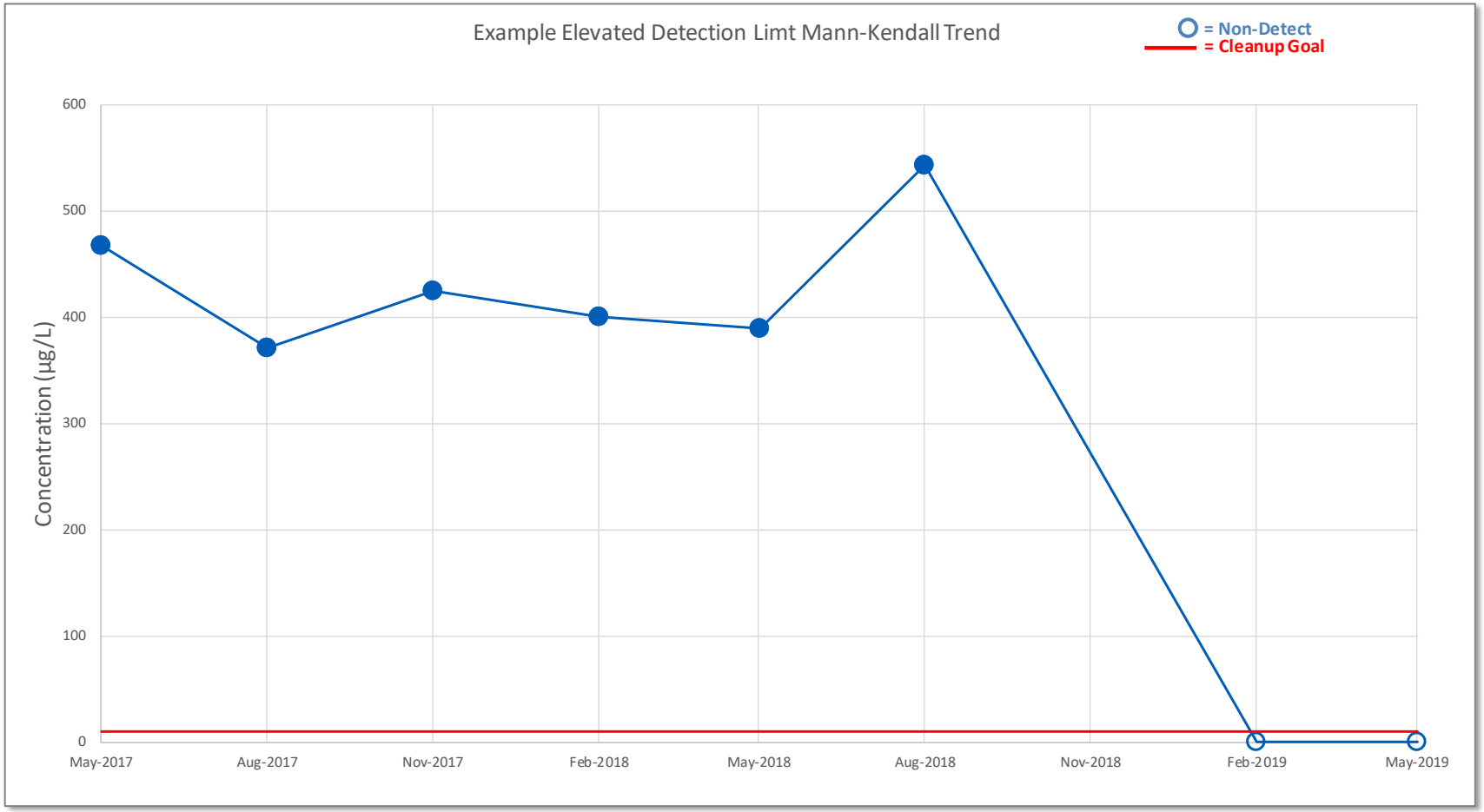


Data Set ID:	Example Elevated Detection Limt		
Units:	µg/L		
Event #	Date	Value	MK Value
1	05/01/2017	467	
2	08/01/2017	371	
3	11/01/2017	425	
4	02/01/2018	400	
5	05/01/2018	389	
6	08/01/2018	543	
7	02/01/2019	<1000	0
8	05/01/2019	<1000	0

Mann-Kendall Results	
n:	8
S:	-11
SES:	8.02
Z:	-1.25
Confidence Factor:	89%
Coefficient of Variation:	0.64
Conclusion:	**Stable**

Trend Threshold:	90%

Mann-Kendall Interpretation		
Mann-Kendall Statistic	**Statistical Confidence**	**Trend Conclusion**
S > 0	≥ 90%	Increasing
S > 0	< 90%	No Trend
S ≤ 0	< 90% and COV ≥ 1	No Trend
S ≤ 0	< 90% COV < 1	Stable
S < 0	≥ 90%	Decreasing



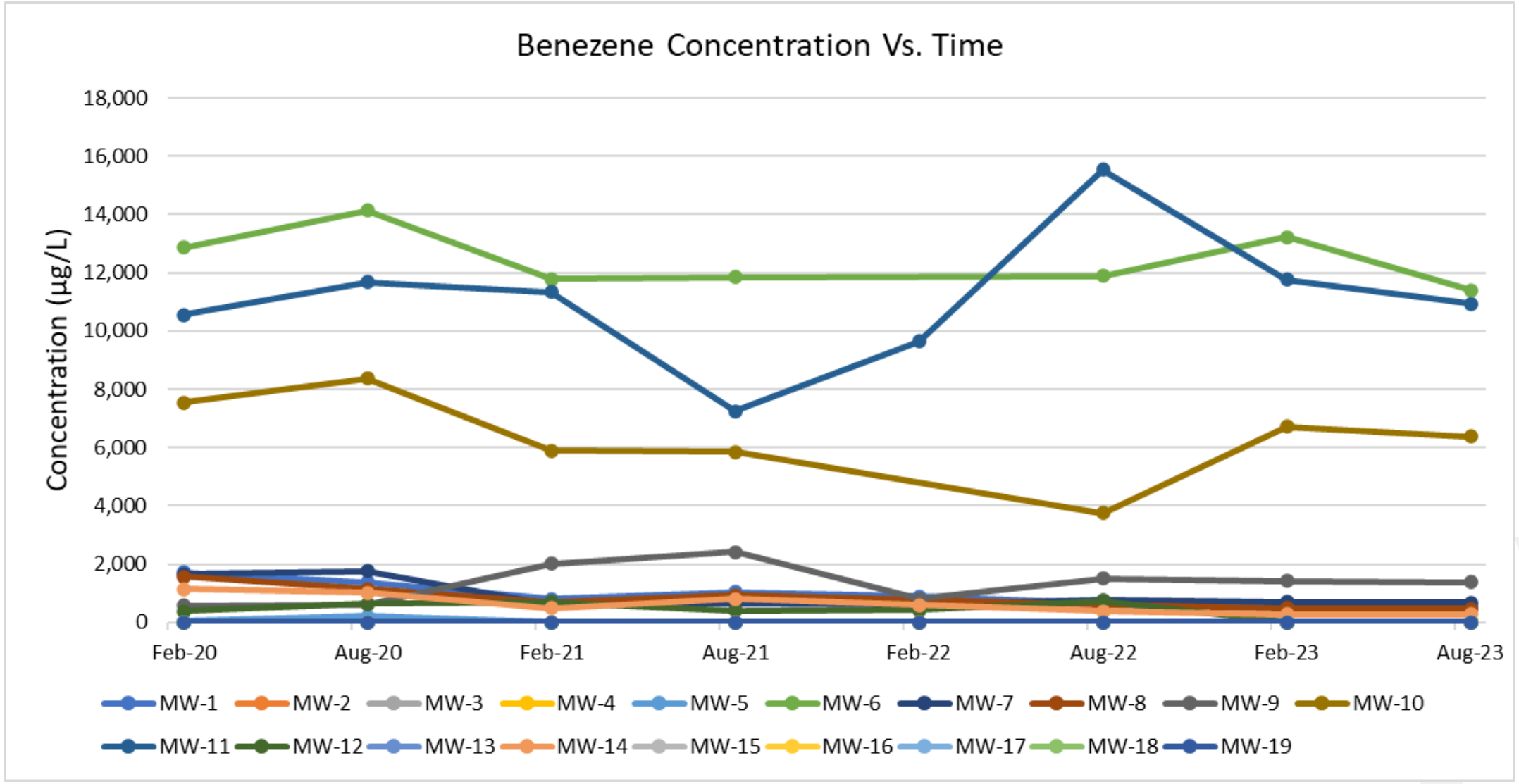
Plume Stability Assessment Methods - Overview

- **Qualitative**
- **Well-by-Well**
- **Plume-Based**

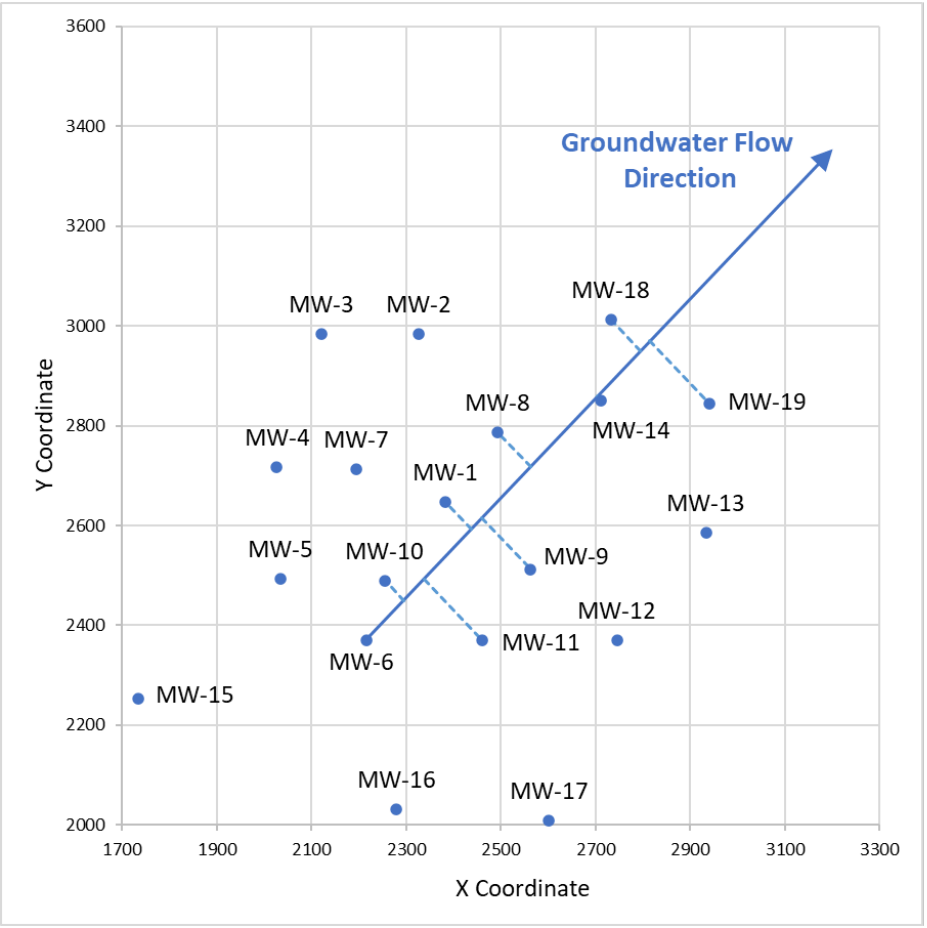
Plume Stability Assessment Methods - Overview

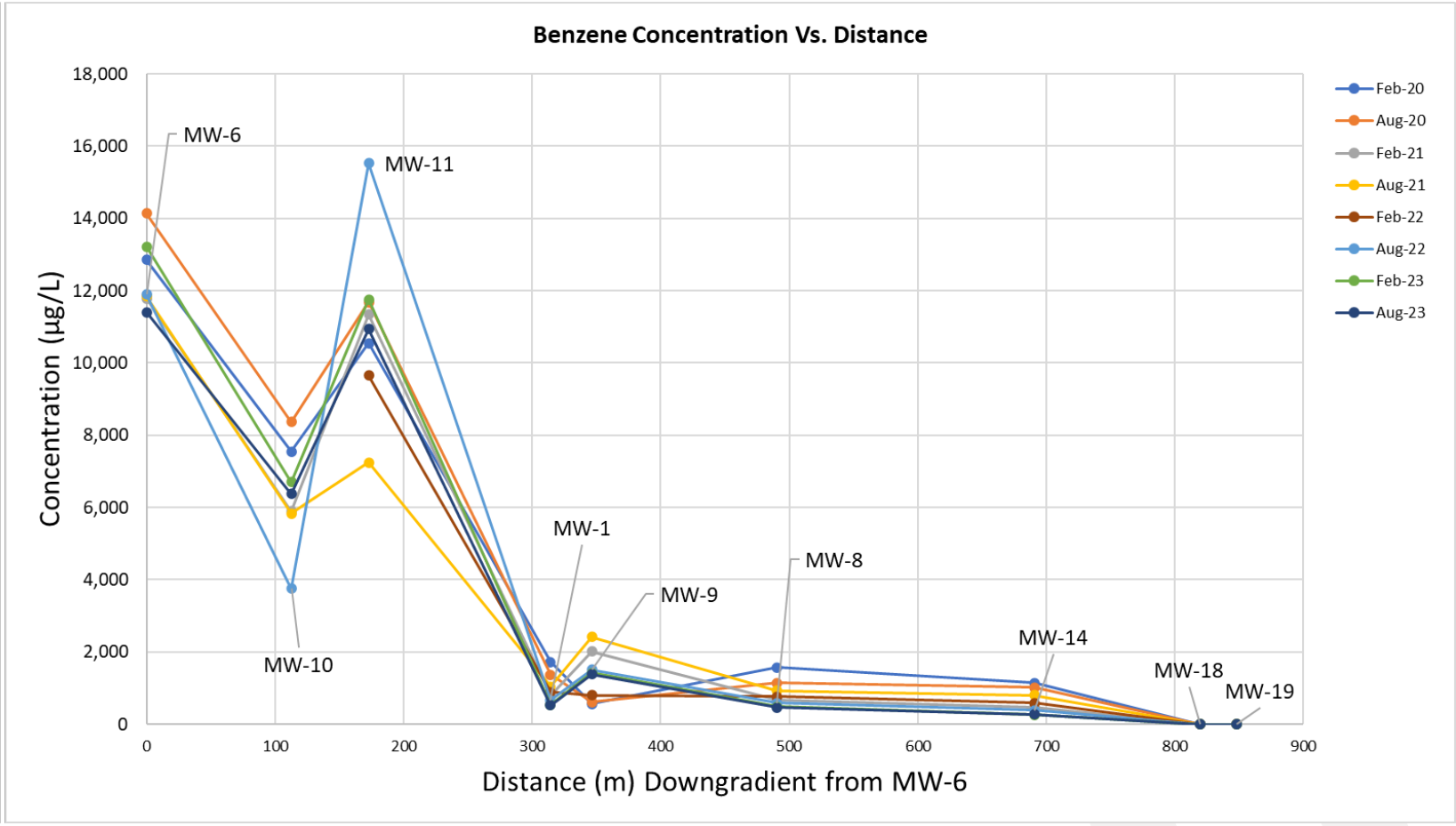
Well	Coordinates		Benzene Monitoring Data (µg/l)							
	X	Y	Feb-20	Aug-20	Feb-21	Aug-21	Feb-22	Aug-22	Feb-23	Aug-23
MW-1	2382	2647	1,723	1,372	801	1,042	895	661	538	533
MW-2	2326	2983	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3	2120	2984	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4	2026	2716	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5	2035	2493	35	204	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6	2215	2370	12,854	14,143	11,786	11,845	--	11,895	13,222	11,400
MW-7	2194	2713	1,643	1,757	624	643	592	758	697	676
MW-8	2492	2787	1,568	1,139	681	927	770	595	484	460
MW-9	2563	2513	563	612	2,020	2,414	803	1,511	1,417	1,387
MW-10	2255	2490	7,541	8,370	5,891	5,838	--	3,749	6,708	6,373
MW-11	2459	2371	10,551	11,680	11,345	7,247	9,650	15,529	11,755	10,932
MW-12	2746	2370	381	635	688	395	423	751	13	12
MW-13	2934	2586	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-14	2711	2851	1,145	1,014	477	807	585	387	266	269
MW-15	1733	2253	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-16	2280	2031	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-17	2602	2008	<1.0	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0
MW-18	2732	3013	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MW-19	2941	2844	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Qualitative Plume Stability Assessments

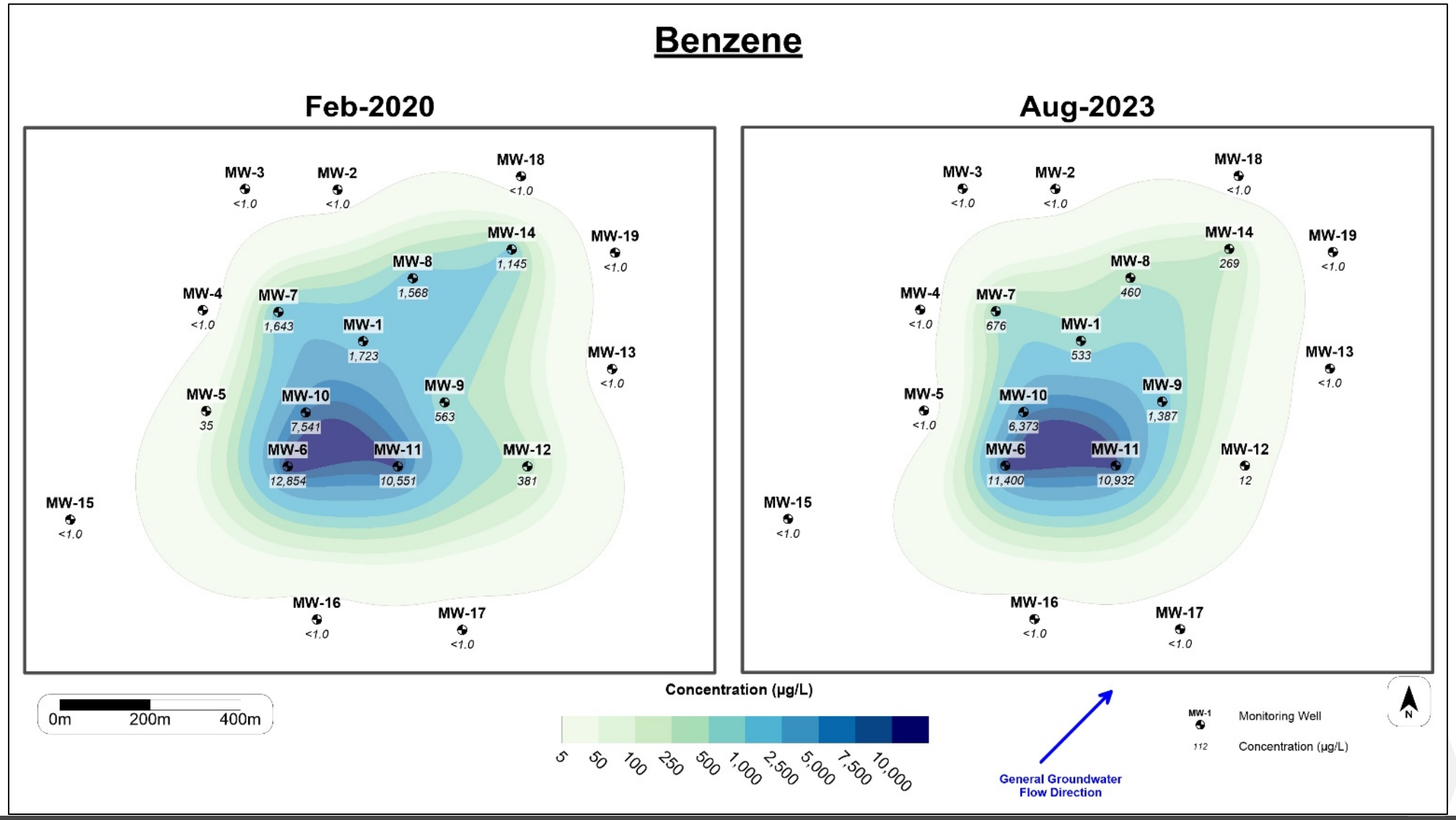


Qualitative Plume Stability Assessments





Qualitative Plume Stability Assessments



Well-by-Well Plume Stability Assessments

- **Mann-Kendall Test**
- **Linear Regression**

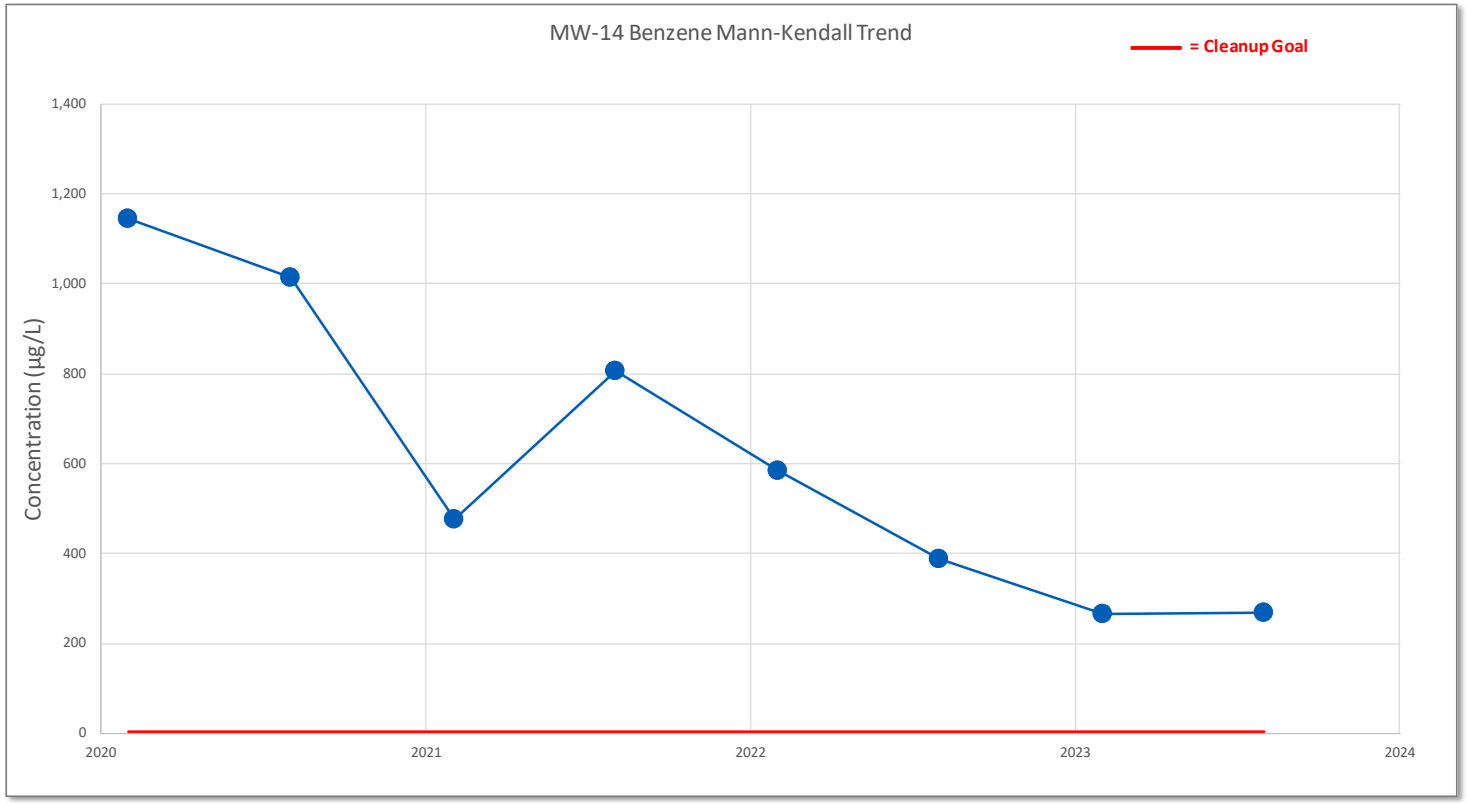
Mann-Kendall Test

Data Set ID:	MW-14 Benzene		
Units:	µg/L		
Event #	Date	Value	MK Value
1	02/01/2020	1,145	
2	08/01/2020	1,014	
3	02/01/2021	477	
4	08/01/2021	807	
5	02/01/2022	585	
6	08/01/2022	387	
7	02/01/2023	266	
8	08/01/2023	269	

Mann-Kendall Results	
n:	8
S:	-22
SES:	8.08
Z:	-2.60
Confidence Factor:	>99%
Coefficient of Variation:	0.54
Conclusion:	**Decreasing Trend**

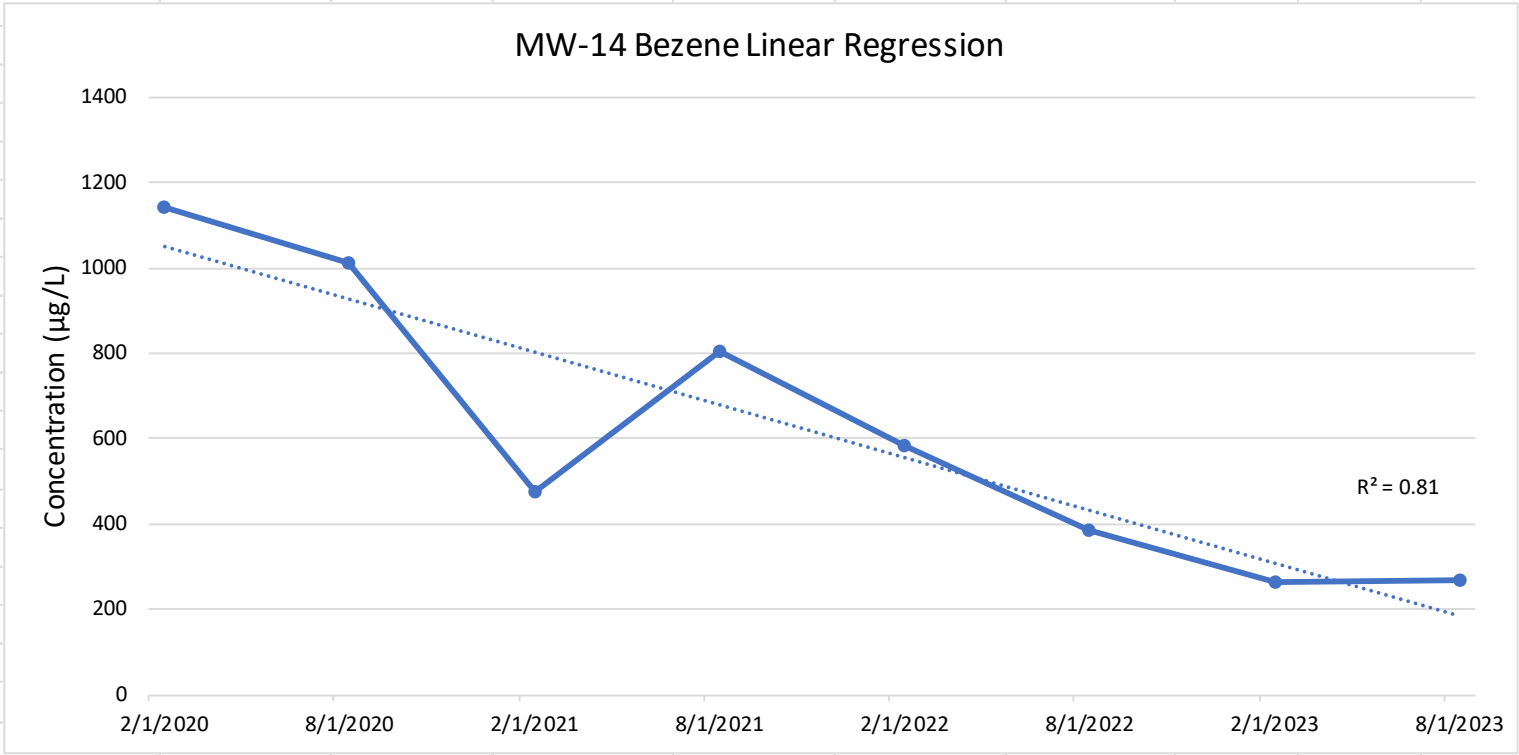
Trend Threshold:	90%

Mann-Kendall Interpretation		
Mann-Kendall Statistic	**Statistical Confidence**	**Trend Conclusion**
S > 0	≥ 90%	Increasing
S > 0	< 90%	No Trend
S ≤ 0	< 90% and COV ≥ 1	No Trend
S ≤ 0	< 90% COV < 1	Stable
S < 0	≥ 90%	Decreasing



Linear Regression

MW-14	Benzene (µg/L)
2/1/2020	1145
8/1/2020	1014
2/1/2021	477
8/1/2021	807
2/1/2022	585
8/1/2022	387
2/1/2023	266
8/1/2023	269



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.90
R Square	0.81
Adjusted R Square	0.78
Standard Error	158.28
Observations	8.00

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	639990.6370	639990.6370	25.5474	0.0023
Residual	6	150306.8630	25051.1438		
Total	7	790297.5000			

Confidence Factor 99.8%

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	30716.83867	5955.045206	5.158120149	0.002098568	16145.36798	45288.30936	16145.36798	45288.30936
X Variable 1	-0.676348244	0.133812701	-5.054439818	0.002323411	-1.003776128	-0.34892036	-1.003776128	-0.34892036

Mann-Kendall Test Summary

Data Set ID	n	S	SES	Z	Confidence Factor	Coefficient of Variation	Conclusion	Most Recent Value	Units	All Values Below Screening Level	Most Recent Value Below Screening Level
MW-6 Benzene	7	-5	6.66	-0.6	72%	0.08	Stable	11,400	µg/L	N	N
MW-7 Benzene	8	-6	8.08	-0.62	73%	0.52	Stable	676	µg/L	N	N
MW-8 Benzene	8	-24	8.08	-2.85	>99%	0.45	Decreasing Trend	460	µg/L	N	N
MW-9 Benzene	8	6	8.08	0.62	73%	0.49	No Trend	1,387	µg/L	N	N
MW-10 Benzene	7	-7	6.66	-0.9	81%	0.23	Stable	6,373	µg/L	N	N
MW-11 Benzene	8	4	8.08	0.37	64%	0.21	No Trend	10,932	µg/L	N	N
MW-12 Benzene	8	-6	8.08	-0.62	73%	0.69	Stable	11.76	µg/L	N	N
MW-14 Benzene	8	-22	8.08	-2.6	>99%	0.54	Decreasing Trend	269	µg/L	N	N

n - number of data points

S - sum of comparisons

SES - square root of variance

Z - Mann-Kendall Statistic

Wells not listed were always non-detect

Plume-Based Methods

- **Ricker Method® Plume Stability**
- **GWSDAT**
- **MAROS**
- **Mass Discharge/Mass Flux**

- **Analysis of plume-wide metrics**
  - Area
  - Concentration
  - Mass
  - Centre of Mass
  - Spread of Mass

Missing Data for Plume-Based Methods

Well	Coordinates		Benzene Monitoring Data (µg/l)							
	X	Y	Feb-20	Aug-20	Feb-21	Aug-21	Feb-22	Aug-22	Feb-23	Aug-23
MW-1	2382	2647	1,723	1,372	801	1,042	895	661	538	533
MW-2	2326	2983	<1	<1	<1	<1	<1	<1	<1	<1
MW-3	2120	2984	<1	<1	<1	<1	<1	<1	<1	<1
MW-4	2026	2716	<1	<1	<1	<1	<1	<1	<1	<1
MW-5	2035	2493	35	204	<1	<1	<1	<1	<1	<1
MW-6	2215	2370	12,854	14,143	11,786	11,845		11,895	13,222	11,400
MW-7	2194	2713	1,643	1,757	624	643	592	758	697	676
MW-8	2492	2787	1,568	1,139	681	927	770	595	484	460
MW-9	2563	2513	563	612	2,020	2,414	803	1,511	1,417	1,387
MW-10	2255	2490	7,541	8,370	5,891	5,838		3,749	6,708	6,373
MW-11	2459	2371	10,551	11,680	11,345	7,247	9,650	15,529	11,755	10,932
MW-12	2746	2370	381	635	688	395	423	751	13	12
MW-13	2934	2586	<1	<1	<1	<1	<1	<1	<1	<1
MW-14	2711	2851	1,145	1,014	477	807	585	387	266	269
MW-15	1733	2253	<1	<1	<1	<1	<1	<1	<1	<1
MW-16	2280	2031	<1	<1	<1	<1	<1	<1	<1	<1
MW-17	2602	2008	<1	<1	<1	<1		<1	<1	<1
MW-18	2732	3013	<1	<1	<1	<1	<1	<1	<1	<1
MW-19	2941	2844	<1	<1	<1	<1	<1	<1	<1	<1

Missing Data for Plume-Based Methods

Well	Coordinates		Benzene Monitoring Data (µg/l)							
	X	Y	Feb-20	Aug-20	Feb-21	Aug-21	Feb-22	Aug-22	Feb-23	Aug-23
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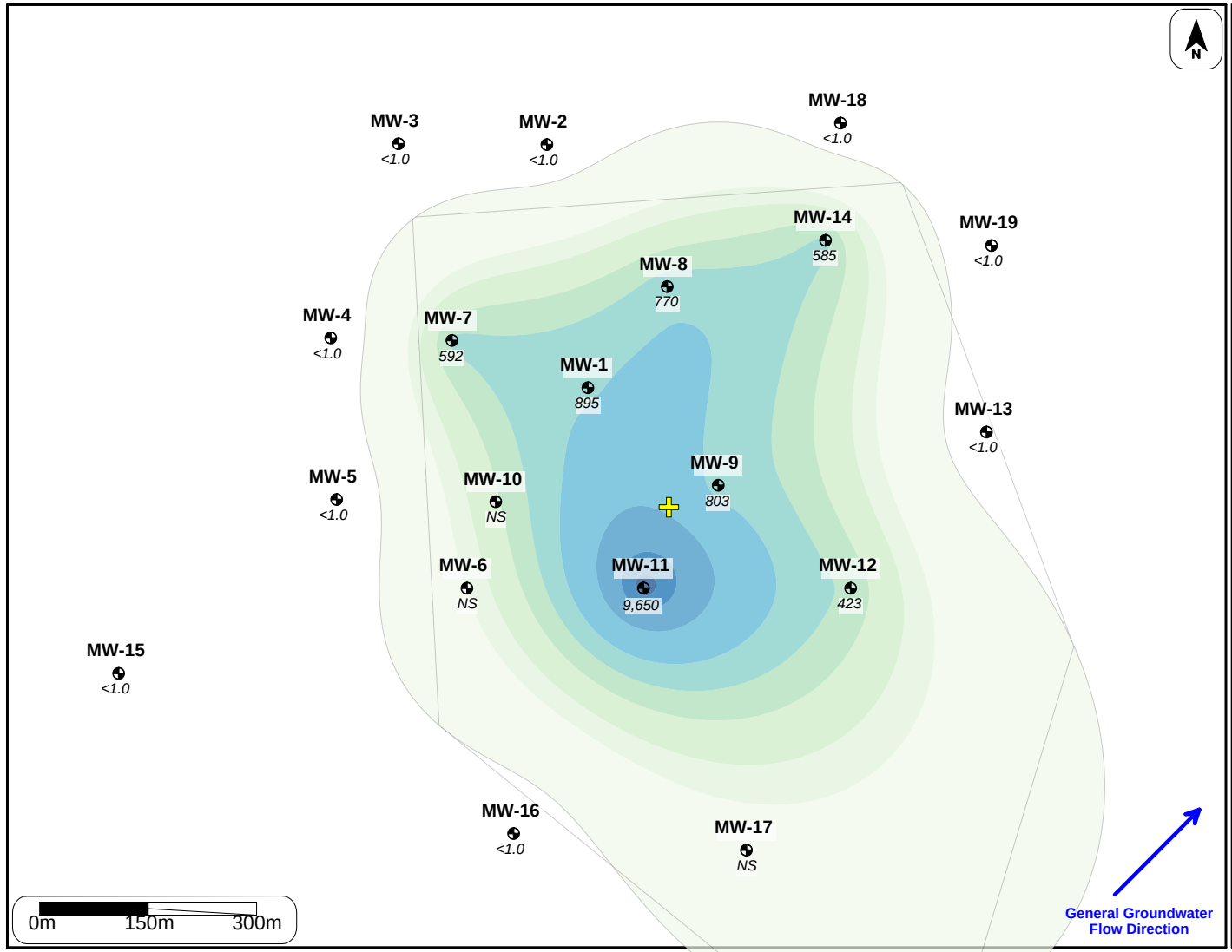
MW-2	2326	2983	<1	<1	<1	<1	<1	<1	<1	<1
MW-3	2120	2984	<1	<1	<1	<1	<1	<1	<1	<1
MW-4	2026	2716	<1	<1	<1	<1	<1	<1	<1	<1
MW-5	2035	2493	35	204	<1	<1	<1	<1	<1	<1
MW-6	2215	2370	12,854	14,143	11,786	11,845	11,870	11,895	13,222	11,400
MW-7	2194	2713	1,643	1,757	624	643	592	758	697	676
MW-8	2492	2787	1,568	1,139	681	927	770	595	484	460
MW-9	2563	2513	563	612	2,020	2,414	803	1,511	1,417	1,387
MW-10	2255	2490	7,541	8,370	5,891	5,838	4,785	3,749	6,708	6,373
MW-11	2459	2371	10,551	11,680	11,345	7,247	9,650	15,529	11,755	10,932
MW-12	2746	2370	381	635	688	395	423	751	13	12
MW-13	2934	2586	<1	<1	<1	<1	<1	<1	<1	<1
MW-14	2711	2851	1,145	1,014	477	807	585	387	266	269
MW-15	1733	2253	<1	<1	<1	<1	<1	<1	<1	<1
MW-16	2280	2031	<1	<1	<1	<1	<1	<1	<1	<1
MW-17	2602	2008	<1	<1	<1	<1	<1	<1	<1	<1
MW-18	2732	3013	<1	<1	<1	<1	<1	<1	<1	<1
MW-19	2941	2844	<1	<1	<1	<1	<1	<1	<1	<1

Missing Data for Plume-Based Methods



Benzene

Feb-2022

Concentration (µg/L)

5 50 100 250 500 1,000 2,500 5,000 7,500 10,000

Plume Characteristics

Plume Area: **20.8 acres**

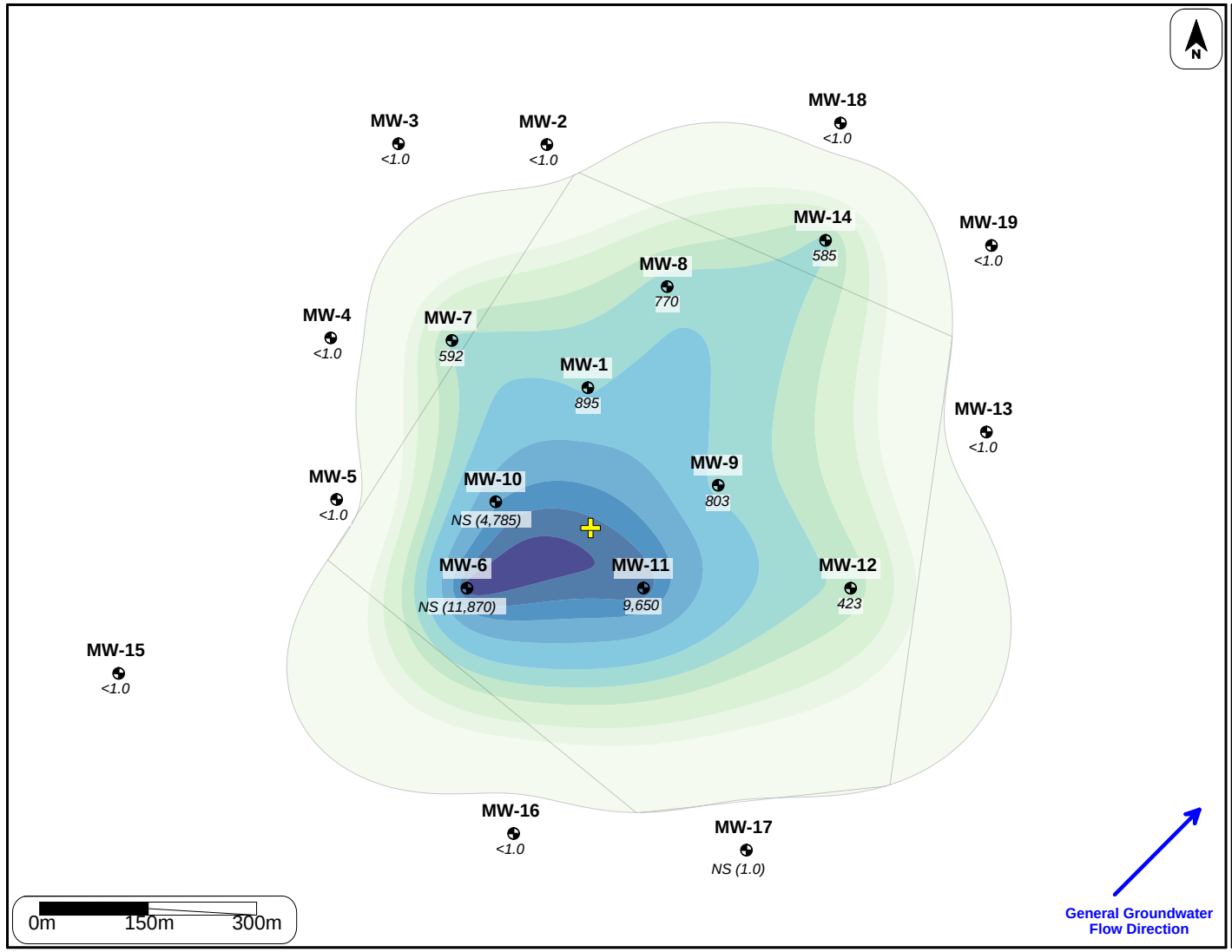
Plume Average Concentration: **364 µg/L**

Plume Mass Indicator: **61.9 lbs**

MW-1	Monitoring Well
	Hanging Well
112	Concentration (µg/L)
NS (146)	Well Not Sampled (Assigned Value Shown)
	Centre of Mass

WSP

Missing Data for Plume-Based Methods



Benzene

Feb-2022

Concentration (µg/L)

5 50 100 250 500 1,000 2,500 5,000 7,500 10,000

Plume Characteristics

Plume Area: **17.2 acres**

Plume Average Concentration: **961 µg/L**

Plume Mass Indicator: **135 lbs**

MW-1 Monitoring Well

Hanging Well

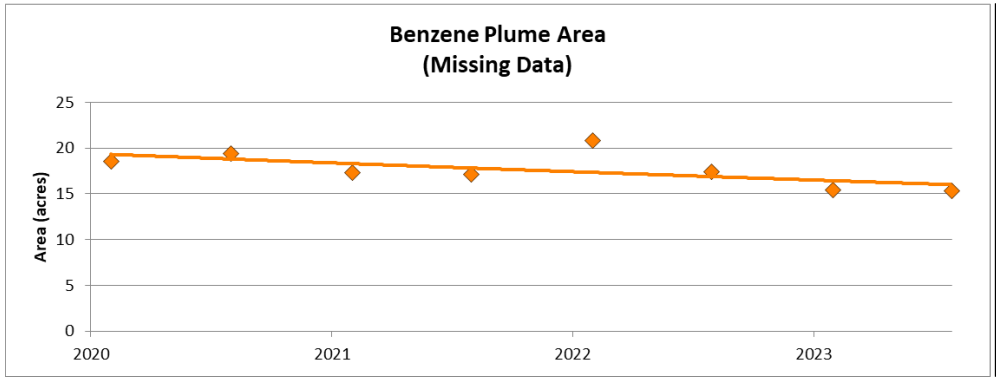
112 Concentration (µg/L)

NS (146) Well Not Sampled (Assigned Value Shown)

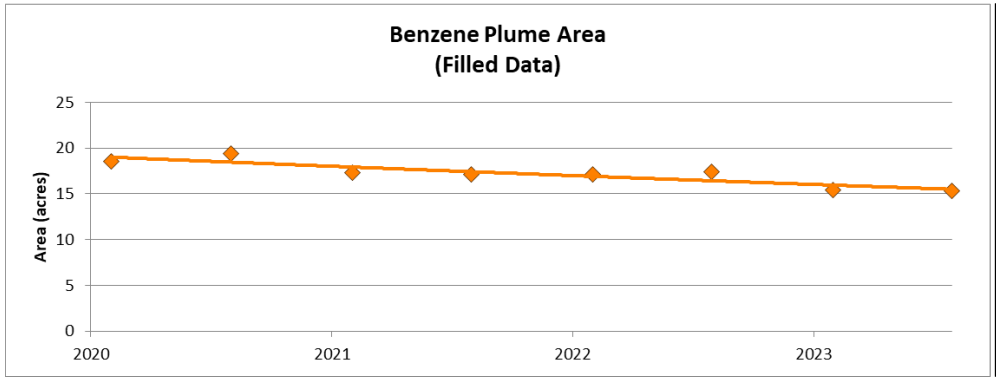
Centre of Mass

WSP

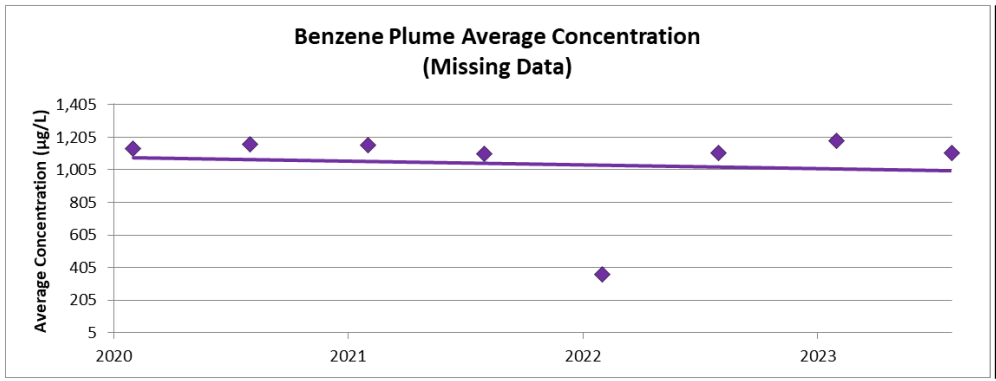
Missing Data for Plume-Based Methods



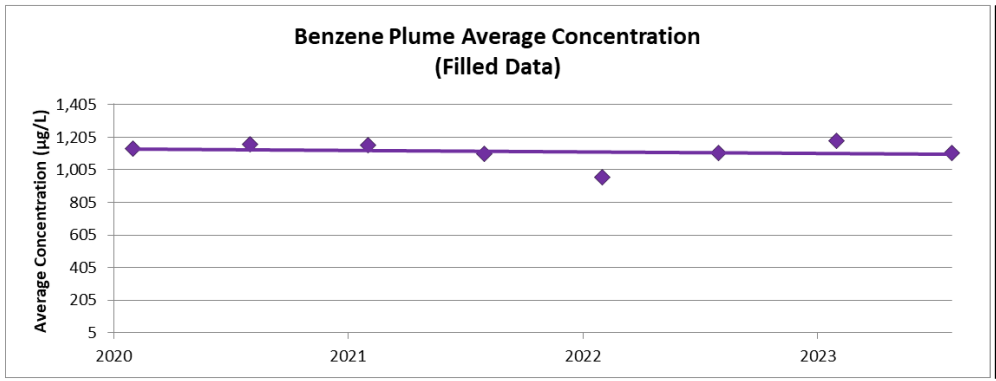
Feb-2020 to Aug-2023
Decreasing Trend
Mann-Kendall: 95% Confidence
Regression: 90% Confidence



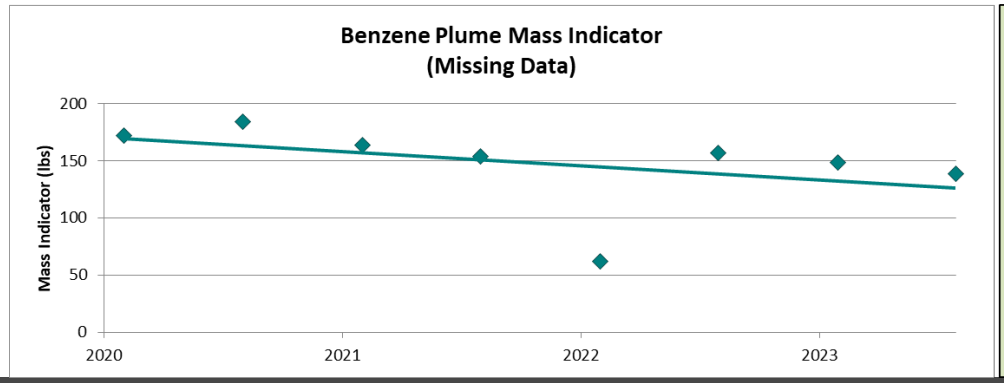
Feb-2020 to Aug-2023
Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: >99% Confidence



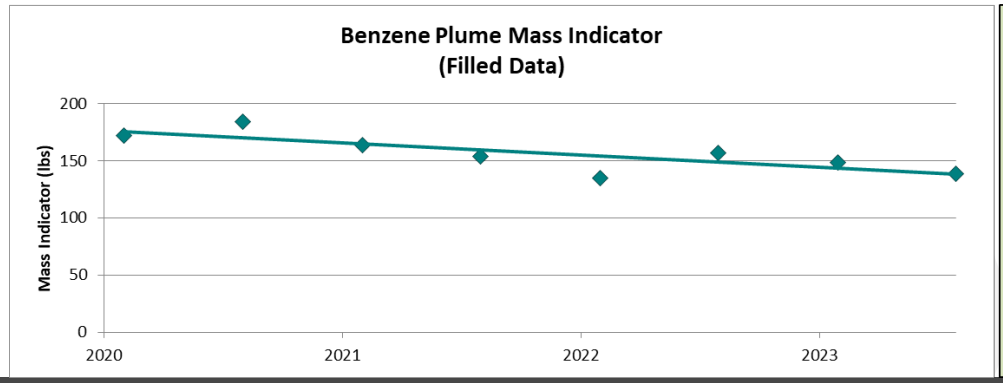
Feb-2020 to Aug-2023
Stable
Mann-Kendall: 55% Confidence
Regression: 19% Confidence



Feb-2020 to Aug-2023
Stable
Mann-Kendall: 55% Confidence
Regression: 30% Confidence



Feb-2020 to Aug-2023
Stable/Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: 68% Confidence

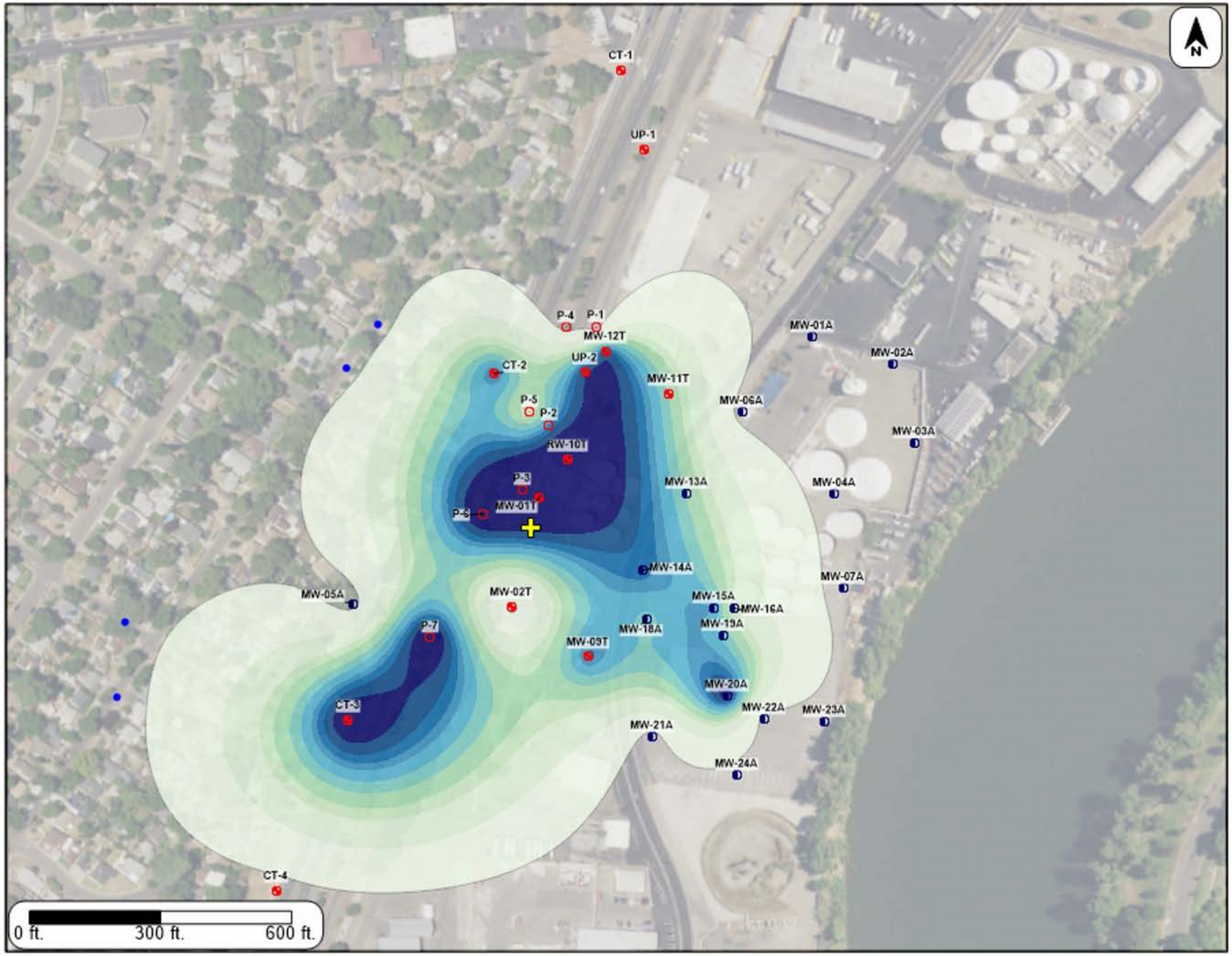


Feb-2020 to Aug-2023
Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: 98% Confidence

CSM: Petroleum Hydrocarbon Site

Petroleum Hydrocarbon Site

- **Bulk fuel terminal in northern California**
- **Two water-bearing zones**
  - shallow A-Zone and deeper B-Zone
- **Multiple remediation systems employed 1990s – 2019**
- **Contaminants of concern**
  - total petroleum hydrocarbons as gasoline (TPHg)
  - total petroleum hydrocarbons as diesel (TPHd)
  - Benzene
  - Toluene
  - Ethylbenzene
  - Xylenes
  - methyl tert-butyl ether (MTBE)
  - tert-butyl alcohol (TBA)



Benzene
A-Zone
Jan-1994

Concentration (µg/L)

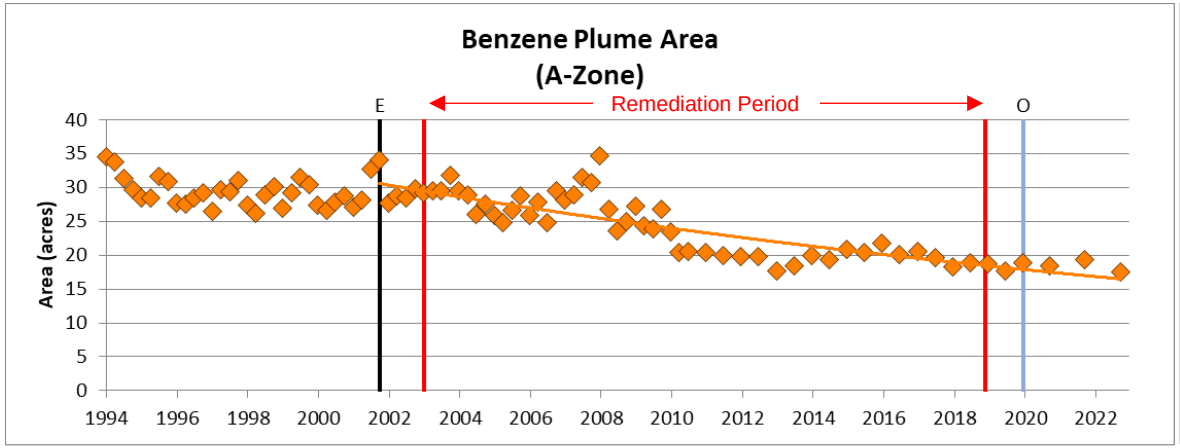
1 10 50 100 250 500 1,000 1,500 2,500 5,000

Plume Characteristics

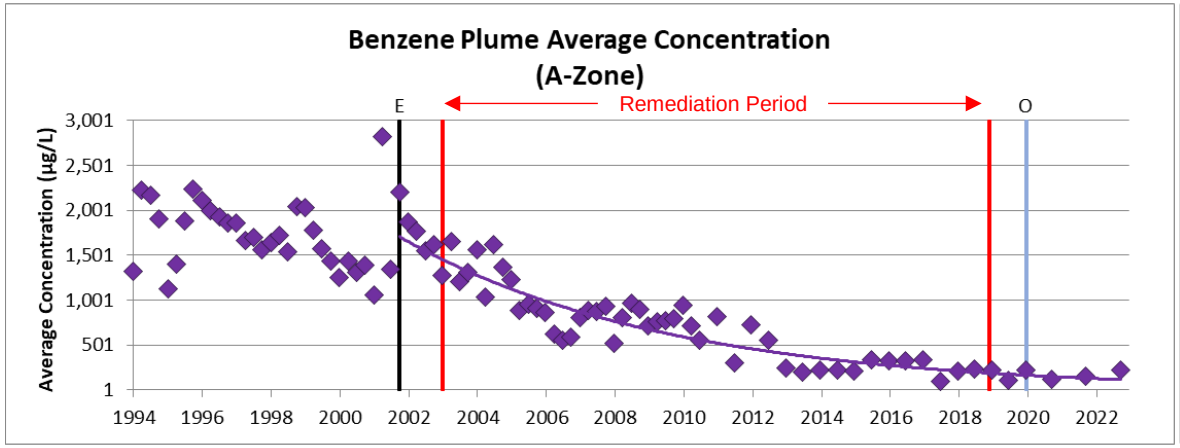
Plume Area: **34.6 acres**
Plume Average Concentration: **1,317 µg/L**
Plume Mass Indicator: **1,115 lbs**

- FTT Monitoring Well
- FTT Piezometer
- Buckeye Monitoring Well
- 7-11 Monitoring Well
- Hanging Well
- Control Point
- Plume Center of Mass
- Sparge Well
- U-Shaped Oxygen Well
- Vapor Extraction Well
- Dual Phase Extraction Well
- Groundwater Extraction Well

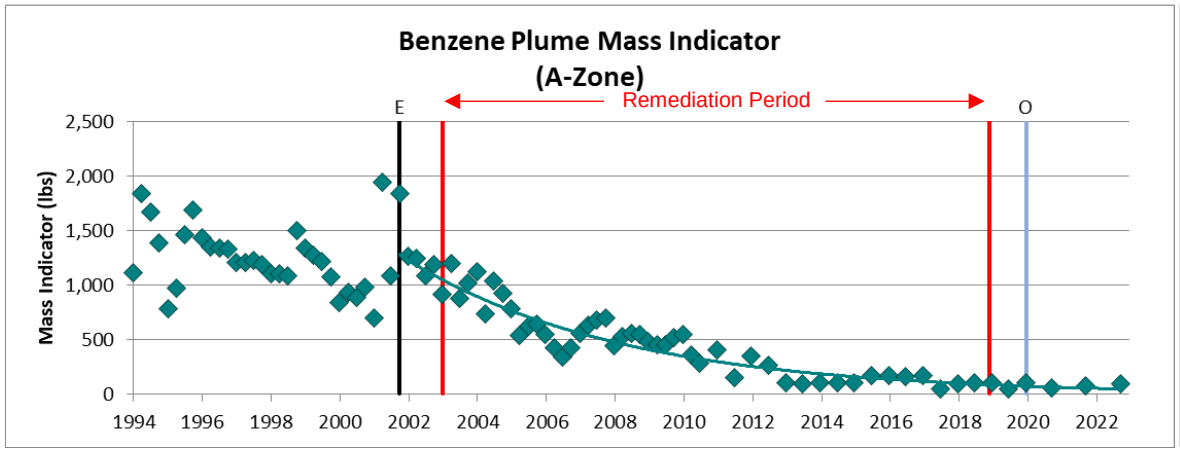
WSP



Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

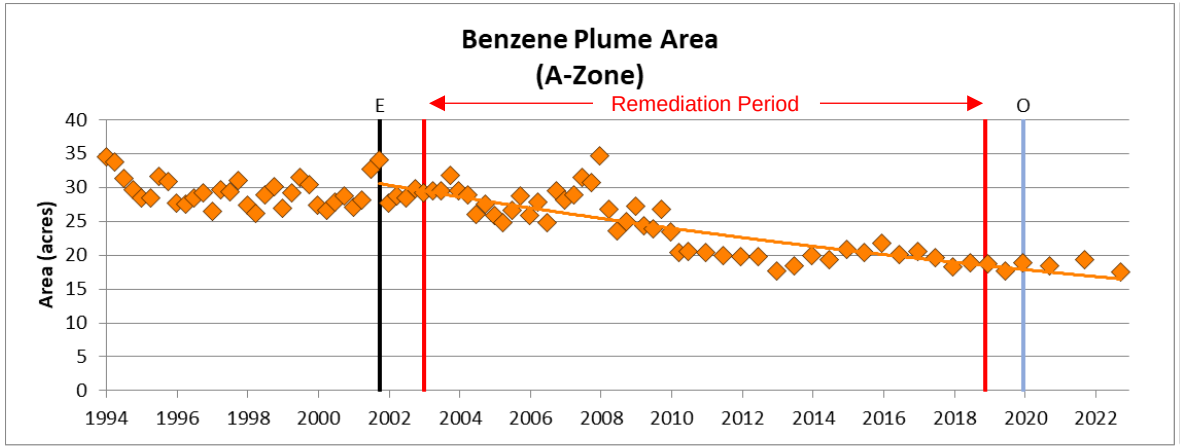


Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

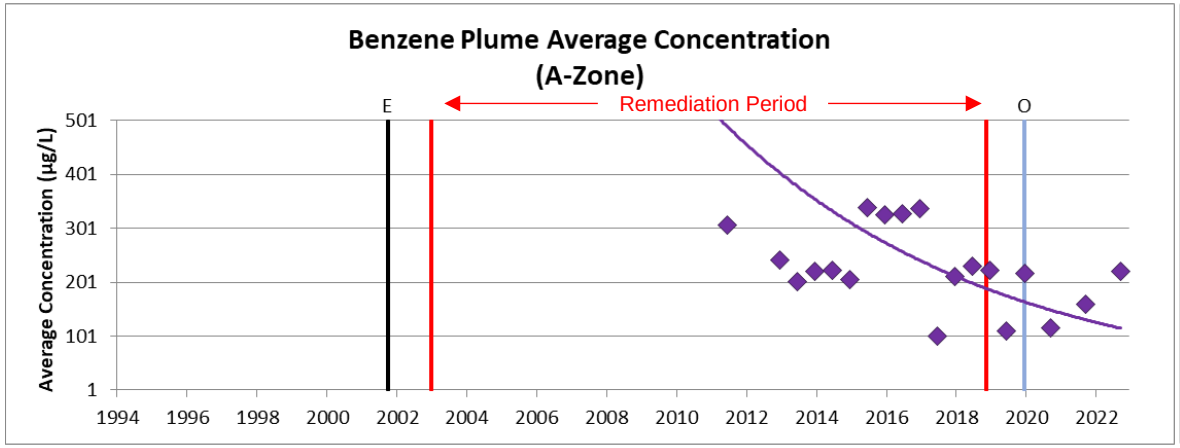


Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

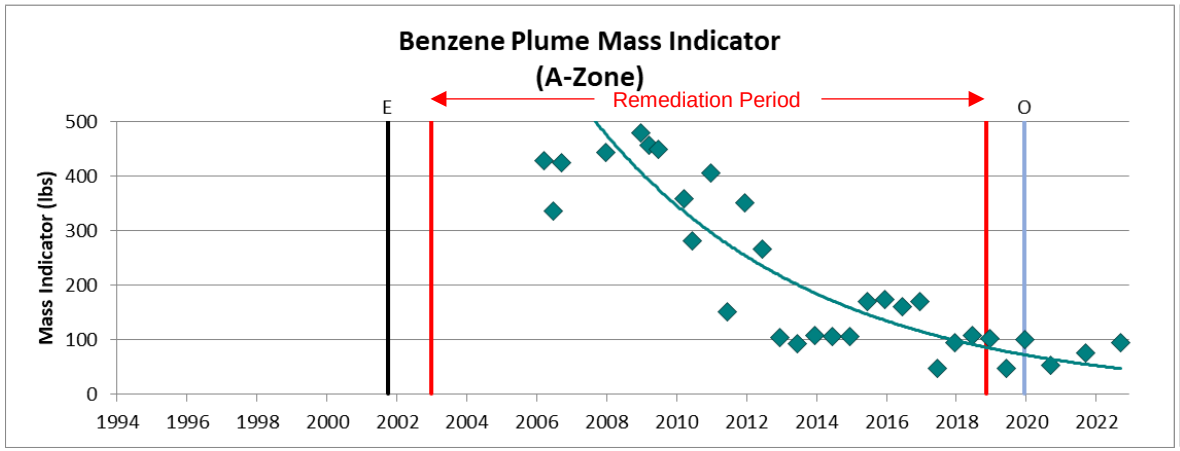
E – Network Expansion
O – Network Optimization



Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

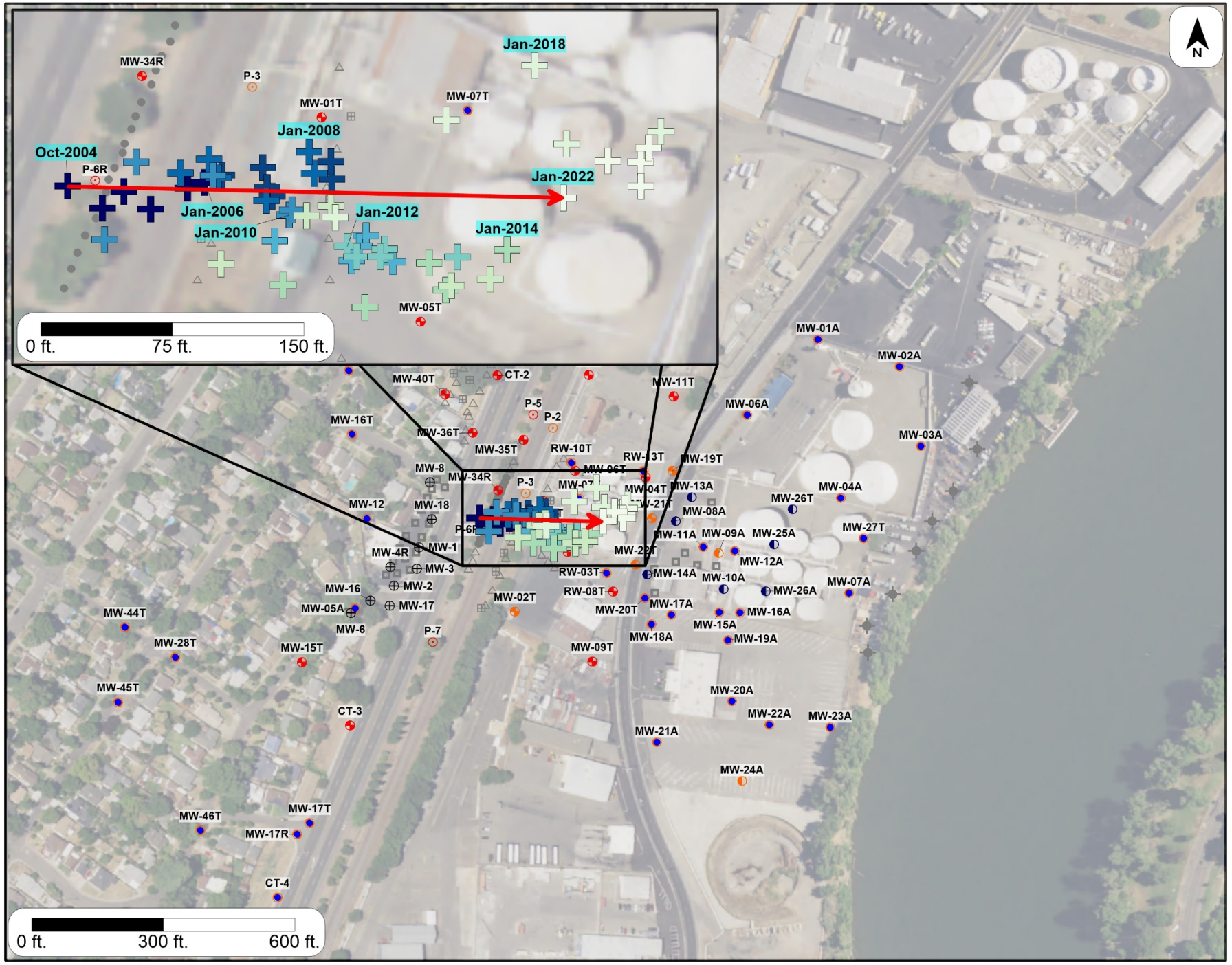


Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence



Oct-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

E – Network Expansion
O – Network Optimization

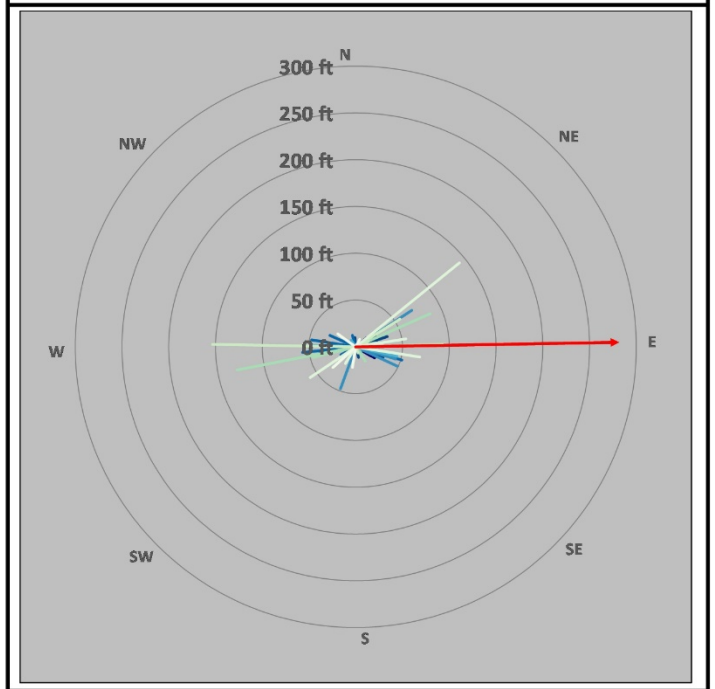


Benzene

A-Zone

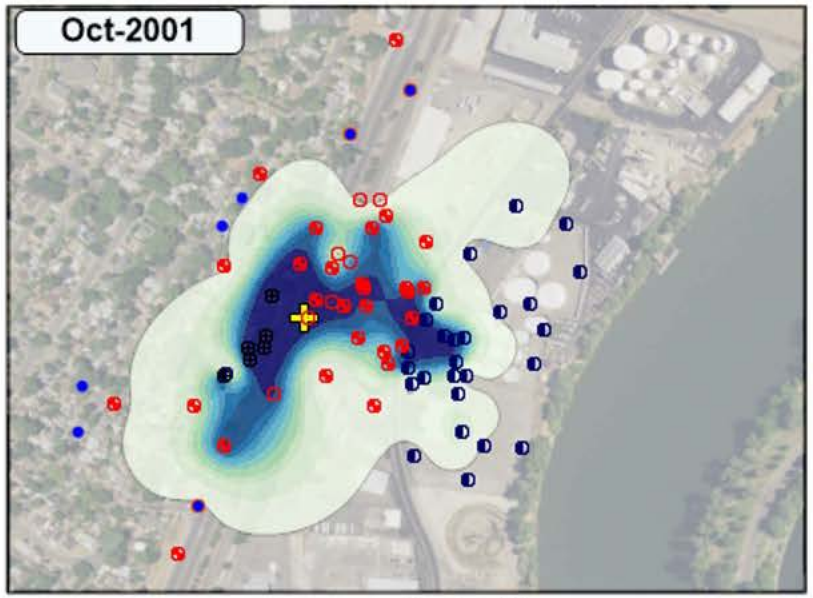
Center of Mass Scale

2004 → 2022



- FFT Monitoring Well
- FFT Piezometer
- Buckeye Monitoring Well
- 7-11 Monitoring Well
- Hanging Well
- Center Of Mass Movement
- Net Movement
- Control Point
- Sparge Well
- U-Shaped Oxygen Well
- Vapor Extraction Well
- Dual Phase Extraction Well
- Groundwater Extraction Well

Benzene A-Zone Spatial Changes Oct-2001 vs Jan-2002



Plume Characteristics

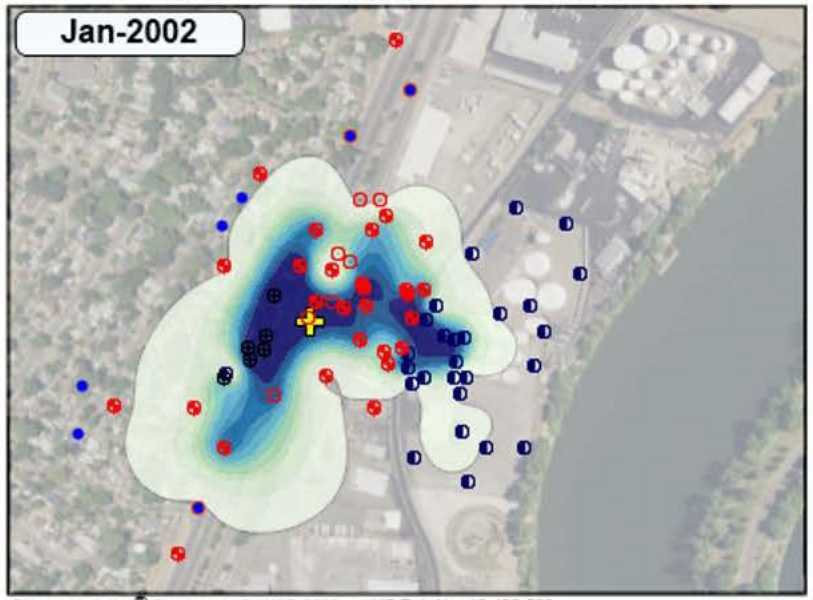
Area: **19% Decrease**
Average Concentration: **15% Decrease**
Mass Indicator: **31% Decrease**
Mass Increase: **19.3 lbs Increase**
Mass Decrease: **597 lbs Decrease**

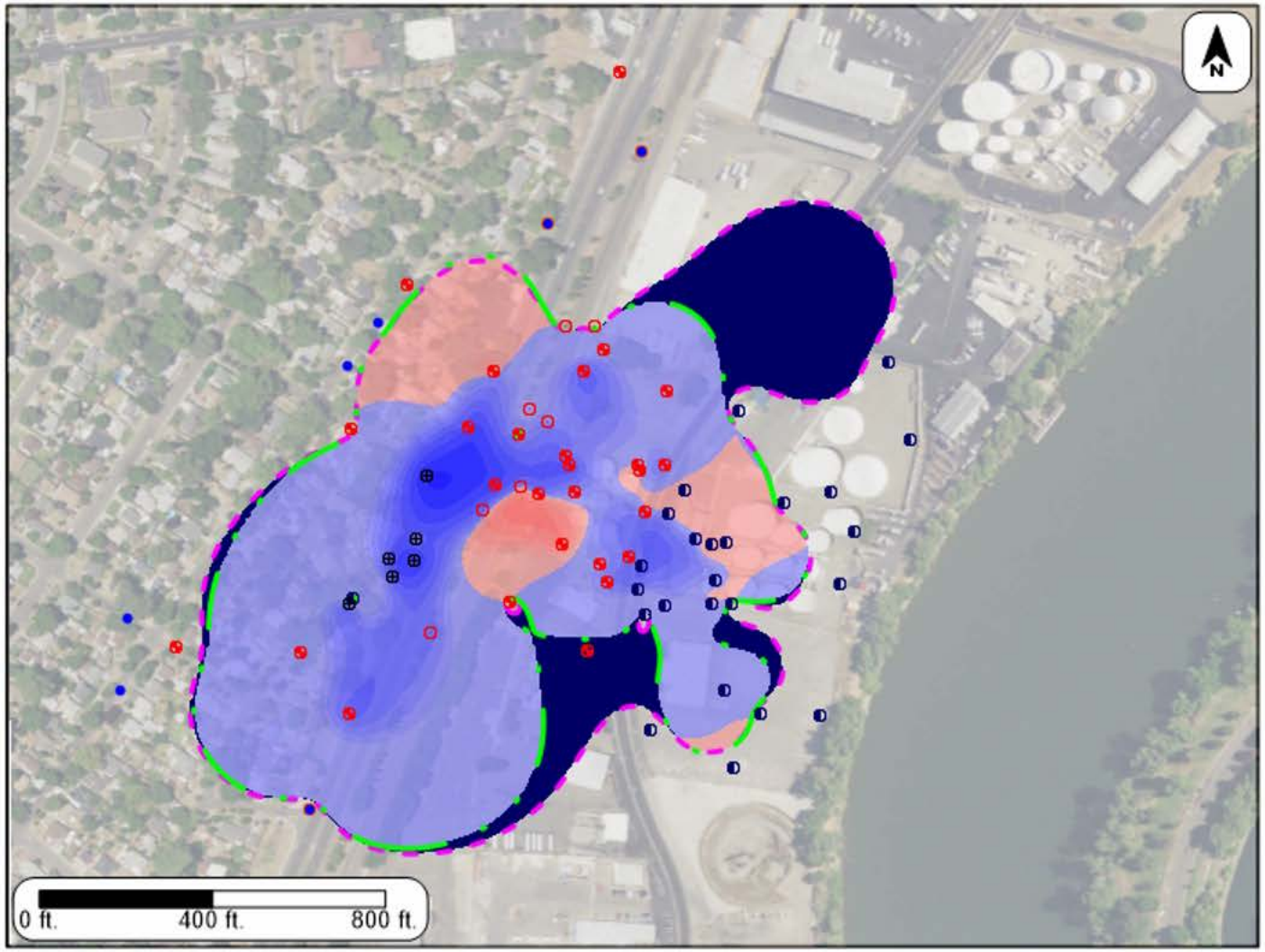
- FTT Monitoring Well
- FTT Piezometer
- Buckeye Monitoring Well
- 7-11 Monitoring Well
- Hanging Well
- Control Point
- Plume Center of Mass
- Sparge Well
- U-Shaped Oxygen Well
- Vapor Extraction Well
- Dual Phase Extraction Well
- Groundwater Extraction Well
- Oct-2001 Plume Boundary
- Jan-2002 Plume Boundary

Concentration (µg/L)

1 10 50 100 250 500 1,000 1,500 2,500 5,000

0 ft. 700 ft. 1400 ft.

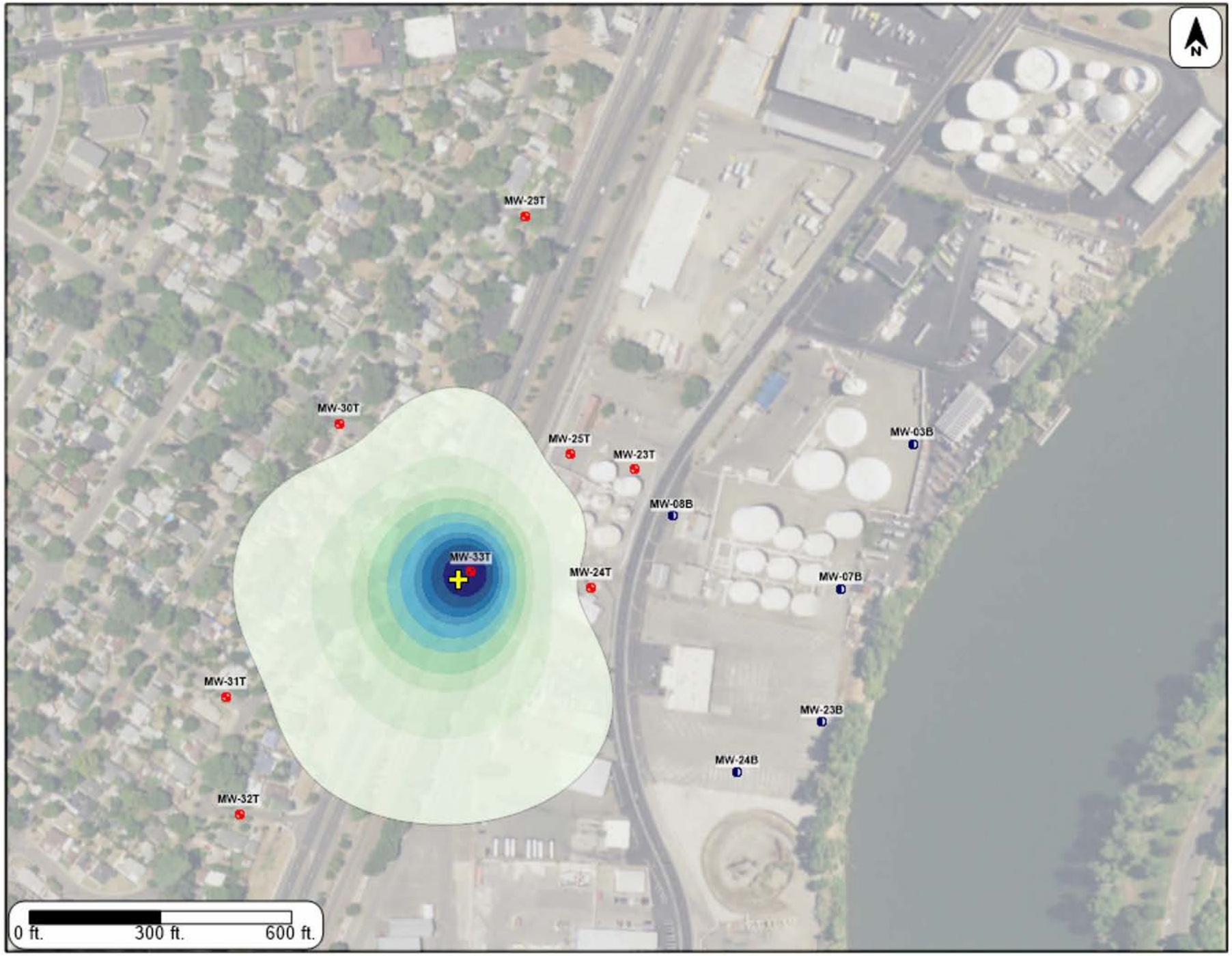




Spatial Change Indicator™

Increase

Decrease



Benzene
B-Zone
Jan-1996

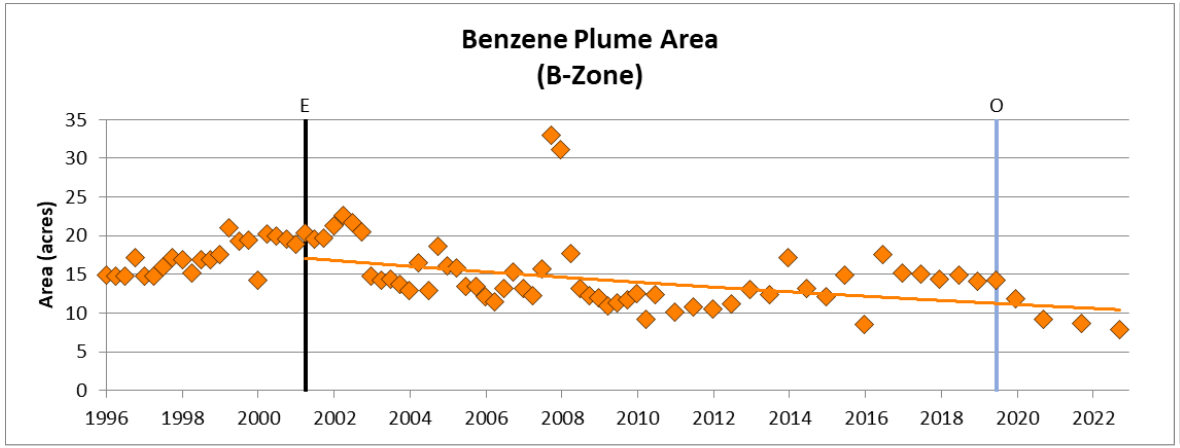
Concentration (µg/L)

1 10 50 100 250 500 1,000 1,500 2,500 5,000

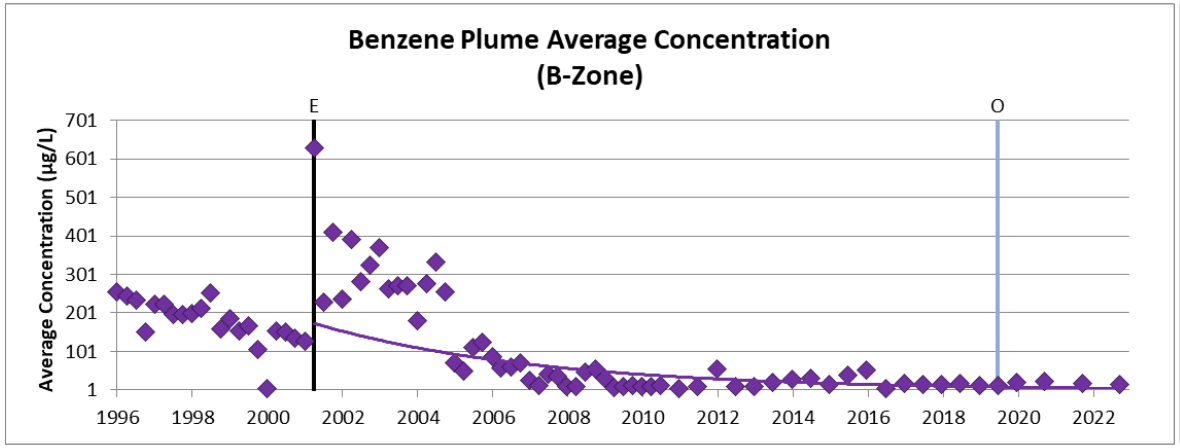
Plume Characteristics

Plume Area: **14.9 acres**
Plume Average Concentration: **256 µg/L**
Plume Mass Indicator: **93.1 lbs**

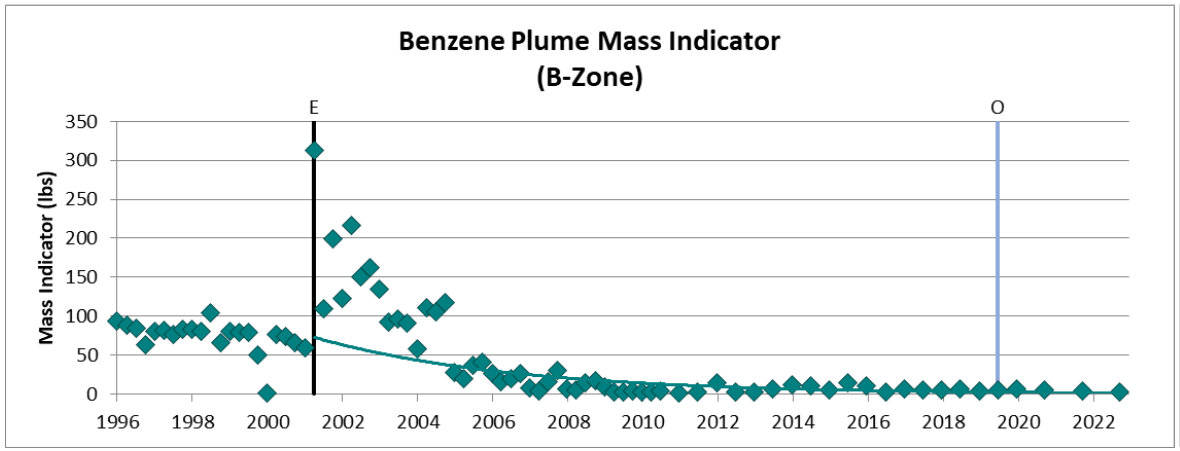
- FTT Monitoring Well
- FTT Piezometer
- Buckeye Monitoring Well
- 7-11 Monitoring Well
- Hanging Well
- Control Point
- Plume Center of Mass
- Sparge Well
- U-Shaped Oxygen Well
- Vapor Extraction Well
- Dual Phase Extraction Well
- Groundwater Extraction Well



Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

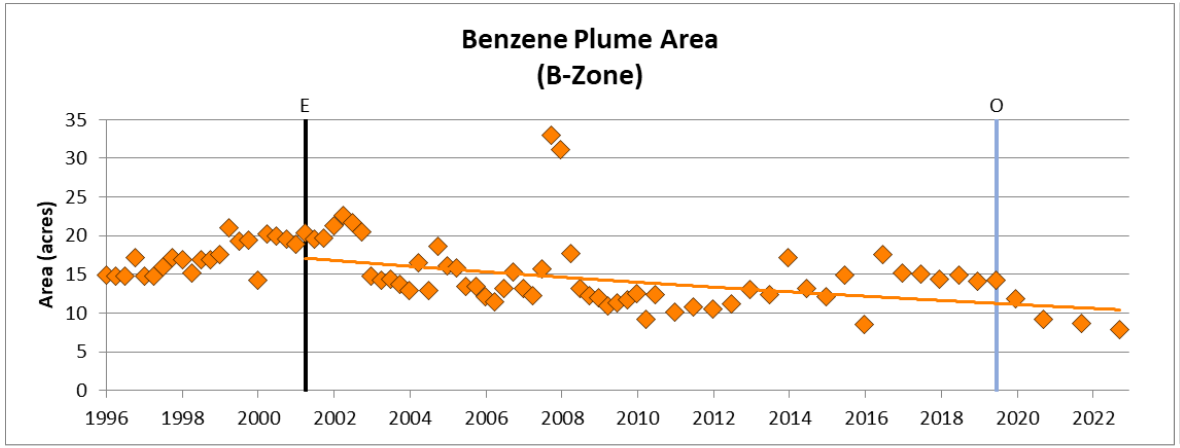


Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence



Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

E – Network Expansion
O – Network Optimization



Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
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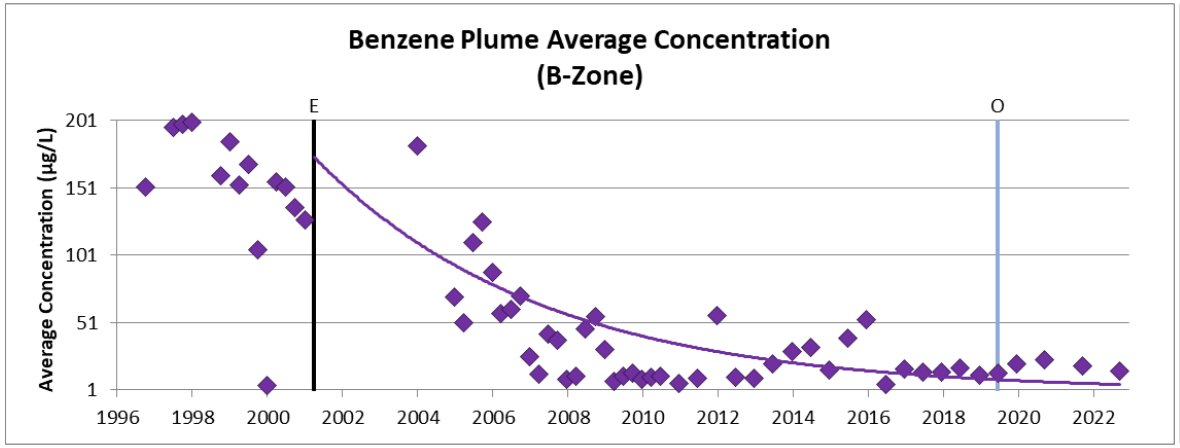
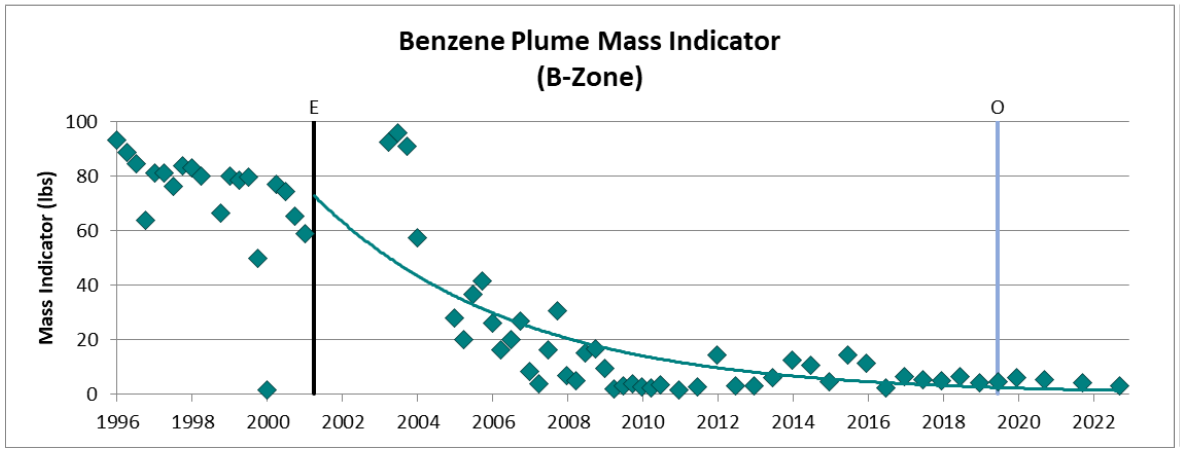


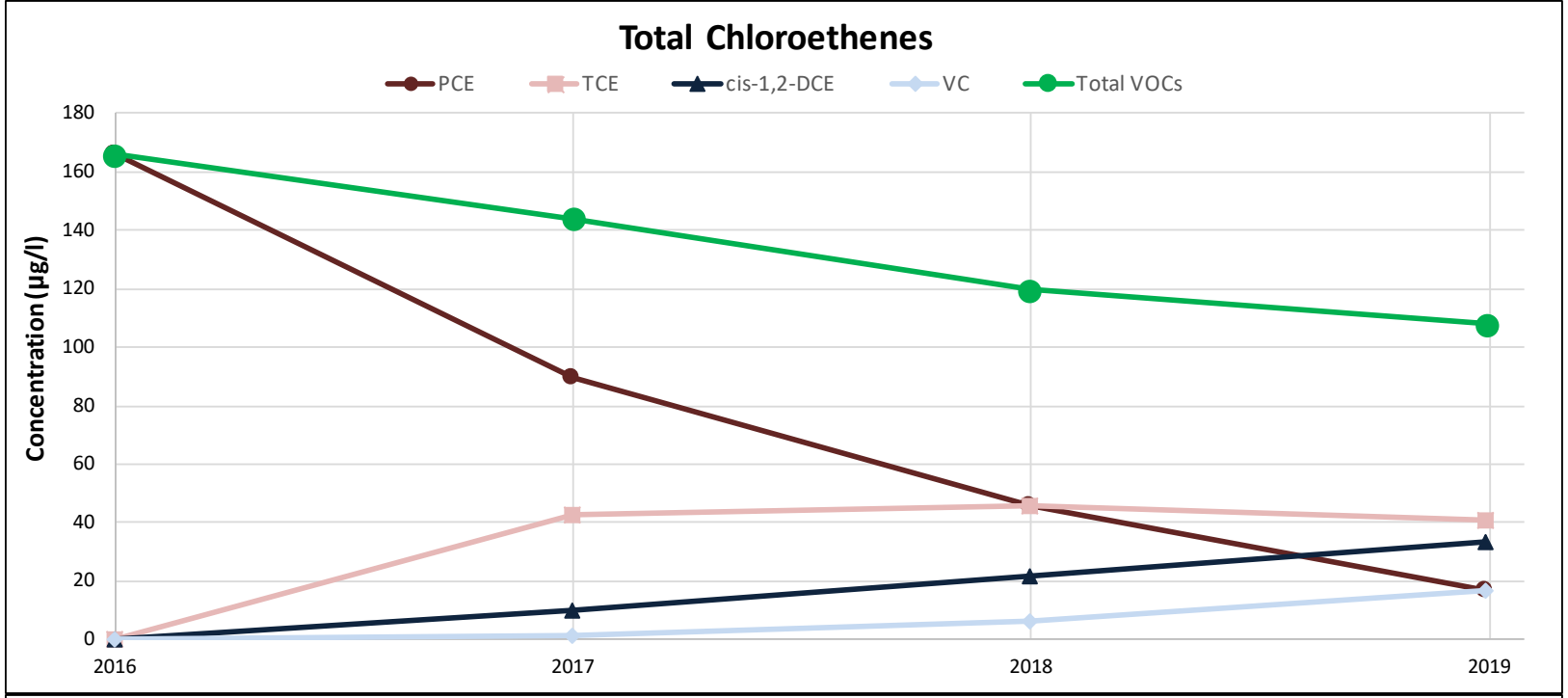
Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

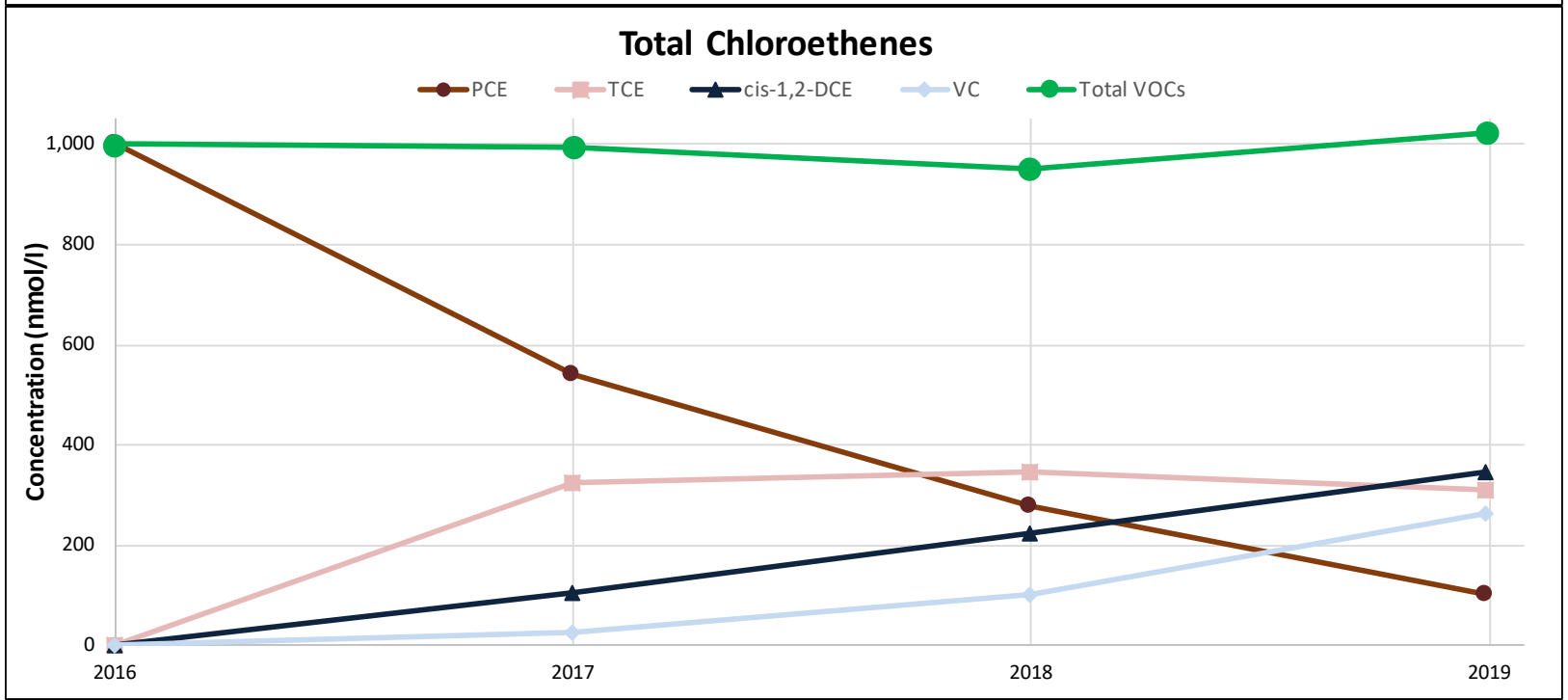


Apr-2001 to Oct-2022
Decreasing Trend
Mann-Kendall: >99% Confidence
Regression: >99% Confidence

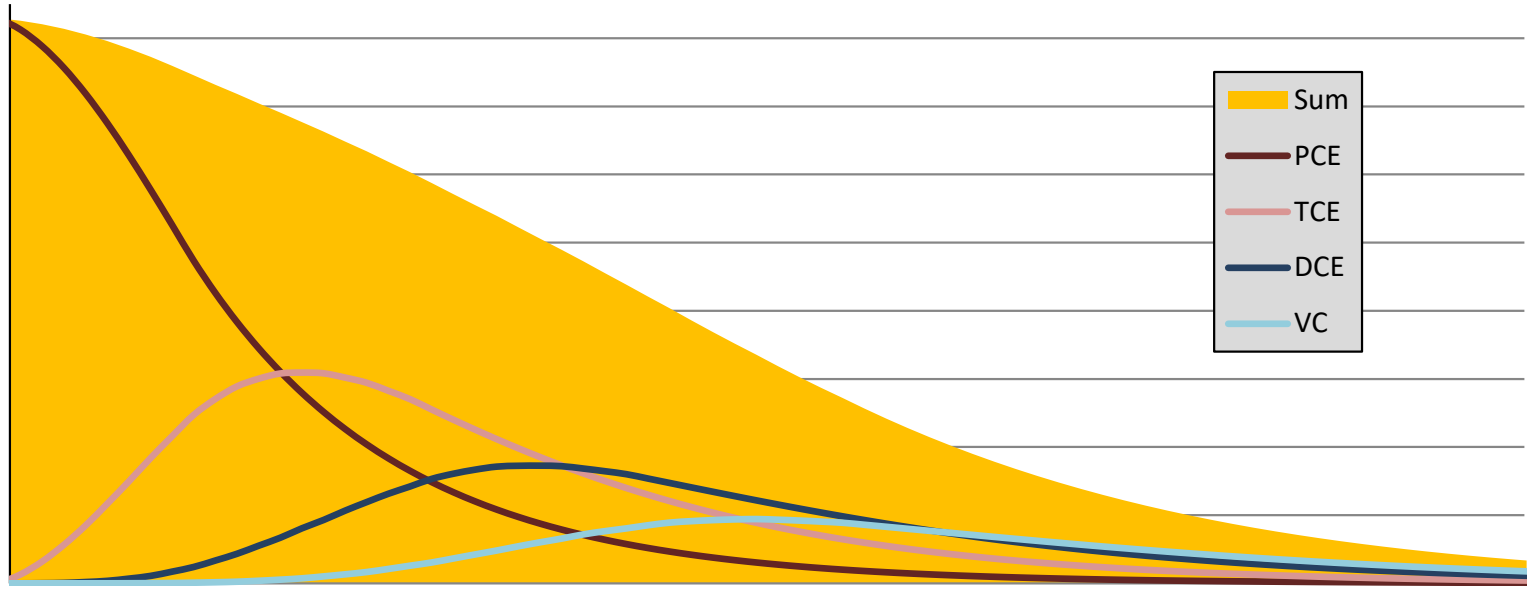
E – Network Expansion
O – Network Optimization

CSM: Chlorinated Solvent Site

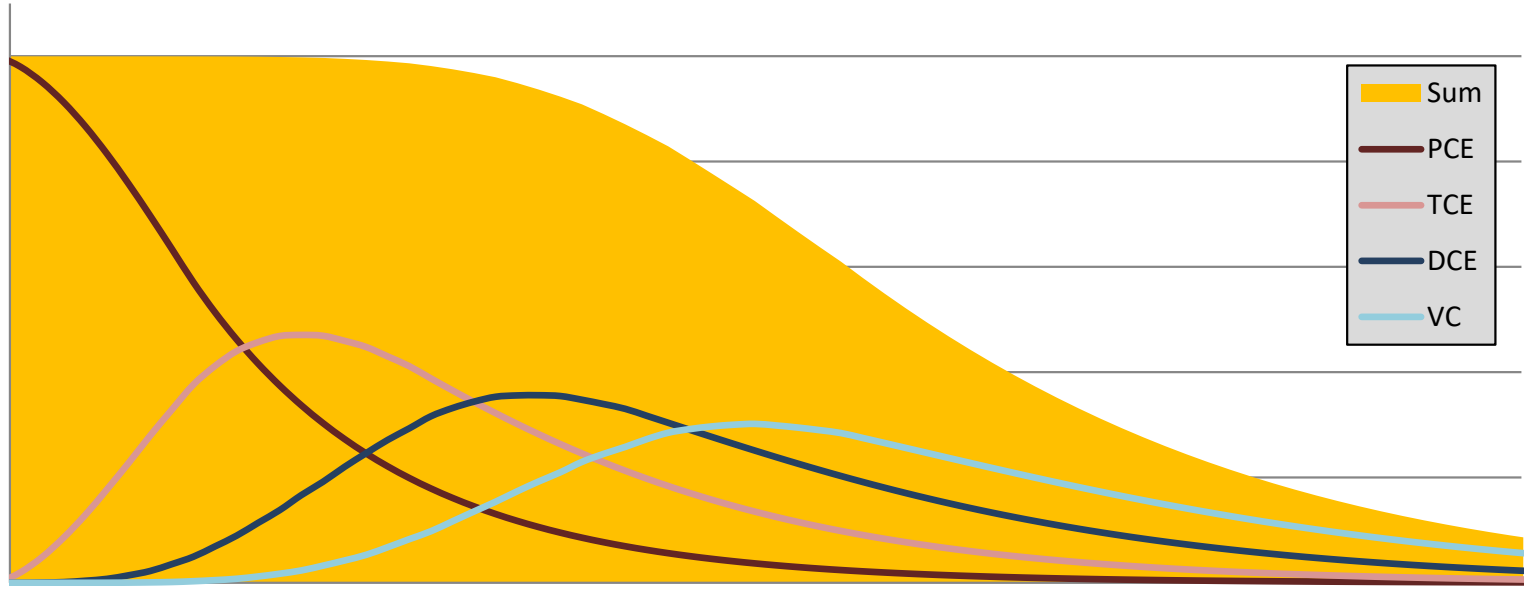

Total Chloroethenes
PCE
TCE
cis-1,2-DCE
VC
Total VOCs
Concentration (µg/l)
180
160
140
120
100
80
60
40
20
0
2016
2017
2018
2019

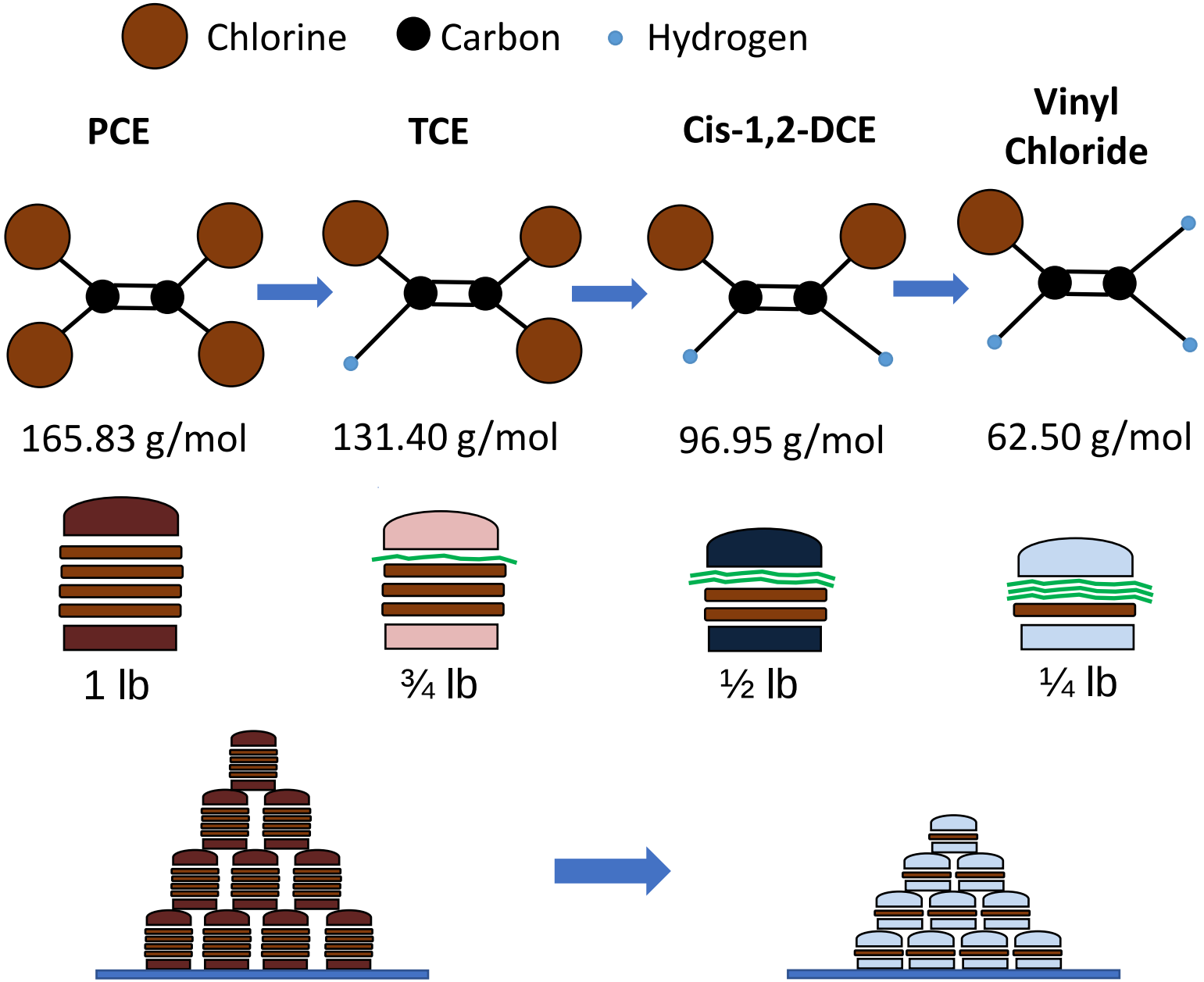

Total Chloroethenes
PCE
TCE
cis-1,2-DCE
VC
Total VOCs
Concentration (nmol/l)
1,000
800
600
400
200
0
2016
2017
2018
2019

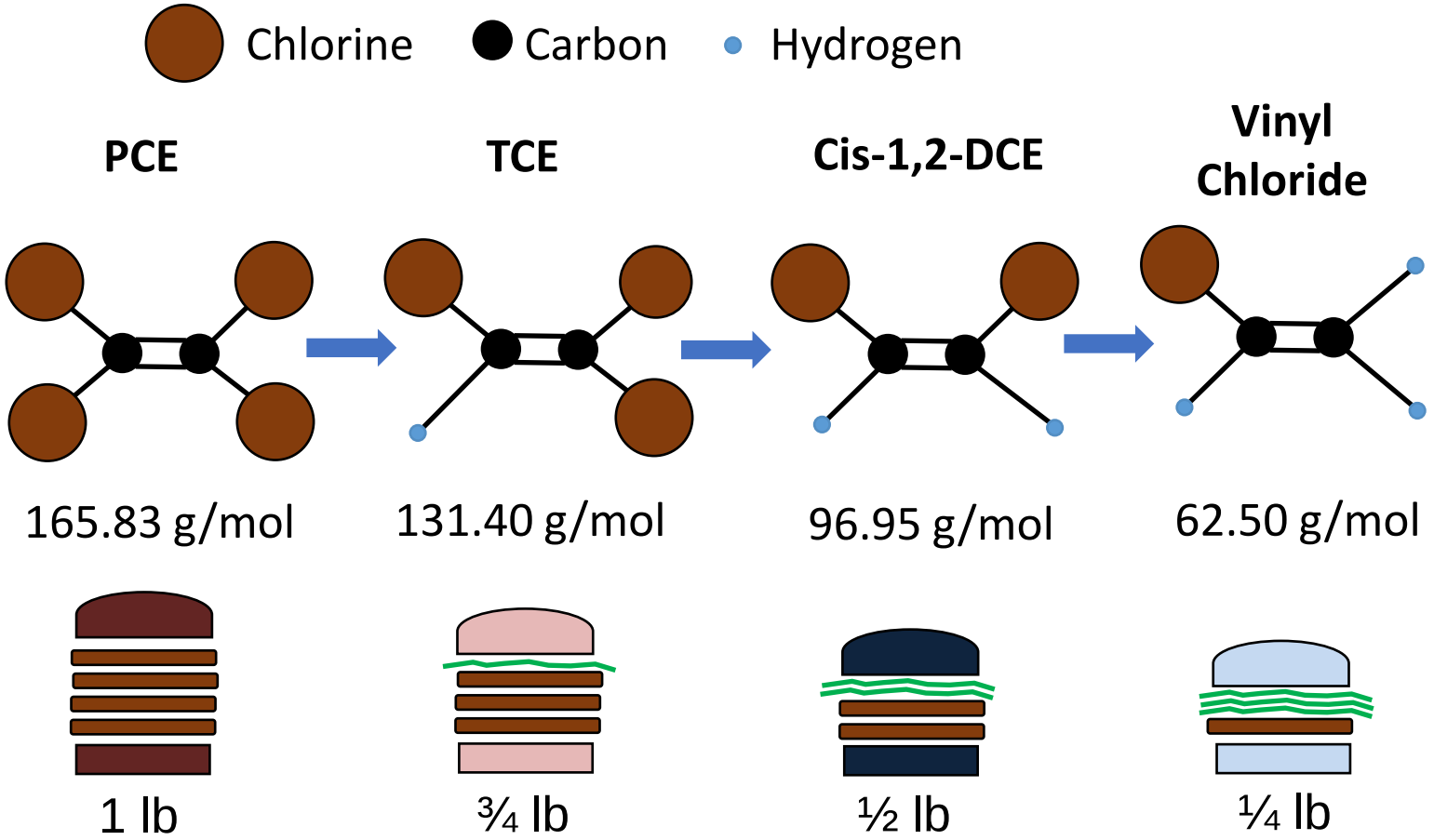
Theoretical Trends (Mass Basis)

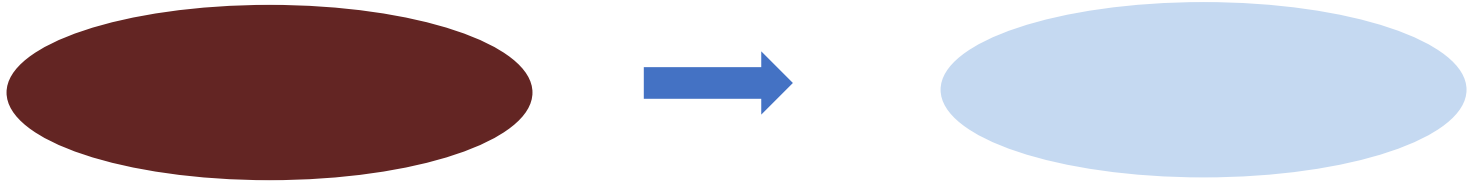


Theoretical Trends (Molar Basis)




Chlorine
Carbon
Hydrogen
PCE
TCE
Cis-1,2-DCE
Vinyl Chloride
165.83 g/mol
131.40 g/mol
96.95 g/mol
62.50 g/mol
1 lb
¾ lb
½ lb
¼ lb
Total Burgers: 10
Total weight: 10 lbs
Total Burgers: 10
Total weight: 2.5 lb



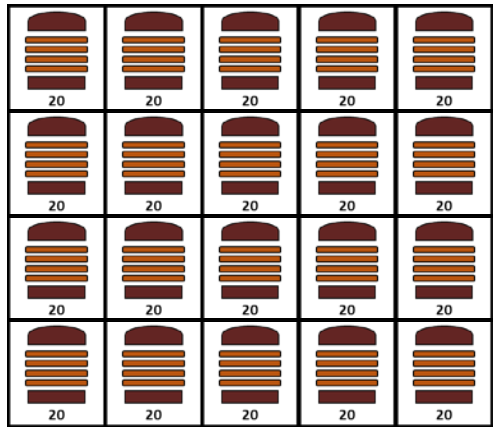


PCE Plume Mass: 3.7 lbs (10 mol)

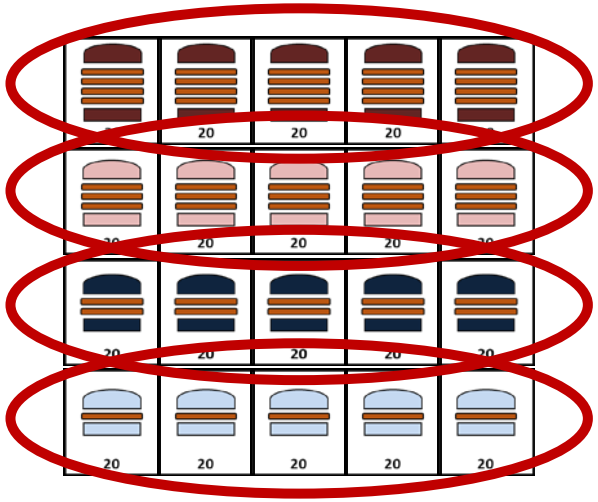
PCE Concentration: 10 mg/l

VC Plume Mass: 1.4 lbs (10 mol)

VC Concentration: 3.8 mg/l



400 Burgers

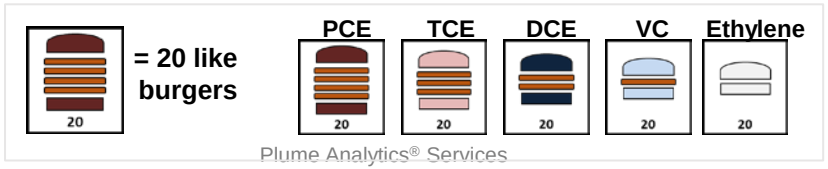


400 Burgers

Example 2

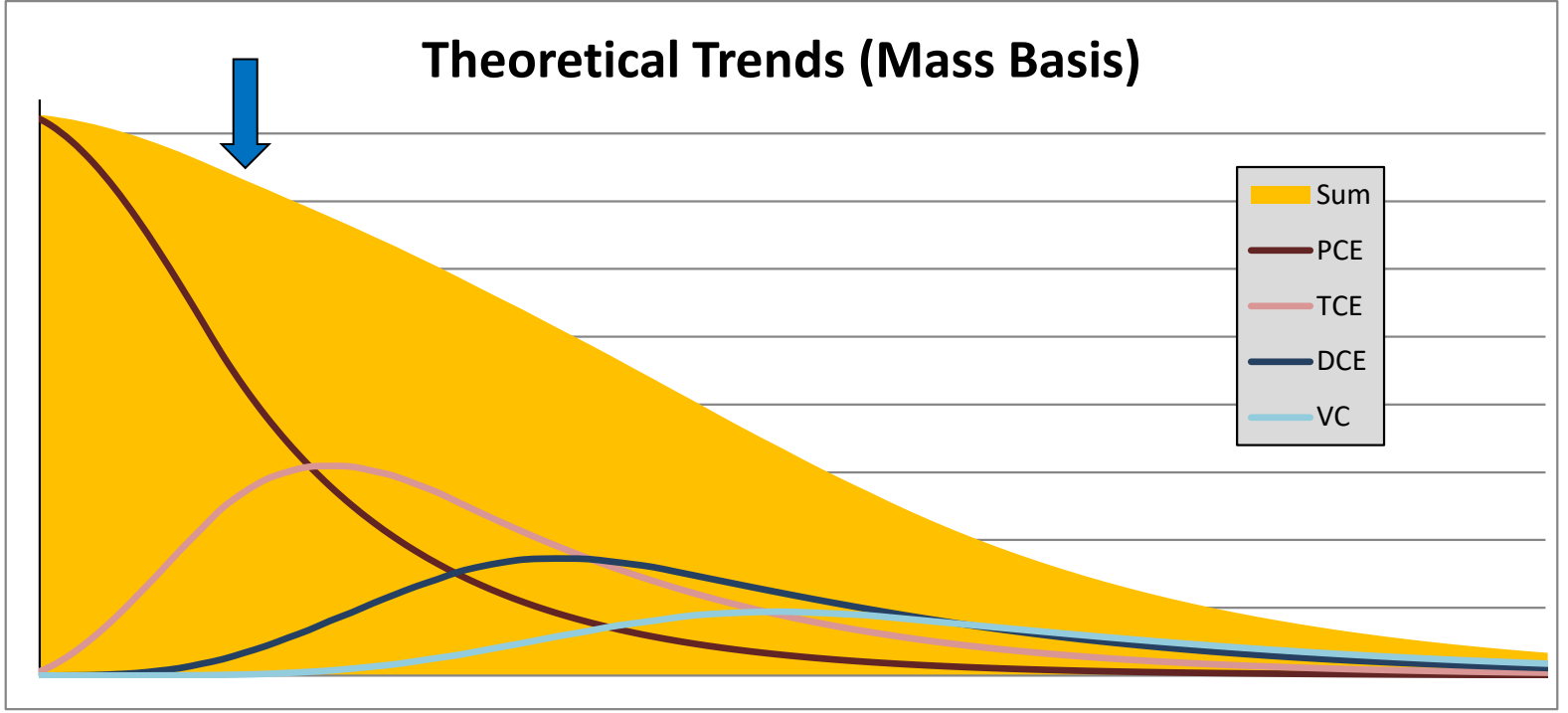
100% PCE degrades to: 25% PCE; 25% TCE; 25% DCE; 25% VC

	Initial Concentration		Final Concentration	
	nmol/L	µg/L	nmol/L	µg/L
PCE	400	66.3	100	16.6
TCE	0	0.0	100	13.1
DCE	0	0.0	100	9.7
VC	0	0.0	100	6.3
Total CVOCs	**400**	**66.3**	**400**	**45.7**

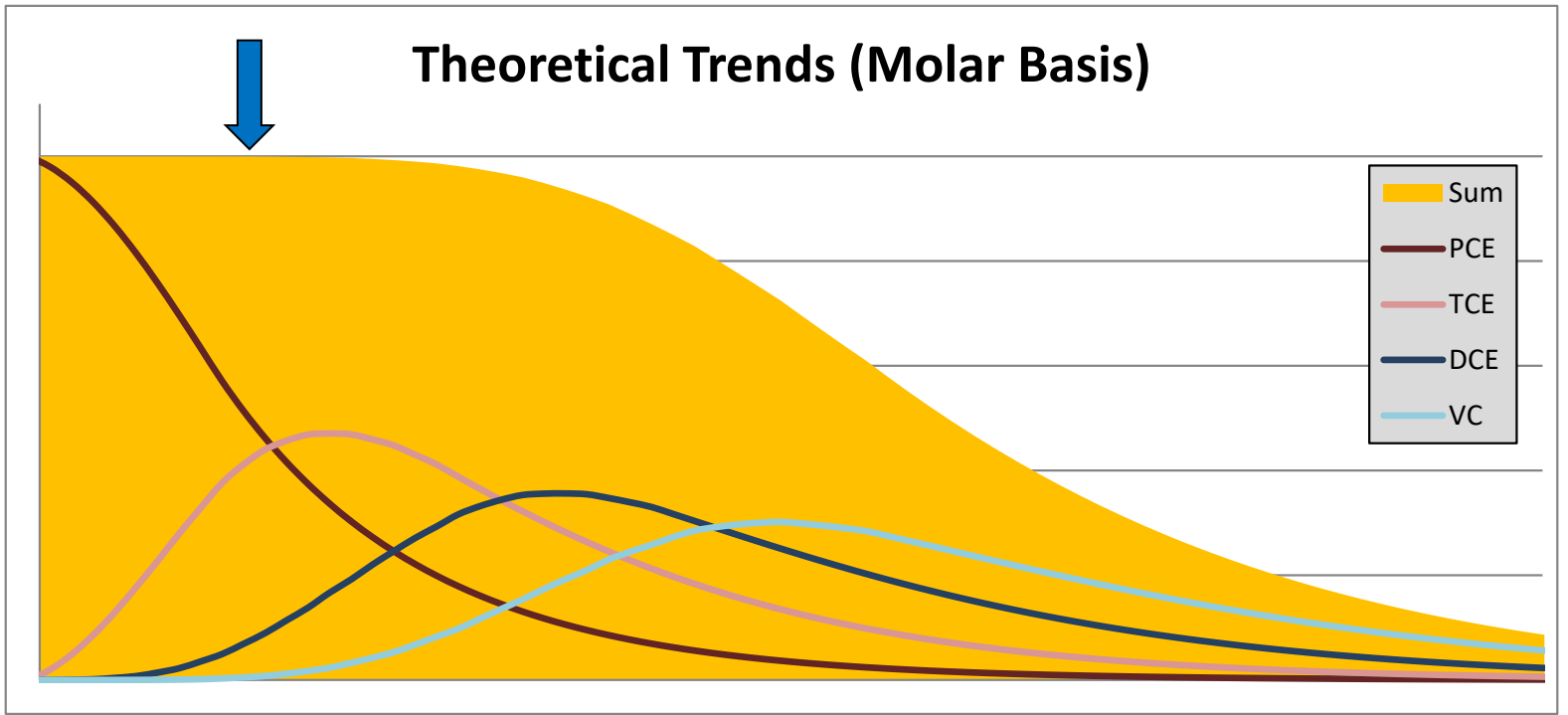


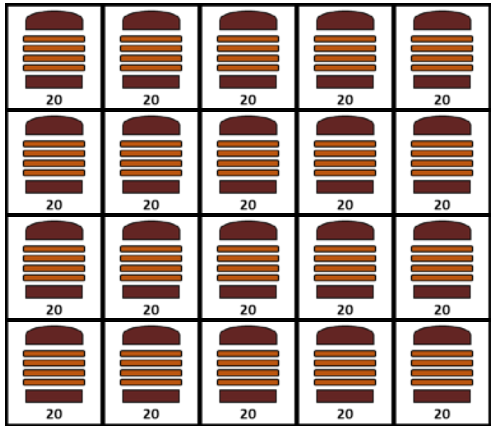
Plume Analytics® Services

Theoretical Trends (Mass Basis)

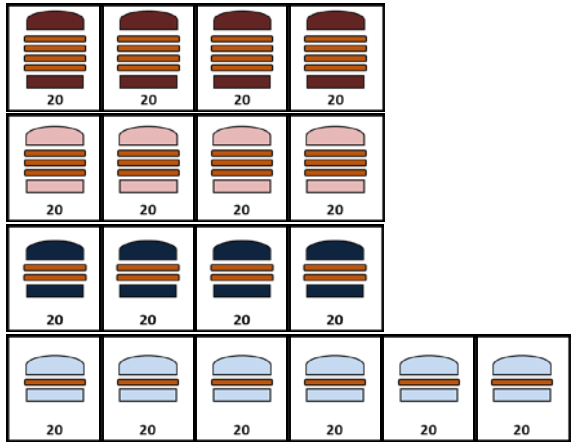


Theoretical Trends (Molar Basis)





400 Burgers

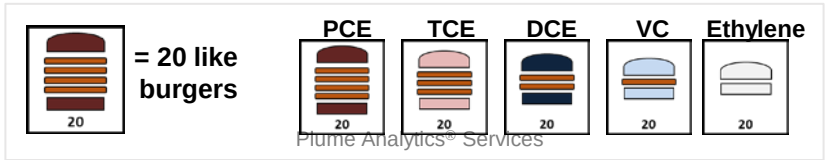


360 Burgers

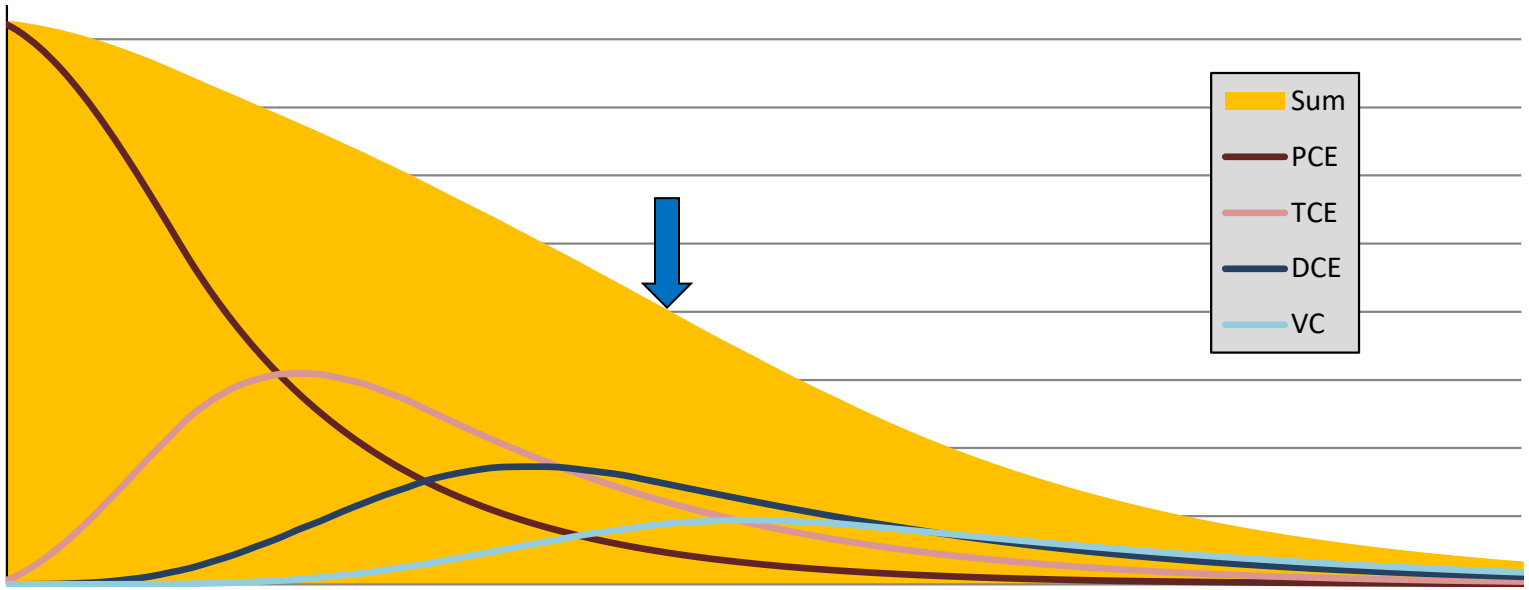
Example 3

100% PCE degrades to: 20% PCE; 20% TCE; 20% DCE; 30% VC

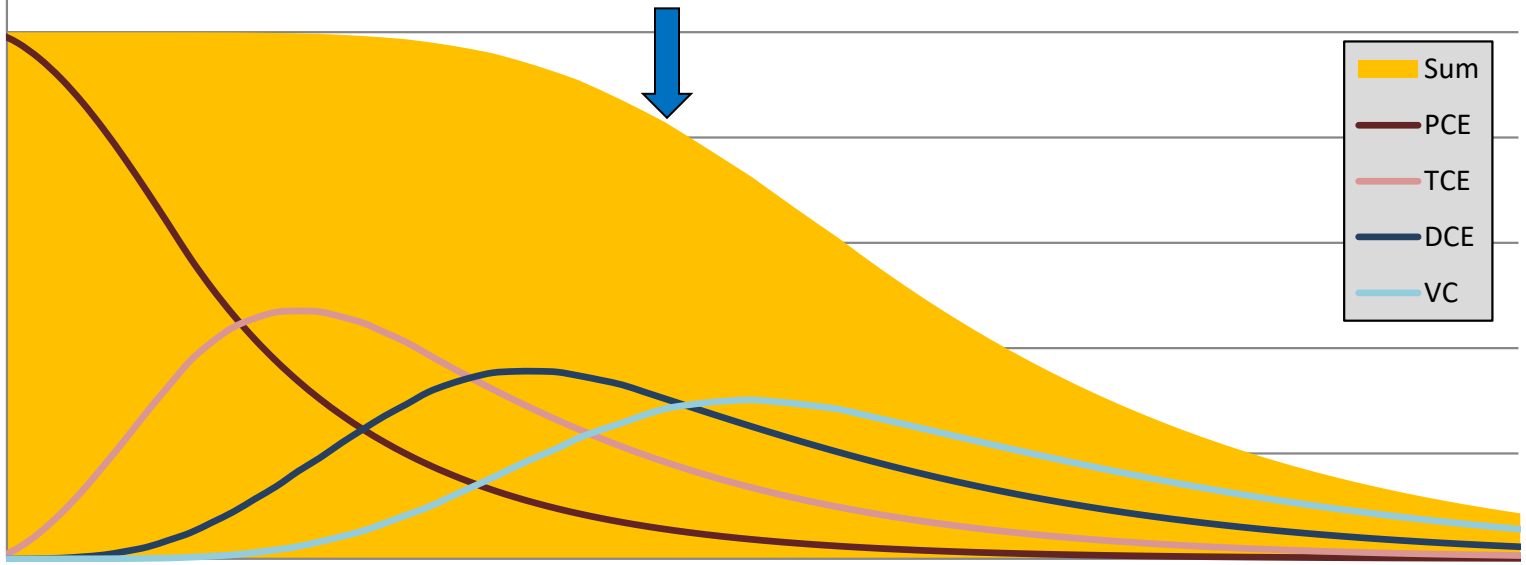
	Initial Concentration		Final Concentration	
	nmol/L	µg/L	nmol/L	µg/L
PCE	400	66.3	80	13.3
TCE	0	0.0	80	10.5
DCE	0	0.0	80	7.8
VC	0	0.0	120	7.5
Total CVOCs	**400**	**66.3**	**360**	**39.0**

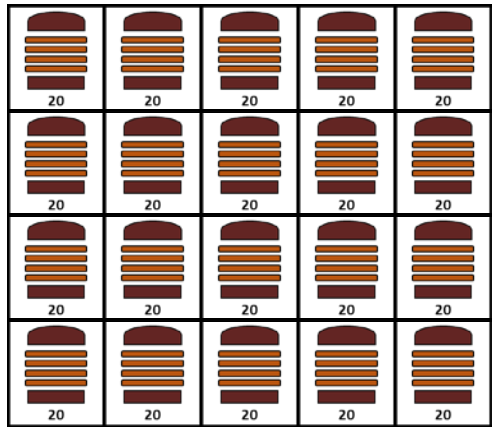


Theoretical Trends (Mass Basis)

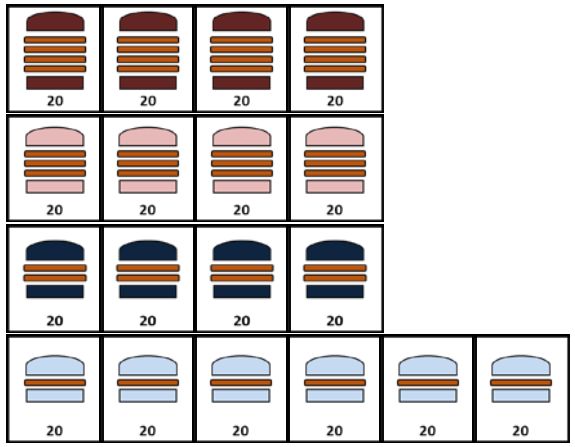


Theoretical Trends (Molar Basis)





400 Burgers



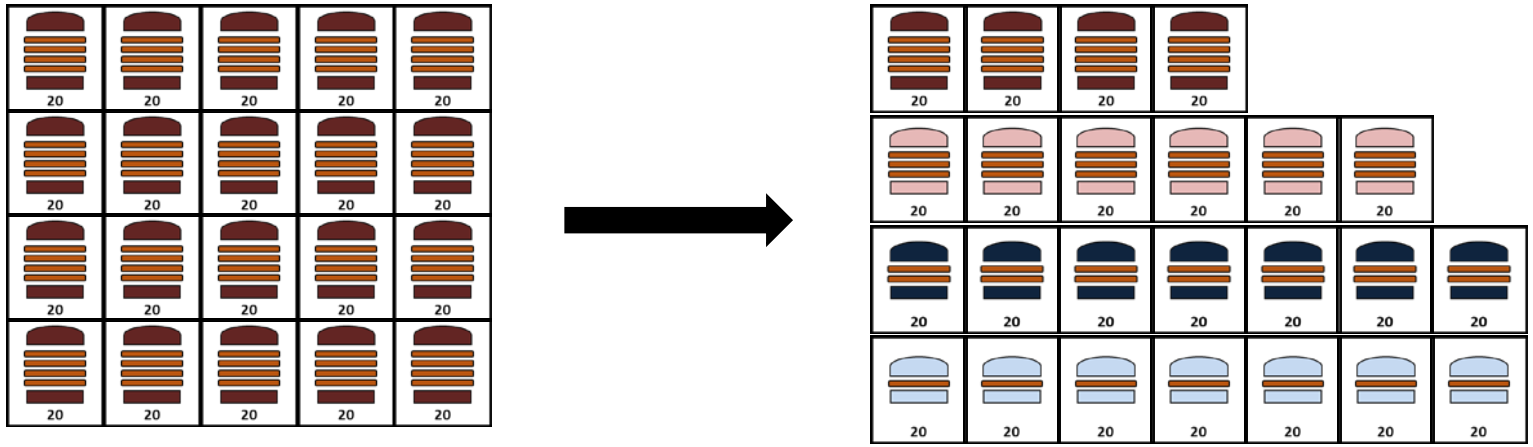
360 Burgers

Example 3

100% PCE degrades to: 20% PCE; 20% TCE; 20% DCE; 30% VC

	Initial Concentration		Final Concentration	
	nmol/L	µg/L	nmol/L	µg/L
PCE	400	66.3	80	13.3
TCE	0	0.0	80	10.5
DCE	0	0.0	80	7.8
VC	0	0.0	120	7.5
Total CVOCs	**400**	**66.3**	**360**	**39.0**

= 20 like burgers

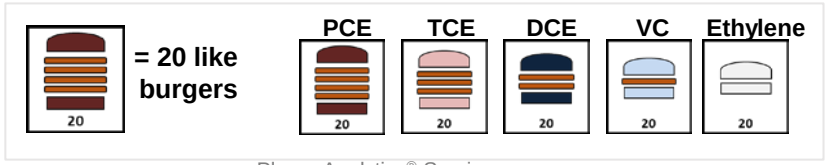


Example 4

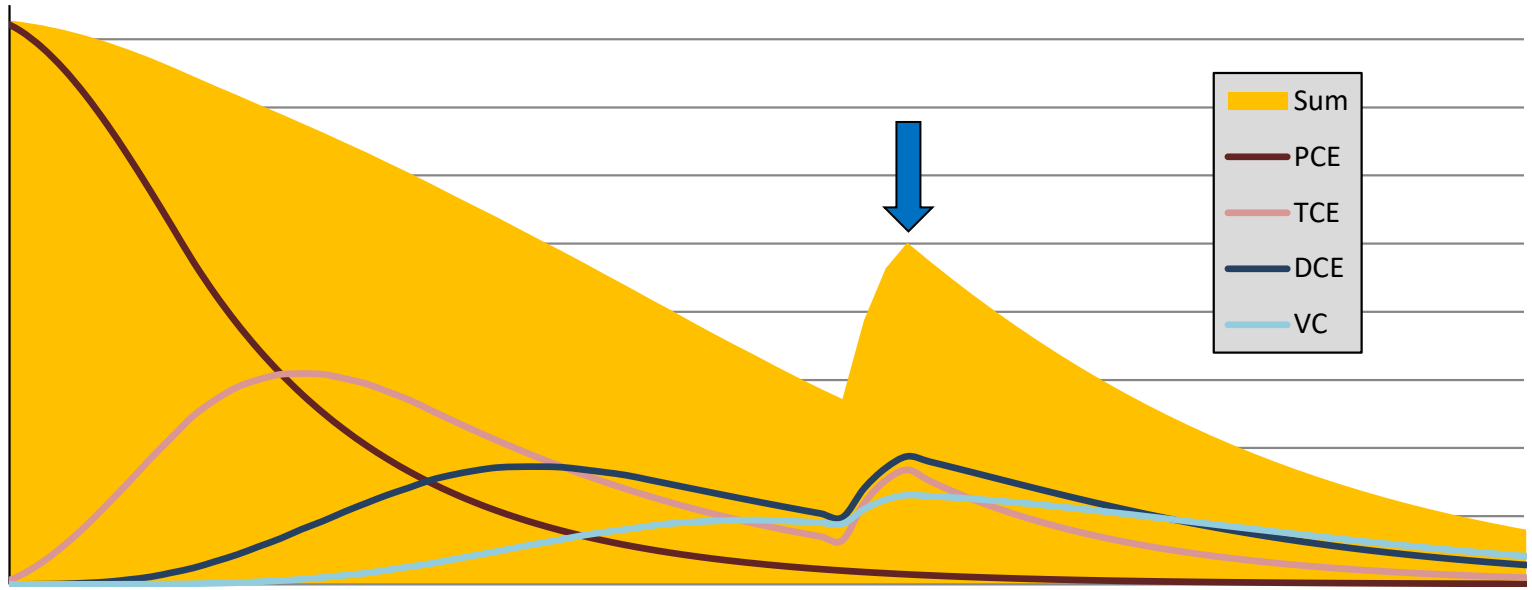
PCE Degradation with evidence of additional sourcing

	Initial Concentration		Final Concentration	
	nmol/L	µg/L	nmol/L	µg/L
PCE	400	66.3	80	13.3
TCE	0	0.0	120	15.8
DCE	0	0.0	160	15.5
VC	0	0.0	160	10.0
Total CVOCs	**400**	**66.3**	**520**	**54.5**

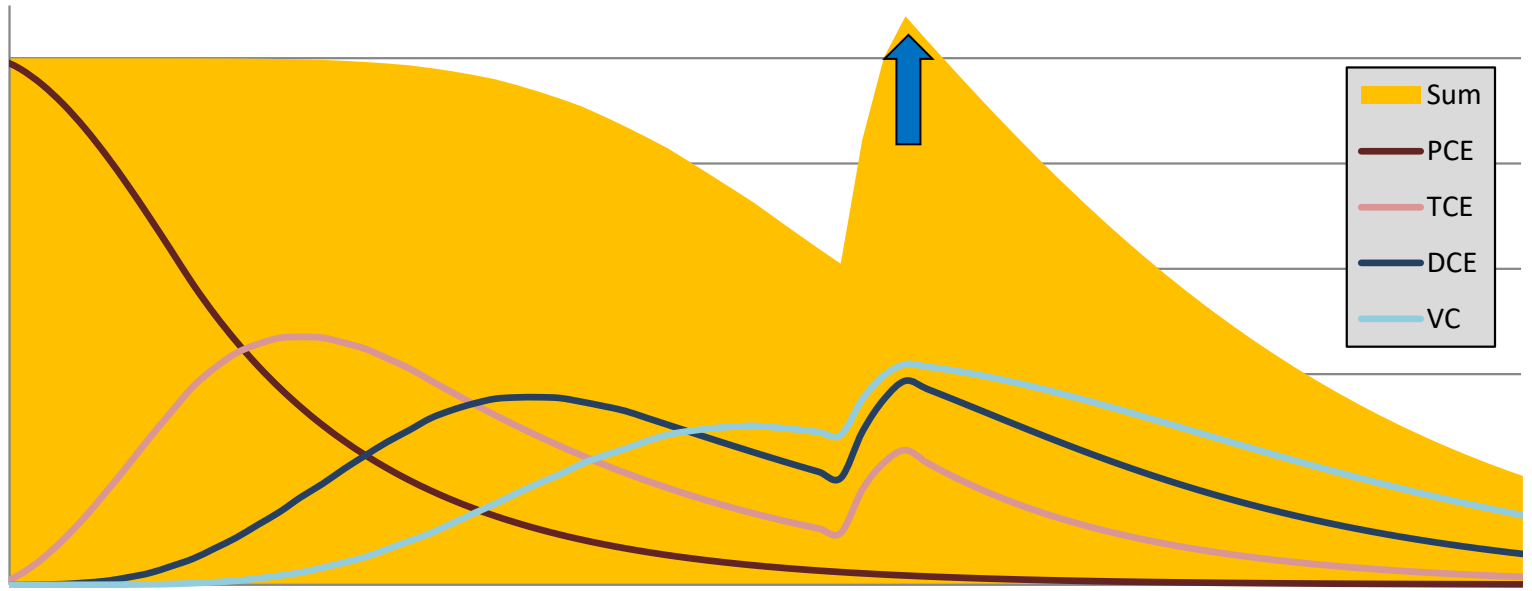
!

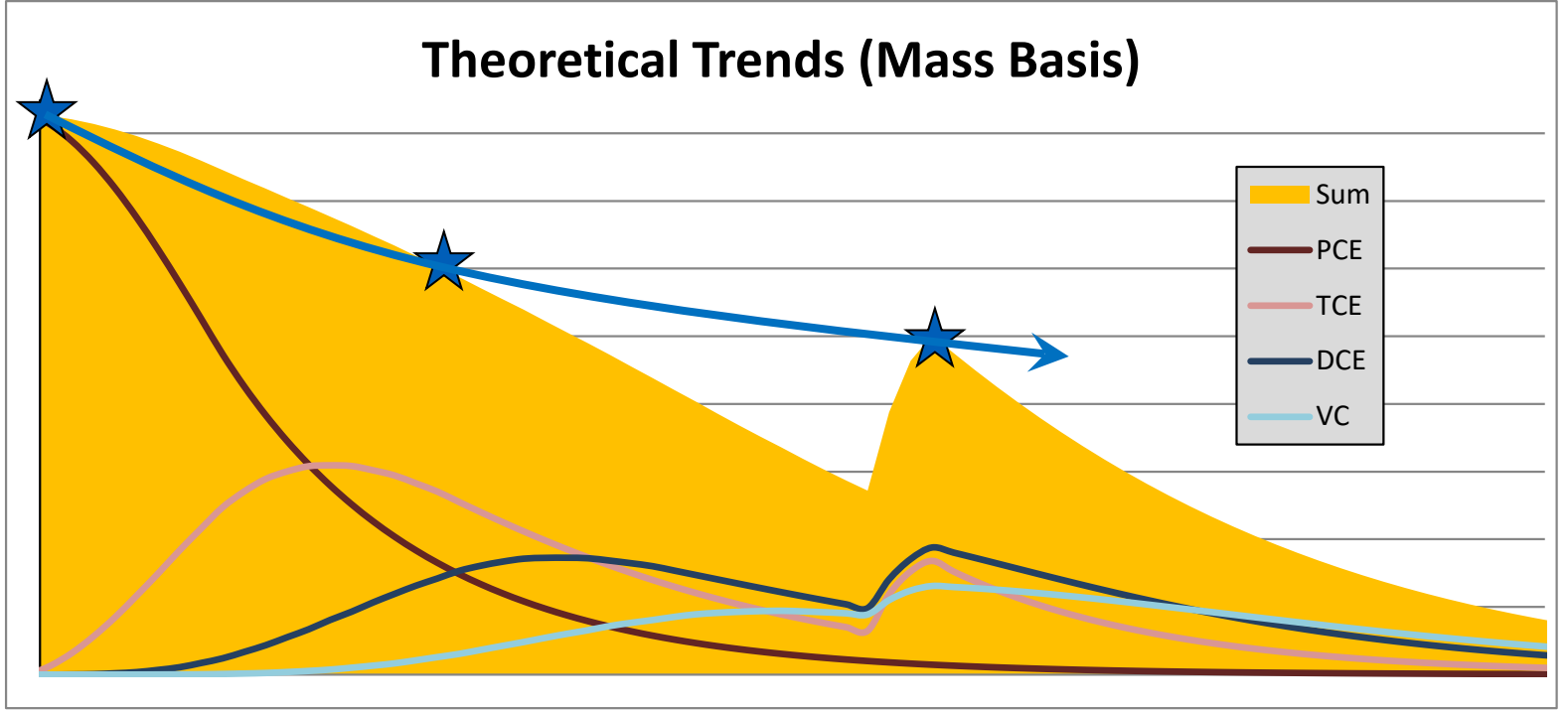


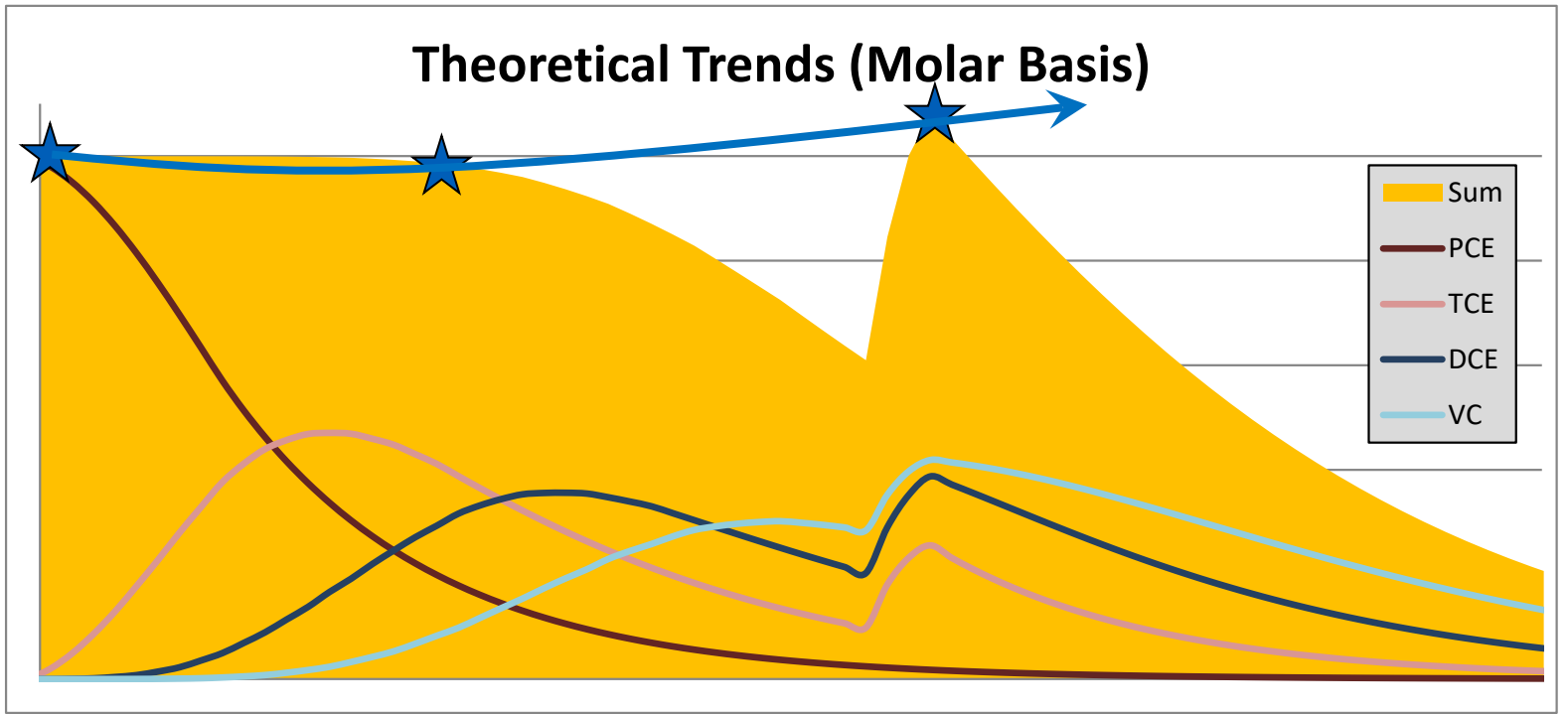
Theoretical Trends (Mass Basis)



Theoretical Trends (Molar Basis)




Theoretical Trends (Mass Basis)
Sum
PCE
TCE
DCE
VC


Theoretical Trends (Molar Basis)
Sum
PCE
TCE
DCE
VC

Chlorinated Solvent Site

- **Chemical recycling facility from 1974 through 1980 - Ohio**
- **Groundwater pump & treat system 1987 – 2015**
- **System shut down in June 2015 for two-year MNA pilot test**
- **Contaminants of concern**

Chloroethenes

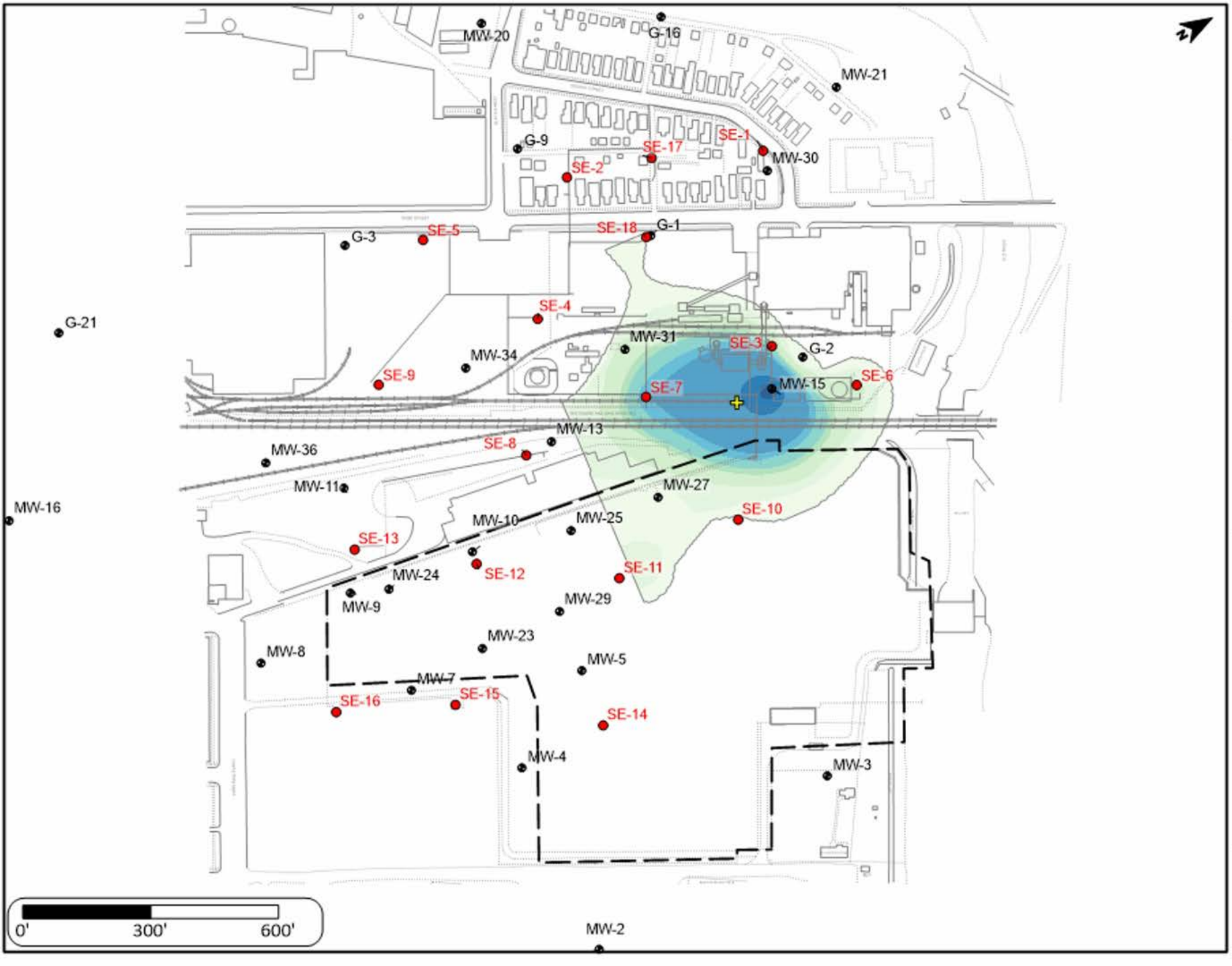
- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- Cis-1,2-dichloroethene (cis-1,2-DCE)
- Vinyl chloride

Chloroethanes

- 1,1,2,2-tetrachloroethane
- 1,1,2-trichloroethane
- 1,1,1-trichloroethane
- 1,2-dichloroethane
- 1,1-dichloroethane

Chloromethanes

- Carbon tetrachloride
- Chloroform
- Methylene chloride
- chloromethane



Chloroethenes

Mar-2010

Concentration (nmol/L)

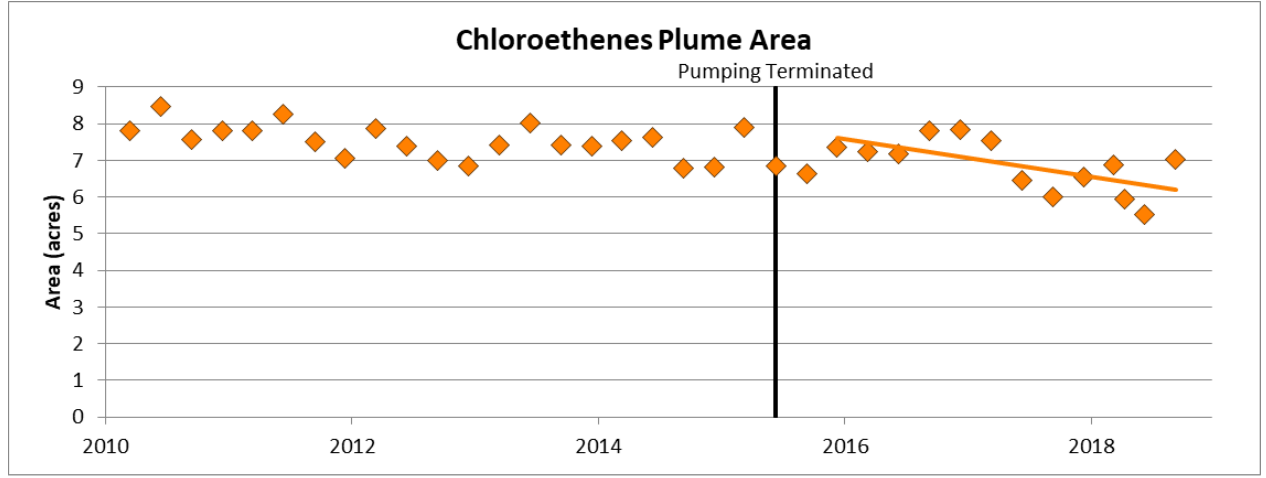
0 100 200 400 500 750 1,000 5,000 10,000 20,000

Plume Characteristics

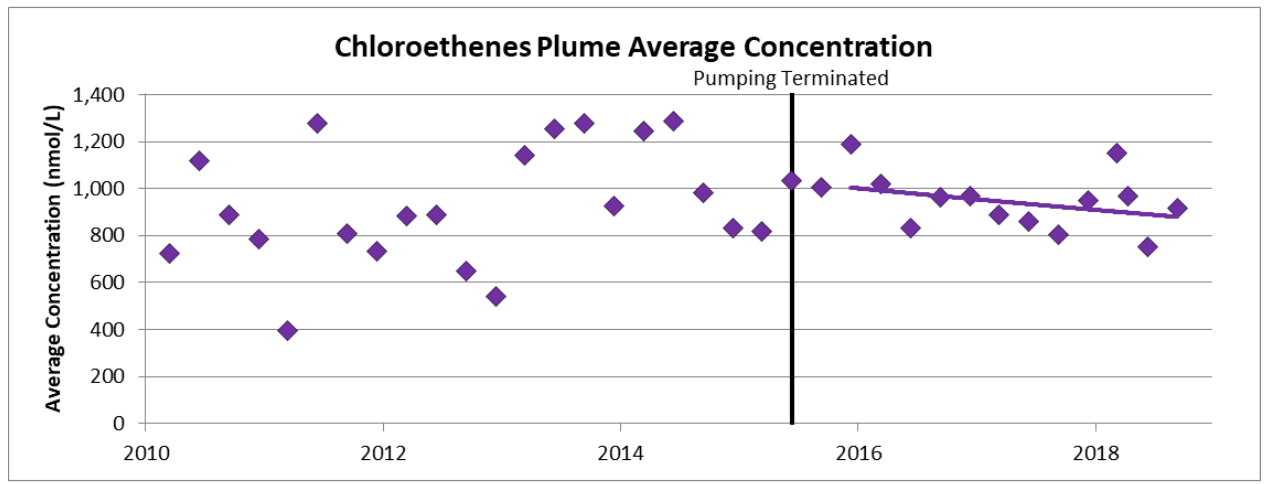
Plume Area: **7.8 acres**
Plume Average Concentration: **724 nmol/L**
Plume Mass Indicator: **31.4 moles**

- MW-15 Monitoring Well
- SE-10 Extraction Well
- Hanging Well
- Center of Mass
- Approximate Property Boundary

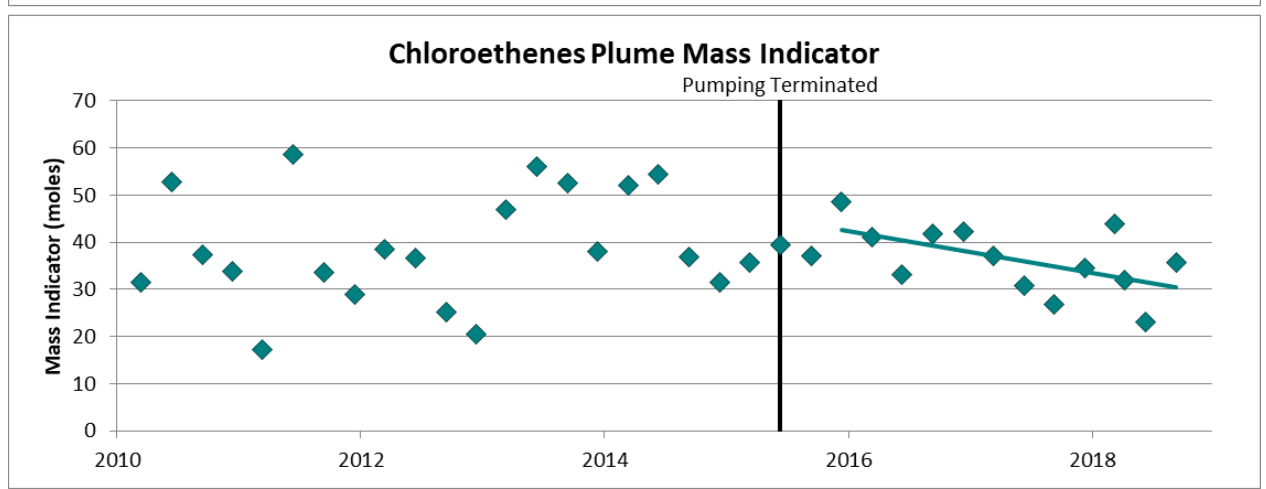
Note:
Chloroethenes is the sum of molar concentration for: PCE; TCE; cis-1,2-DCE, 1,1-DCE and VC.



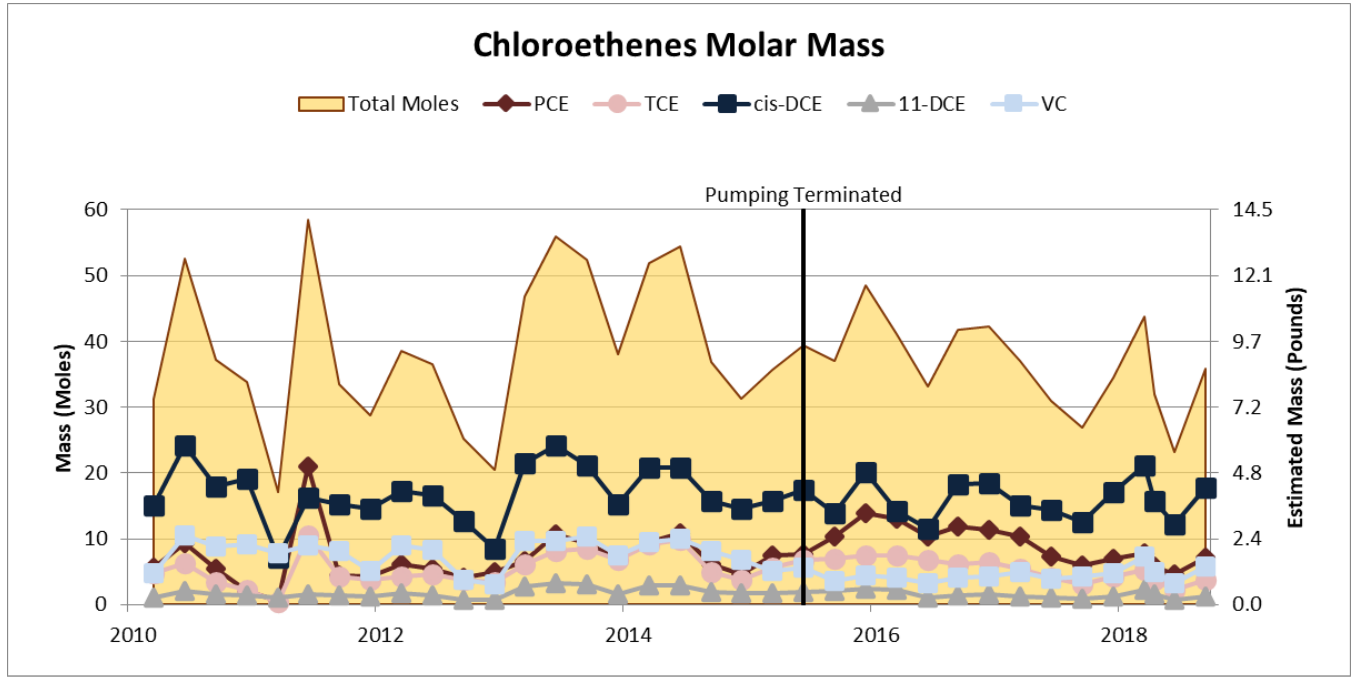
Dec-2015 to Sep-2018
Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: 98% Confidence

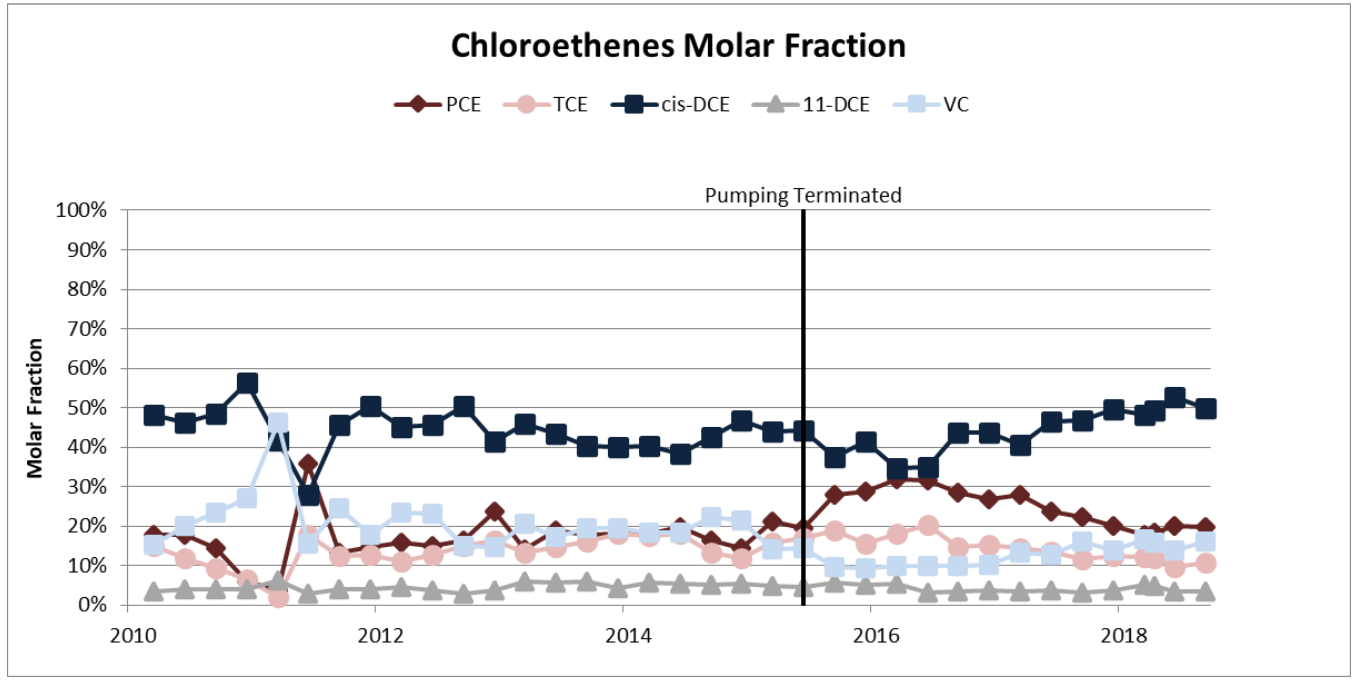


Dec-2015 to Sep-2018
Stable
Mann-Kendall: 90% Confidence
Regression: 73% Confidence



Dec-2015 to Sep-2018
Decreasing Trend
Mann-Kendall: 95% Confidence
Regression: 95% Confidence


Chloroethenes Molar Mass
Total Moles
PCE
TCE
cis-DCE
11-DCE
VC
Pumping Terminated
Mass (Moles)
Estimated Mass (Pounds)
60
50
40
30
20
10
0
14.5
12.1
9.7
7.2
4.8
2.4
0.0
2010
2012
2014
2016
2018


Chloroethenes Molar Fraction
PCE
TCE
cis-DCE
11-DCE
VC
Pumping Terminated
Molar Fraction
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2010
2012
2014
2016
2018

Chloroethanes

Mar-2010

Concentration (nmol/L)

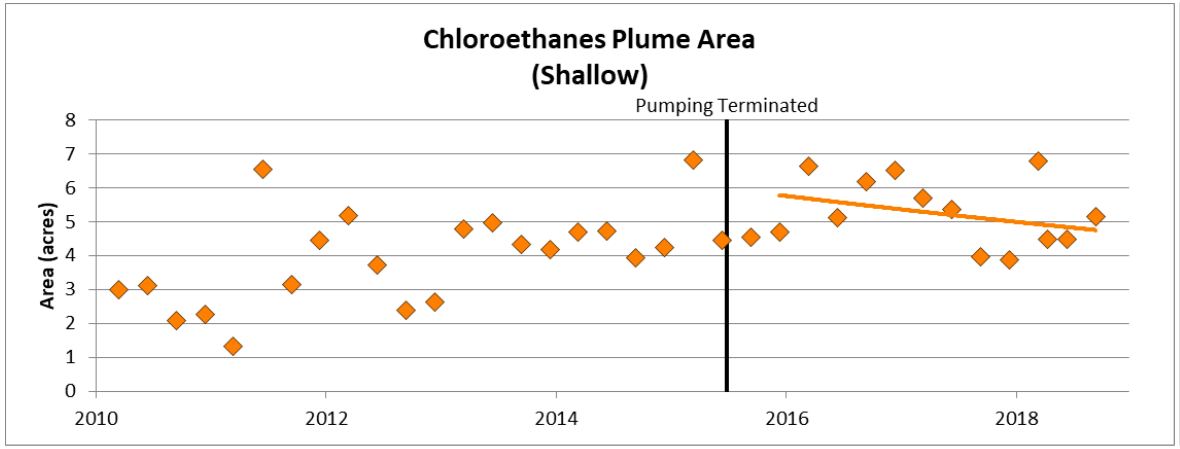
0 100 200 400 500 750 1,000 5,000 10,000 20,000

Plume Characteristics

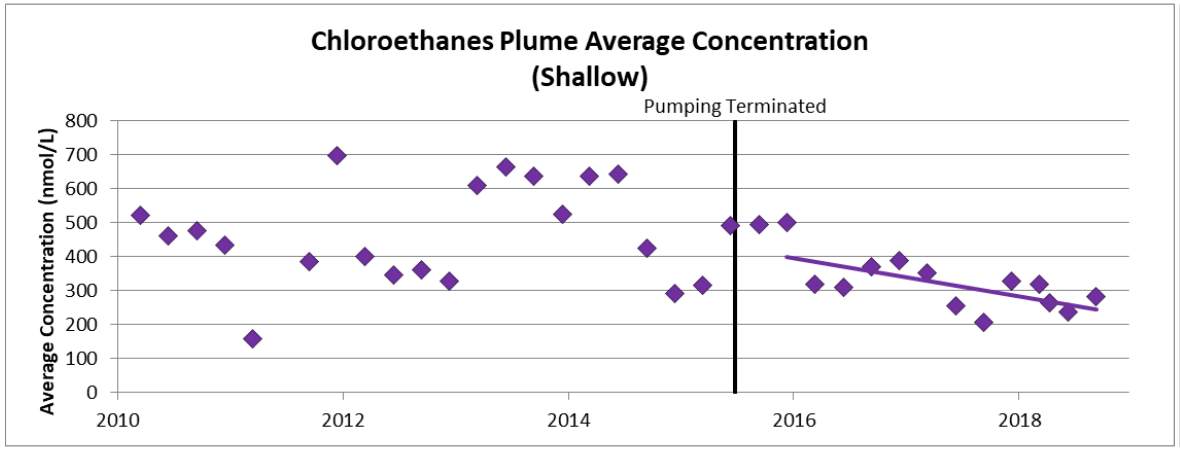
Plume Area: **3.0 acres**
Plume Average Concentration: **521 nmol/L**
Plume Mass Indicator: **8.6 moles**

MW-15 Monitoring Well
SE-10 Extraction Well
Hanging Well
Center of Mass
Approximate Property Boundary

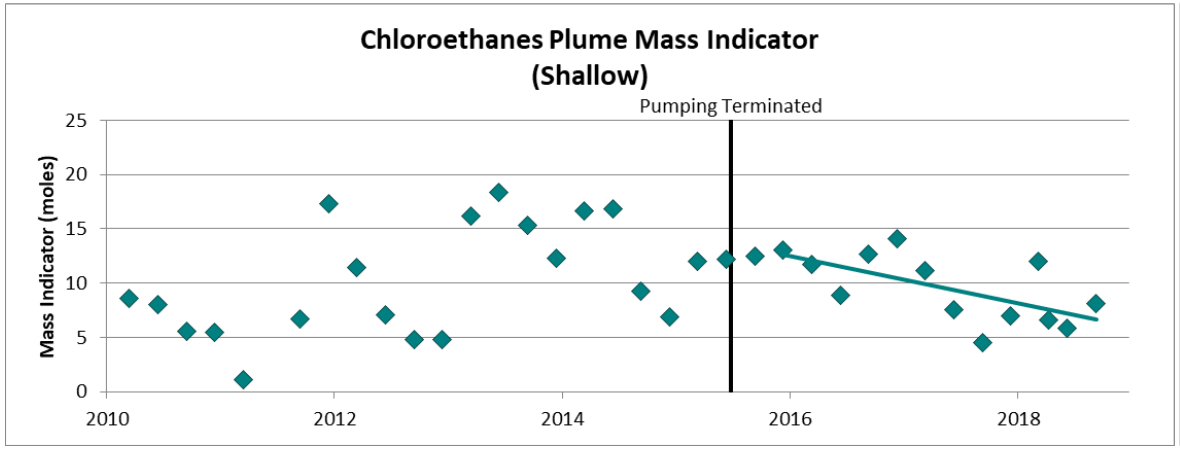
Note:
Chloroethenes is the sum of molar concentration for: 1,1,2,2-PeCA; 1,1,2-TCA; 1,1,1-TCA, 1,2-DCA and 1,1-DCA.



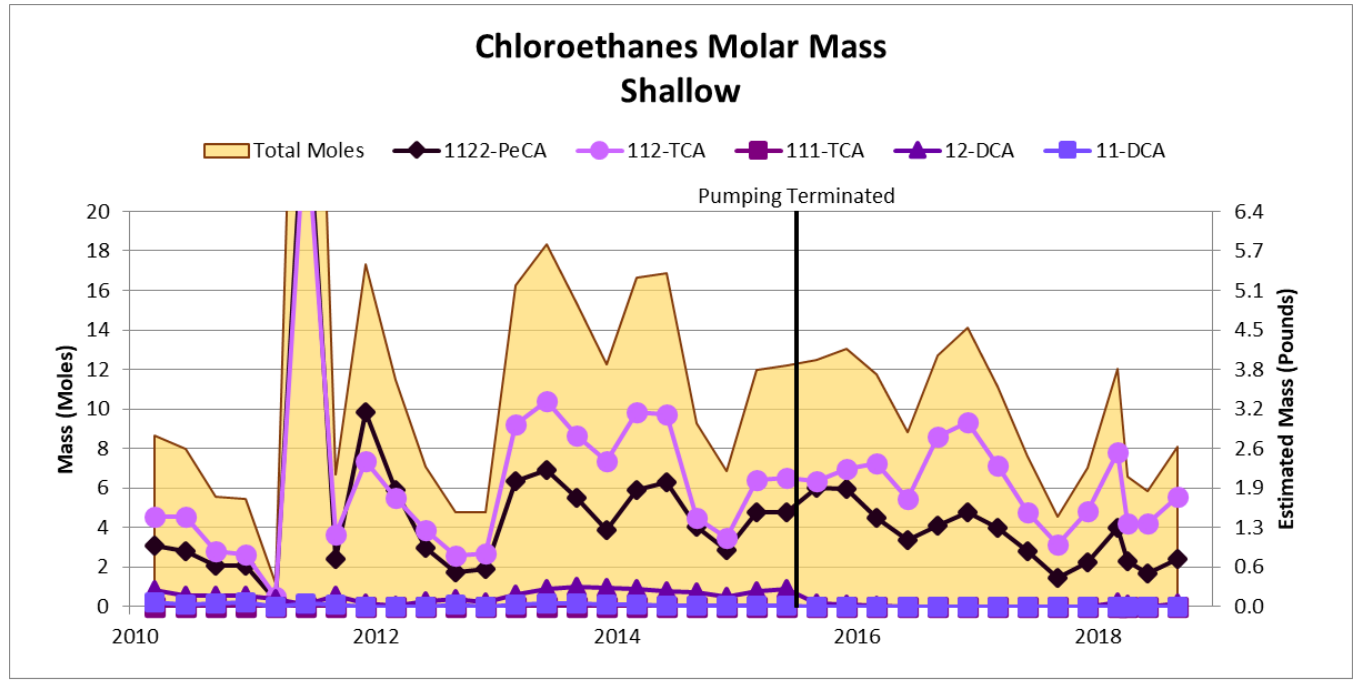
Dec-2015 to Sep-2018
Stable
Mann-Kendall: 85% Confidence
Regression: 74% Confidence

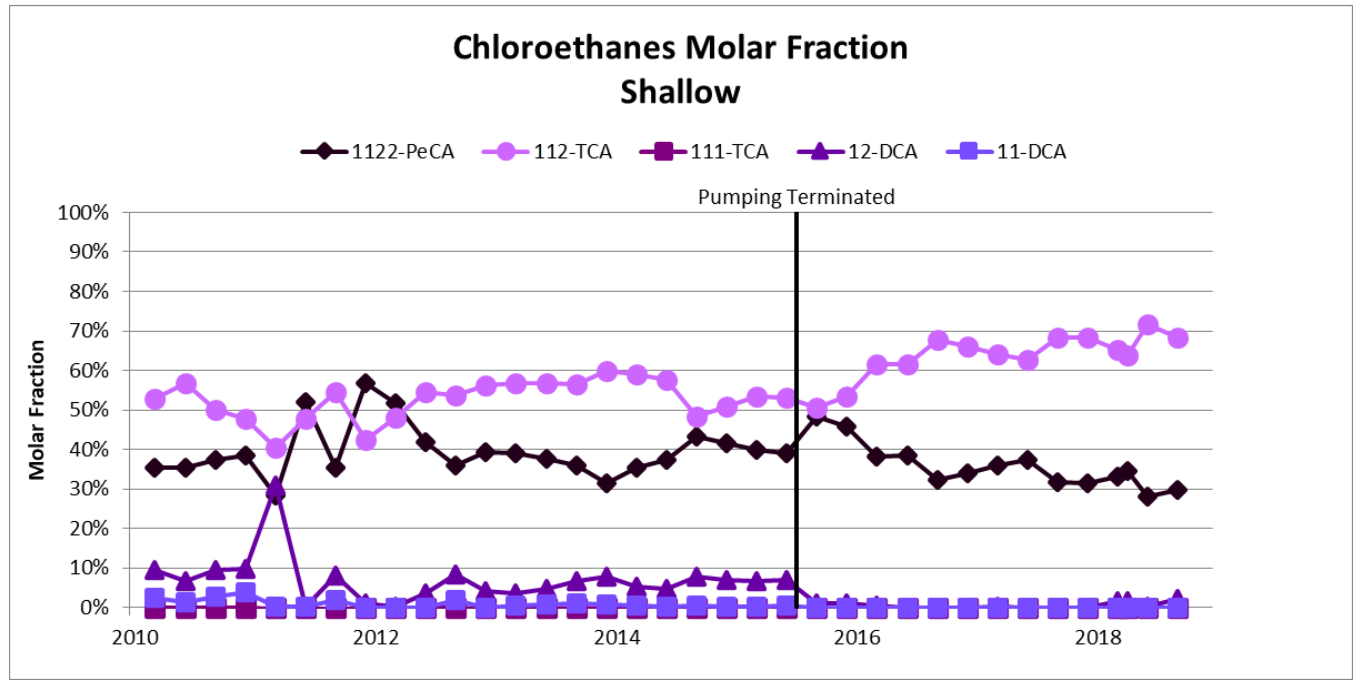


Dec-2015 to Sep-2018
Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: 99% Confidence



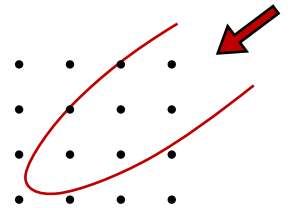
Dec-2015 to Sep-2018
Decreasing Trend
Mann-Kendall: 98% Confidence
Regression: 98% Confidence

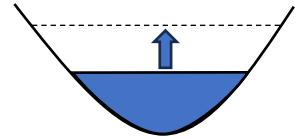

Chloroethanes Molar Mass
Shallow
Total Moles
1122-PeCA
112-TCA
111-TCA
12-DCA
11-DCA
Pumping Terminated
Mass (Moles)
Estimated Mass (Pounds)
0
2
4
6
8
10
12
14
16
18
20
0.0
0.6
1.3
1.9
2.6
3.2
3.8
4.5
5.1
5.7
6.4
2010
2012
2014
2016
2018

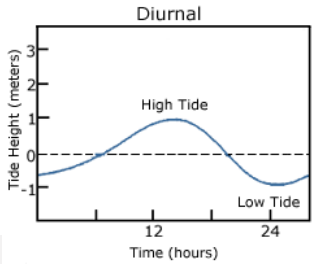

Chloroethanes Molar Fraction
Shallow
1122-PeCA
112-TCA
111-TCA
12-DCA
11-DCA
Pumping Terminated
Molar Fraction
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
2010
2012
2014
2016
2018

Considerations for Sites in British Columbia

- Plume delineation approach
  - An evenly-spaced monitoring network is ideal for plume-based methods
  - A monitoring network focused on the plume perimeter (common on many sites) is more restrictive
- Meteorological and hydrological considerations
  - Freshet
  - Large or frequent precipitation events
  - The practitioner must determine how the groundwater flow regime is affected
  - This may require extended hydraulic head monitoring (i.e., one or multiple years)
- Tides
  - Affect the groundwater flow regime over very short durations
  - Over longer time frames, the effects on the flow regime are less relevant
  - Sampling should be completed at the same point in the tidal cycle for consistency
  - Hydraulic head monitoring requires tidal averaging (e.g., Serfes method)
- The practitioner must determine if advection or diffusion is dominant, and how this changes seasonally with the above factors.
- These concepts should be incorporated into plume stability assessments.







Questions?

Thank You!

wsp.com

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Working on Reserve Lands and Lands Planned for Addition to Reserve

Jo-Ann Aldridge, M.A.Sc., P.Eng.
Indigenous Services Canada, BC Region

Working on Reserve Lands and Lands Planned for Addition to Reserve

Presentation to CSAP November 2024

Jo-Ann Aldridge, Senior Environmental Specialist

Contaminated Sites, BC Region

Indigenous Services Canada | Services aux Autochtones Canada

Canada

Outline

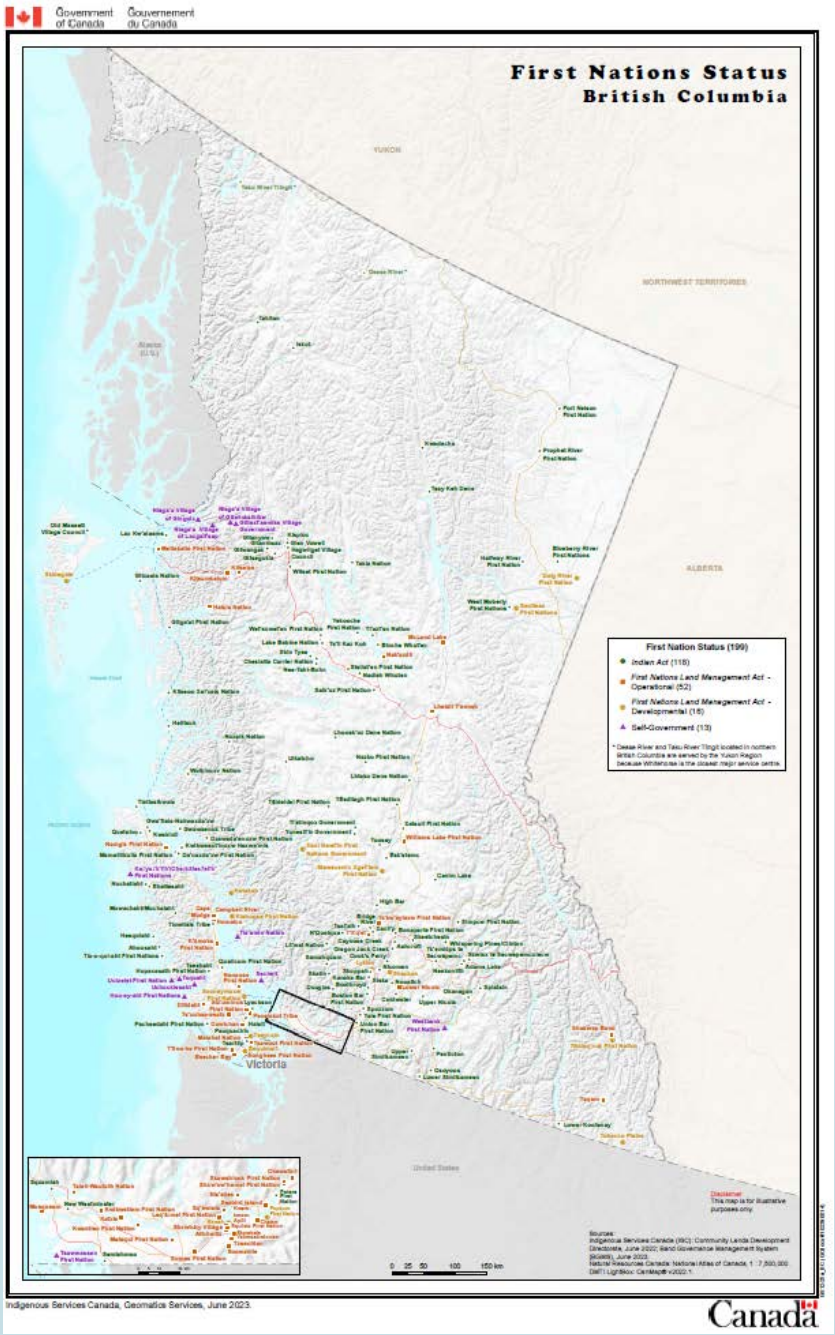
- Background - ISC - Contaminated Sites
- Applicable Guidelines for Reserve Lands
- Notifications
- Adoption of Provincial Standards / Legislation
- Additions to Reserve
- Questions / Discussion

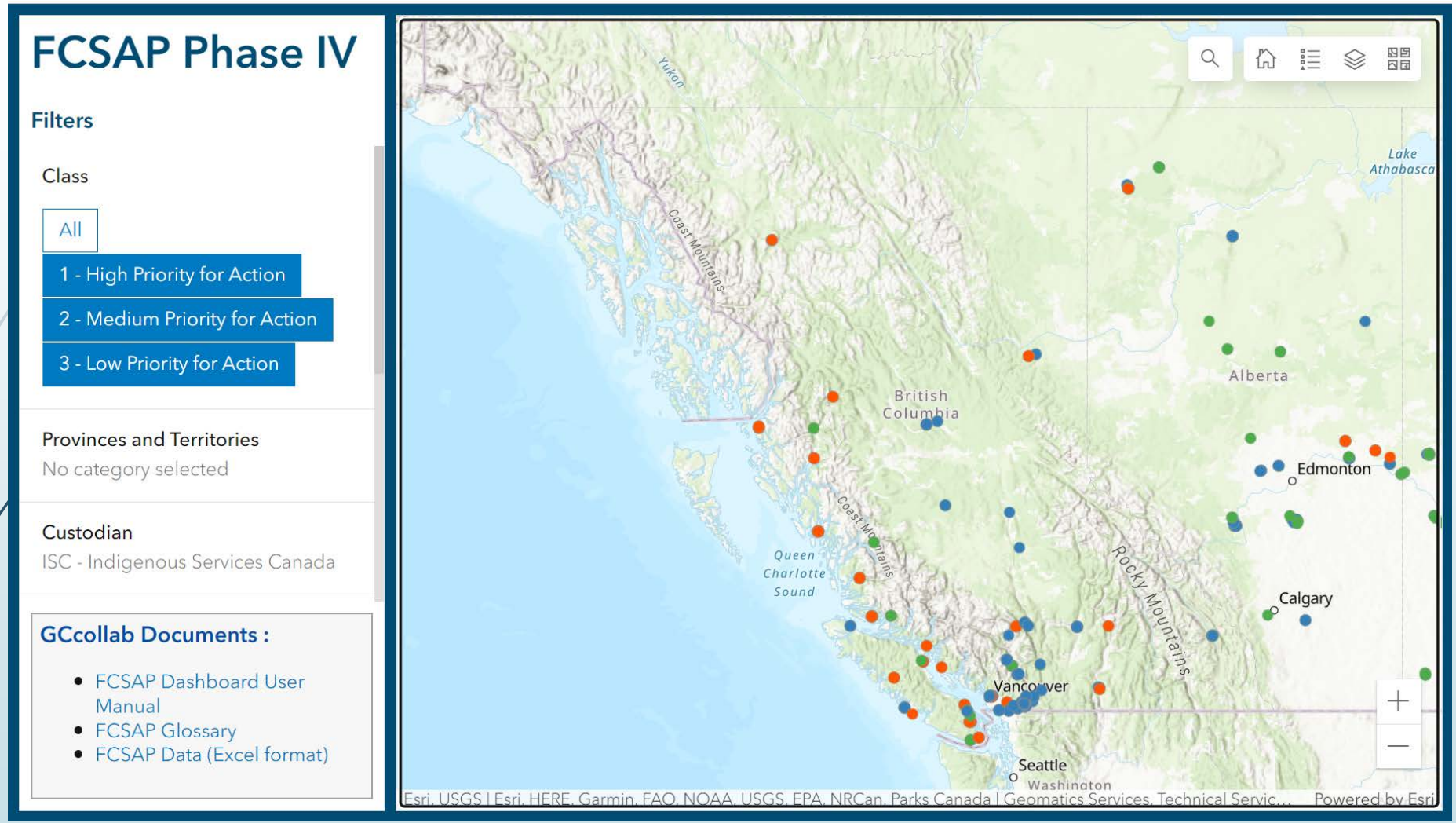
ISC ENVIRONMENT

CONTAMINATED SITES	ENVIRONMENT AND NATURAL RESOURCE SPECIALISTS
FNLMA – Phase I, Phase II, Phase III Investigations	Environmental Review Process in support of permits/leases/designations
Contaminated Site on Reserve / FCSAP: ESAs, Remediation/Risk Assessment, Site Closures	Departmental Support for designated projects
ESA Reviews for Additions to Reserve	Timber/Gravel permits
Support to ENR on sites with Contaminated Sites issues	Federal Authority reviews (Section 81-91 of IAA) for triggered projects on Reserve/Federal Lands.
Waste Management	

First Nations Governance

- Indian Act (118) -
- First Nations Land Management Act – Operational (58)
- First Nations Land Management Act – Developmental (13 Active; 2 Inactive)
- Self Government (2)





FCSAP IV Dashboard (arcgis.com)

Guidelines for ESAs on Federal Lands

- The applicable Environmental Quality Guidelines for reserve lands are typically Federal, but may be Provincial if the First Nation is under :
  - Self Government,
  - Treaty, or
  - First Nations Lands Management and has opted to apply Provincial Guidelines under their Land Code.
- The above also applies to Provincial lands planned to be added to reserve.
- It will also be important to determine the planned future land use. Land use categories are agricultural (AL), residential (RL), parkland (PL), commercial (CL), and industrial (IL).
- The guidelines may be numerical or risk based.

Applicable Federal Guidelines

Agency	Guidance Document
CCME	Canadian **Sediment** Quality Guidelines for the Protection of Aquatic Life
CCME	Canadian **Soil** Quality Guidelines for the Protection of Environmental and Human Health
CCME	Canada-Wide Standards for Petroleum Hydrocarbons in **Soil** (CWS PHC)
ECCC	Federal Interim Groundwater Guidelines for Federal Contaminated Sites (FIGQG) Version 4 (non-potable water)
Health Canada	Guidelines for Canadian **Drinking Water** Quality (potable and recreational water)
Health Canada	Federal Contaminated Site Risk Assessment in Canada: Supplemental Guidance for Soil **Vapour** Intrusion Assessment at Federal Contaminated Sites, Version 2.0
BC MOE	Contaminated Sites Regulation, B.C. Reg. 375/96, Schedule 3.3 - Generic Numerical **Vapour** Standards
***Note: Where applicable, the latest version of the guideline for a specific media type and contaminant applies, and provincial guidelines may be applied where no federal guideline exists.**	

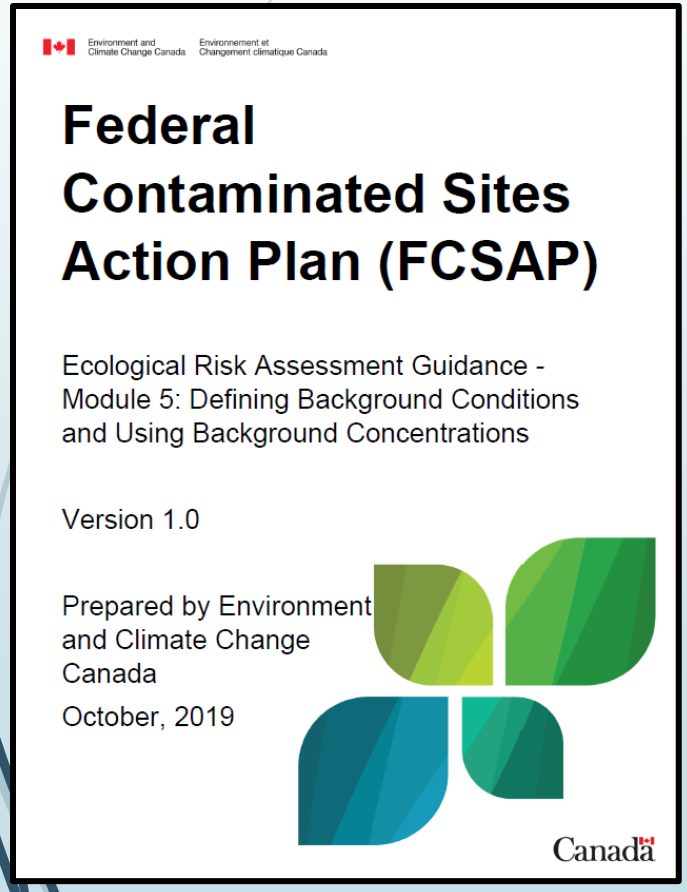
Registering Risk Managed Sites

- **A Band Council Resolution (BCR) is required accepting the assumptions and conditions of the risk assessment.**
- A survey of any risk managed areas is required.
- An instrument (e.g. indemnity, restrictive covenant, other?) will be registered on the Indian Lands Registry System or First Nations Lands Registry System.

Background Assessment for Reserve Lands

- Federal Guidance (Ecological Risk Assessment Module 5)
- BC MOECC Protocol 4
  - Establishing local background concentrations in soil based on ministry data
  - Establishing local background concentrations in soil based on supplemental data and reference sites
- BC MOECC Protocol 9
  - Establishing local background concentrations in groundwater based on regional background concentrations
  - Establishing local background concentrations in groundwater based on site specific criteria
- Other Site-Specific Assessments (e.g. ISC accepted Coquitlam River Water Quality Monitoring Program values for long term monitoring trigger levels for iron in surface water for a site in Coquitlam; ISC has also accepted urban park values from Ontario for some PAHs in surface soils.)

Federal Guidance on Establishing Background Concentrations



- When establishing background is needed
- Selecting reference areas for sampling
- Sampling designs
- Applying background concentrations to ERAs

Notifications for Off-Site Migration

To Reserve

- Follow EMA/CSR
- Notification to the Nation and ISC if Indian Act Nation
- Notification to the Nation if Treaty, Operational, Self Government
- If potential health issues, also engage the First Nations Health Authority (all Governance regimes).
- Chief and Council will determine level and best means of engagement.

From Reserve

- Follow EMA/CSR
- Engage with ISC and the Nation to determine who is the polluter

Land Code

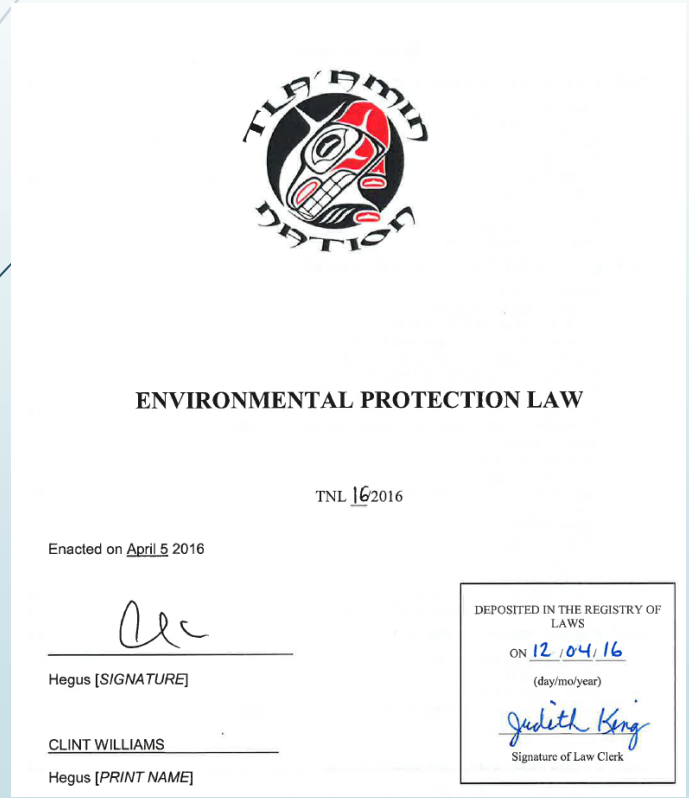
Operational Nations under *The Framework Agreement on First Nation Land Management Act*

- Operational Nations are exempt from 44 Sections of the Indian Act th
to lands management
- The council of a First Nation with a land co
make laws, in accordance with its l
conservation, protection
and interests or l
laws on
ver to
development,
session of First Nation land,
elation to that land. This includes
ancillary to the making of laws in relation to
cludes laws on environmental assessment and

ISC will recommend contacting Operational Nations directly for questions related to lands management, including environmental management.

- The Parties agree to harmonize their respective environmental regimes and processes, with the involvement of the provinces or territories where they agree to participate, to promote effective and consistent environmental regimes and processes and to avoid uncertainty and duplication.
- Operational Nations are responsible for contamination that occurs following operational date.

Example
Environmental Protection Laws



ENVIRONMENTAL PROTECTION LAW

TNL 16/2016

Enacted on April 5 2016

Hegus [*SIGNATURE*]

CLINT WILLIAMS

Hegus [*PRINT NAME*]

DEPOSITED IN THE REGISTRY OF LAWS
ON 12/04/16
(day/mo/year)

Signature of Law Clerk

PART 4 - CONTAMINATED SITE REMEDIATION

Application of the Environmental Management Act

36. (1) Subject to subsections (2) and (3), Part 4 of the *Environmental Management Act*, and all provincial regulations enacted to give effect to that Part, apply on Tla'amin Lands to the effect that British Columbia may determine a site on Tla'amin Lands is a Contaminated Site and may make decisions regarding liability for remediation and the implementation of remediation of Contaminated Sites.

(2) Subsections 52(2)(g), 55(9), and sections 57, and 61 of *the Environmental Management Act* do not apply on Tla'amin Lands.

(3) The references to municipalities at

(a) sections 40, 44, and 47 of the *Environmental Management Act,* and

(b) sections 2, 3, 4, 6, 7, 9, paragraph 44(a)(i) and subsection 52(2) in the *Contaminated Sites Regulation,*

shall be interpreted to apply to the Tla'amin Nation.

Example Nations Adopting Provincial Standards

- Aitchelitz, Skowkale and Yakweakwioose
- Shxw'owhamel First Nation
- Leq'a:mel First Nation
- Tzeachten First Nation

Shxw'owhamel First Nation

- PART 4 – ENVIRONMENTAL STANDARDS

"Contaminated Site" means an area of Leq'á:mel Lands in which the soil or any groundwater lying beneath it, or the Water or the underlying sediment, contains a

F. **Under section 24.3 of the of the Framework Agreement), the standards of environmental protection established by First Nation laws and the punishments imposed for failure to meet those standards must be at least equivalent in their effect to any standards established and punishments imposed by the laws of the province in which the First Nation's land is situated;**

Regulation"

- (c) for sources of potable water, the water quality standards for potable water outlined in the Drinking Water Protection Regulation (British Columbia); and
- (d) such other Environmental Standards that Council may by resolution set or incorporate by reference from time to time.

Best practice - Ask Operational First Nations early on for a copy of their Environmental Protection Law and Environmental Protection Standards.
If no law, consider Section 24.3 of the Framework Agreement as this outlines the minimum EP targets they will be working towards.

Addition to Reserve (ATR)

- An ATR, or reserve creation, refers to adding lands to an existing reserve or creating a new reserve for the benefit of a First Nation.
- An ATR can be adjacent to an existing reserve or a distinct parcel of land in a First Nation's traditional territory.
- An ATR can be in either rural or urban settings.

ATR Policy & Legislation

- The ATR process is guided by the 2016 Additions to Reserve/Reserve Creation policy DIRECTIVE 10-1 ANNEX A – RESERVE CREATION PROPOSAL CRITERIA provides additional information on environmental requirements
- and,
- The 2019 *Additions of Lands to Reserve and Reserve Creation Act* (*ALRRCA*), allows for lands to be set apart as reserve by the Minister of Crown-Indigenous Relations through a Ministerial Order.
- *ALRRCA* also allows for pre-reserve tenures (permits, leases, designations) which become effective on the date the lands are set apart as reserve.
- First Nations which are operational under the *Framework Agreement on First Nation Land Management Act* must also meet the ATR process requirements.

ATR CORE REQUIREMENTS

SURVEY

ENVIRONMENT

THIRD PARTY INTERESTS

CONSULTATION

And, if necessary,

SERVICES

An ATR, without complications from environmental work or third party interests usually take 2-5 years to complete.

Typically, a Phase 1 ESA report over 5 years old is deemed to be “stale dated” and would require an update of some kind.

Working Together

ISC, Lands & Economic Development (LED) is committed to working with First Nations to achieve the goal of adding lands to their reserve land base.

The process envisions First Nations and Canada working together with First Nations taking the lead in the process.

In the case of the environmental requirement of the ATR process, we rely upon First Nations to work with their consultants and the consultants working with LED environment team, for ATRs that is the Contaminated Sites team.

INITIATING THE ATR PROCESS

The Process is initiated by submitting a proposal which provides key associated documents including environmental information.

The proposal will include a description of the lands and include copies of documents the First Nation has that provide information on the current state of the land *(e.g. Environmental Site Assessments* any follow-up reports*)* as Annexes.

ISC requests First Nations to contact the Program and Project Support Team, Lands and Economic Development, BC Region, to do a Pre-Review of the ATR Proposal.

A Band Council Resolution (BCR) is required to initiate the process and to accompany the proposal.

FIRST NATION KNOWLEDGE OF THE LAND

- Does it have access
- Any visible signs of contamination?
- Is it suitable for intended projects – housing, economic development?

- **A First Nation does not want to acquire contaminated land as this will delay the ATR.**

- It's important for First Nations to be informed of timelines associated with environmental work as reports can become staledated and need to be "refreshed" or have subsequent site visits.

Additions to Reserve Policy

Land Management Manual, Chapter 10 - Additions to Reserve/Reserve Creation - 2016

It is the policy of ISC to avoid the acquisition of contaminated land for Reserve Creation. Acquisition of contaminated land will only be considered where the level of contamination is consistent with the intended use, the risks to human health and the environment are minimal, the risks to Canada are manageable, and there is a strong business case supporting Reserve Creation.

Under the ATR process, a First Nation is responsible for completing a Phase 1 Environmental Site Assessment (ESA) and any required remediation.

In the absence of an Agreement, or other arrangement providing funding, ISC is not obligated, nor prevented from providing funding for Reserve Creation activities, including environmental assessment activities, remediation and monitoring/mitigation activities, or other environmental costs.

Additions to Reserve Policy

From *British Columbia First Nations Guide to Meeting Environmental Requirements*

- Assessing sites against the applicable environmental quality guidelines starts with the completion of a Phase I Environmental Site Assessment (ESA) (CSA Z768-01) completed by a Qualified Environmental Professional (QEP).
- If APECs are identified, further site assessments (Phase II and possibly Phase III ESAs) will need to be completed to assess the quality of affected environmental media (soil, groundwater, surface water, soil gas, indoor air, as appropriate), and if contamination is identified, to delineate the extent of contamination above applicable guidelines.
- Remediation, risk assessment, and/or risk management measures will be required to address any contamination identified above guidelines.
- Once these steps are complete, and after a QEP has stated that the site meets the applicable environmental quality guidelines, Indigenous Services Canada (ISC) will review the associated reports against available guidance to ensure that the work has followed industry best practices and make a recommendation to the ISC Lands Officer wrt ATR Policy Sections 2.3 and 2.4.

KNOW YOUR AUDIENCE

The Phase 1 ESA, and any other reports will have multiple readers with different knowledge and skill sets:

- The First Nation representatives
- Legal counsel for the First Nations – and Canada
- The ISC ATR project lead
- The ISC Environmental Specialists

Who do you write for?

- Ultimately, this is a professional report and must meet professional standards.
- The Executive Summary should be written in Plain English suitable for allow for understanding of the conclusions, assumptions, and recommendations (if necessary) by non-specialists.

Contact

General questions re ATRs:

BCATR@sac-isc.gc.ca

General questions for Contaminated Sites:

bccontaminatedsites@sac-isc.gc.ca

Jo-Ann Aldridge

jo-ann.aldridge@sac-isc.gc.ca

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SWOT Analysis 2024 Summary

David Mitchell, P.Eng., Active Earth Engineering
Chair, CSAP Professional Development Committee

SWOT Analysis

<u>Overview Today:</u>

1. What is a SWOT Analysis? 1 min
2. Who is the 'Organization'? 1 min
3. SWOT Topics Debrief 15 min
4. Open Discussion 3 min

What is a SWOT Analysis?

- SWOT stands for Strengths, Weaknesses, Opportunities, and Threats.
- SWOT analysis is a technique for assessing these four aspects of your “business.”
- SWOT Analysis is a tool that can help you to analyze what you are doing best now, and to devise a successful strategy for the future.

SWOT ANALYSIS

	Helpful to achieving the objective	Harmful to achieving the objective
Internal origin (attributes of the organization)	Strengths	Weaknesses
External origin (attributes of the environment)	Opportunities	Threats

Who is the Organization?

INTERNAL

- Ministry of Environment
- CSAP Society
- Consulting Firms / Practitioners

EXTERNAL

- Public and the Environment
- Government
- Landowners

TOPIC 1 – CSAP SOCIETY

- Focus of SWOT – The scope and function of the CSAP Society

- Common Objective – To reliably certify applications made under the EMA and CSR

TOPIC 1 – CSAP SOCIETY STRENGTHS

- PA process
- Detailed screening
- **Turnaround time for clients**
- Expertise
- Promotion of APs
- Membership involvement
- Peer support
- Scholarship
- Research projects/tech reviews
- **Quick turnaround time**
- Peer support
- Community of professionals working together
- More interaction with ENV
- Focused Review process
- PA process when it's done as a learning experience
  - QA process for ENV

TOPIC 1 – CSAP SOCIETY WEAKNESSES

- **Succession planning**
- No pathways to becoming a CSAP
  - Reserved practice
  - BCIA
- Inconsistent knowledge, experience, and risk tolerance
- **Expect perfection**
- Duplicate tasks – many eyes
- Too manual – limited automated steps
- PA process
- Inconsistent knowledge – submission quality/experience
- Super submitters
- Costs are too high
- Members close to **retirement age**
- Low number of Risk Assessors
- More applications to process than submissions
- **Turnover** leads to loss of institutional memory
- Timelines for preapprovals
- **Regression**
- **Too prescriptive**

TOPIC 1 – CSAP SOCIETY OPPORTUNITIES

- Better promotion of AP expertise to other organizations ad government
- Relationship with ENV
- More mentorship
- Better outreach with universities/courses re: what it takes to become a professional
- Mentorship for less experienced APs (more guidance)
- Less admin, more technical review of work
- "Paralegal" type role can be created
- **SRS web app – input data once and it fills into multiple docs/more automation**
- More or timely feedback form ENV on PA process/questions (more integration with ENV during PA process)
- More detailed **feedback** from PA
- Database (Q&A, GIS system) to increase efficiency

- ENV support to increase professional judgement
  - CSAP could act as "referee"
- More **feedback** from ENV
- **Feedback** from PA process would be used to improve quality of submissions for all APs
- **More lessons learned/info sharing**
- Less oversight form ENV – delegation of authority for low risk work
- **Update Protocol 6**
- **Expand scope of services: high-risk sites, Preapprovals**
- Keep in mind 'big picture" – protection of human health
- Expand role of CSAP for technical expertise
- Work with ENV to provide guidance on remediation technology/application

TOPIC 1 – CSAP SOCIETY THREATS

- Admin and forms not enticing – expensive
- Government disbanding CSAP
- 80/20 rule – weakness?
- Irrelevant
- Communication between CSAP and ENV – relationship
- **Succession/retirement**
- Requalify

TOPIC 1 – CSAP SOCIETY
THE TEA LEAVES

- CSAP PA process is thorough
- We could expand to other government agencies
- We’re worried about succession planning
- We like feedback and lessons learned
- Relationship with ENV is very important

TOPIC 2 – BROWNFIELD SITES

- Focus of SWOT – To remediate and repurpose brownfield sites

- Common Objective – To remediate and repurpose brownfield sites

TOPIC 2 – BROWNFIELD SITES STRENGTHS

- Some funds available
- **Community gardens**
- Long-term AIP possible
- Nanaimo **success** story
- Regulations clear when developer OK
- Public awareness

TOPIC 2 – BROWNFIELD SITES WEAKNESSES

- No driver (**regulatory** driver)
- No **ENV** focus
- Is **CSR** brownfield ready?
- No funds
- **Protocol 19 costs**
- Can there be short form RA?
- **Regulations** keep changing
- ENV does not know about them
- CoC that does not allow development

TOPIC 2 – BROWNFIELD SITES OPPORTUNITIES

- Educate about **funding**
  - UBCM program
  - FCM
- Public good
- Federal **funds**
- Connect to ENV's *Making Contaminated Sites Climate Ready*
- Housing permit navigator
- Informed transfer of liability
- Create BF fund or developers
- Divest liability
  - To make permanent gardens
  - For non-Schedule 2
- UBCM education
- Lock in regulations for upcoming instruments
- Brownfield **funding** (when you can get it)
- Educate (municipalities, public, Crown Corps)
- Collect **fees** to clean brownfields

TOPIC 2 – BROWNFIELD SITES
THREATS

- No **funding**
- Liability management under EMA
- Community garden
- Lingering liability
- Uneducated stakeholders

TOPIC 2 – BROWNFIELD SITES
THE TEA LEAVES

- Funding isn't readily available
- Regulatory changes could facilitate Brownfield development
- Stakeholders would benefit from more education

TOPIC 3 – PROTOCOL 19

- Focus of SWOT – Future amendments to soil characterization, movement

- Common Objective – Provide oversight for movement of soil, increase consultation, simplify soil relocation and increase reuse of soil

TOPIC 3 – PROTOCOL 19 STRENGTHS

- Stage 14 – not requiring an SDS if your building has footings
- Sometimes **soil** has been able to be **reused** on site
- Everything will be **digitized**
- New exemptions – SDS – slab on grade 30m^3 as opposed to 10m^3

TOPIC 3 – PROTOCOL 19 WEAKNESSES

- Intent was to reuse soil but now the opposite is happening (wrt utilities)
  - Much easier to send the **clean soil to a landfill**
- Remediated site – need to do P19 assessment
  - e.g., find arsenic at this point on the "clean site"
  - Do they need to look at COC/determination that has already been issued (unintended consequences)
- **Costs**
  - Local soil receivers are ignorant of the requirements and **costs** are increasing (e.g., soil not related to Schedule 2 activities)
  - Receiver sites are pushing back for more work to be done whether Schedule 2 or not?
    - Education required
- **Missing a place to put all of the soil** (e.g., use for dykes)
- Soil vapour stockpiles
- Not much **enforcement**

- Background numbers
- Soil permitting – soil being a waste if it exceeds the IL standards on site – being addressed per Kerri
- **Sampling of rock**
- **Sampling frequency** – leave it to QP/AP to determine
  - COCs based on activities (TG1) – make it all TGI
  - Focus would be on APs to determine
- Why are First Nation Lands included
  - Some have their own facilities and claim they are not included in P19
  - Lack of understanding (also a threat)
- **Reuse of soil**
- Definition of site – a problem for larger sites with an APEC at one corner – moving soil from very far away
- Competing legislation
  - Archaeology
  - Conservation of sites
- Triggers for testing – property owners refusing testing
- **Large parcels** moving soil

TOPIC 3 – PROTOCOL 19 OPPORTUNITIES

- What is the holistic impact of P19 across the broader community
- **Soil reuse** for dykes
- SDS requires new application with every new permit
- Future engagement to include larger industry (utilities)
- Incorporate SRIS into GIS layer (BC Hydro)
- Get concierge for SRIS system
- Remote in-situ remediation options
- Amend P19 to use TGI for soils sampling protocol
- Potential to **reuse contaminated soil** for certain activities, reduce dumping (ocean/landfill)
- Use Risk Assessment to increase opportunity for **soil reuse**
- **Expand exemptions** for right of way (IL)

TOPIC 3 – PROTOCOL 19
THREATS

- Contaminated soil brought to municipal works yard

- Increased contaminated soil to landfills

TOPIC 3 – PROTOCOL 19
THE TEA LEAVES

- Some soils are being re-used but there is an opportunity to do it more.

- Costs are a concern.

TOPIC 4 – ENVIRONMENTAL SUSTAINABILITY

- Focus of SWOT – Environmental sustainability of the site assessment and remediation process

- Common Objective – Achieving greater sustainability

TOPIC 4 – ENVIRO SUSTAINABILITY STRENGTHS

- **RAs** as a route to ‘closure’
- P2 and P27 to develop **SSS**
- Government nimble to address emerging environmental concerns
- Adaptability of industry
- **RA** used to get lands back into use sooner
- Process of “certifying” site = sites back in use

- We are doing this (a SWOT analysis) = strength
- We are considering sustainability
- Addressing **climate change** impact
- Protection of future sue of groundwater as a drinking water source
- Technical capacity to advise on **climate change** impacts

TOPIC 4 – ENVIRO SUSTAINABILITY WEAKNESSES

- **Regulations** don't address sustainability
- Limited options and **regulations** available done always = sustainability
- Future use of groundwater as drinking water resource (limiting)
- Balancing land use **restrictions** with risk-based closure
- Standards (some) not risk-based
- Lack of requirement to address climate change
- Not everyone is considering sustainability
- Decisions driven by time – what is the quickest
- No **regulated** requirements in 'high-risk' areas (e.g., flood plains – site vulnerability assessment)
- Review of flood plains/update

TOPIC 4 – ENVIRO SUSTAINABILITY OPPORTUNITIES

- Options for compliance
- Increased professional reliance
- Review precluding conditions in P13
- Review other jurisdictions (e.g., Netherlands)
- **Communicate** of our strengths to clients
- “Other” forms of remediation (vs dig and dump and RA)
- Revised regulatory framework to consider RA combined with some remediation
- Optimize sustainability objectives

- Well positioned to **inform** public
- **Outreach**
- GHG analysis tool to compare “impacts”
- Remediation option analysis to consider “impact”
- Indigenous **engagement** adds more weight
- Remediate sites to be climate ready
- Remediate to best possible future use (and develop sites)

TOPIC 4 – ENVIRO SUSTAINABILITY THREATS

- Lack of enforcement of permanent “to the extent practicable”
- Costs
- Lack of awareness of remediation approaches and associated emissions
- Conflicting sustainability objectives (remediating soil but increases GHF in process)
- Climate change impacts
- Preference for “numeric” remediation
- Contaminated sites in **vulnerable** areas
- Fires and impact on conditions = more **vulnerable**
- Lack of land use planning/considering future conditions/**ecosystem** considerations

TOPIC 4 – ENVIRO SUSTAINABILITY
THE TEA LEAVES

- Our strengths are Risk Assessment which is fundamentally sustainable.
- Regulations don’t speak much to sustainability.
- There are opportunities in communication of sustainability.
- Threats are not protecting sensitive areas.

TOPIC 5 – NATURAL RESOURCE SECTOR

- Focus of SWOT – The role of EMA / CSR / CSAP in the natural resource sector (e.g. forestry, pulp mills, refineries, mining, oil and gas, fisheries, pipelines).

- Objective – Protection of human health and the environment in the natural resource sector and economic activity.

TOPIC 5 – RESOURCE SECTOR STRENGTHS

- Practitioners have **strong knowledge** of EMA – future use/closure
- Dormancy and shutdown regulation – remediates more sites
- One window approach to permitting with BCER
- BCER more flexibility – makes SS decisions
- CSAP
  - **Strong peer review**
  - More data will feed CS process
- EA using more CSM approaches

- **CSAP skill set**
  - Varied professions
  - Collaboration in teams
  - Teamwork
    - Technical
    - Regulatory
- ENV – **collaboration** with other ministries (e.g.. wildfire doc)
- **Connections** in government
- EMA transferable to Natural Resources

TOPIC 5 – RESOURCE SECTOR WEAKNESSES

- Economy drives remediation (can also be a strength)
- Cannot forecast cost of remediation in later years (sometimes 50)
- Affected statutory ROW will not allow testing (e.g., pipelines)
- Multiple agencies (too many)
- Future use not protected by current operations
- CSAP not involved at beginning of project – only at the **end**
- CSR at **end** of project
- Government does not have resources for compliance
- **Gap between federal and provincial regulation**
- Different expectations for clean up and investigation for NRS
- Ministry silos – different process
- BCER doesn't accept RA
  - No capacity to review Ras

TOPIC 5 – RESOURCE SECTOR OPPORTUNITIES

- BCER work allows professional judgment – CS allow **more professional judgement**
- Bonding requirements require liability estimates (use CS prof)
- CSAP and government can help train Indigenous workforce
- ENV **consult across agencies** and how protocols affect them
- Improved EAs and CSMs

- **More CSAP involvement** reviewing EAs
- Consider future use of adjacent lands
- **Improve consistency between regulations** (e.g., WCB – CSR)
  - Harmonize standards around real risk
- **Other ministries – OGC**, etc.
- Government bench strength - expertise

TOPIC 5 – RESOURCE SECTOR THREATS

- Orphan sites **insufficiently funded**
- Capacity to approve permits in a timely basis – project fails
- Possible loss of social license
- Hard time hiring skilled people
- Land use – not a proper use for end point
- **Timelines** too long
  - economy cannot respond
  - no development
- Break the **silos** between ministries
- Complicated, too **expensive**

TOPIC 5 – RESOURCE SECTOR
THE TEA LEAVES

- Strong knowledge within the Contaminated Sites / CSAP industry.
- ENV seen as collaborative but the number of government agencies are seen as being a concern.
- There is an opportunity for more professional judgement and collaboration between government agencies
- Threats are that orphan sites are insufficiently funded and remediation is too expensive.

CSAP
SOCIETY OF CONTAMINATED SITES
APPROVED PROFESSIONALS
OF BRITISH COLUMBIA

WWW.CSAPSOCIETY.BC.CA

Protocol 6
Panel Discussion

Travis Deeter, P.Ag., CSAP, Thurber Engineering
Chuck Jochems, P.Eng., CSAP, AECOM Canada Limited
Kerri Skelly, P.Ag., Ministry of Environment and Climate Change Strategy

Moderator: David Mitchell

Protocol 6 Pre-Approvals

Section 4 of Protocol 6 – Pre-approvals required for:

- No plan to delineate or remediate the entire extent of contamination, including for a part of a contaminated site.
- If de novo derivation of one or more toxicity reference values (TRVs) is selected in a risk assessment to support an AP recommendation.
- If a background concentration in sediment, vapour
  or surface water will be established.
- If the application is for a high risk-site.

Approval Required for

- You've been denied access to an affected parcel, leading to incomplete investigation and remediation
- It's not practical or safe to investigate or remediate a site using ministry guidance and protocols
- Neighbouring source parcel owners won't cooperate in the investigation or remediation of merging contamination

Approval Not Required for

- You are remediating a flow-through contaminated site
- There is area wide contamination
- You want to get certification for an affected parcel before the source site is fully remediated
- You are only remediating part of an operating facility and need a certification document or site release for that area
- Contaminants appear in environmental media because of beneficial uses

THANK YOU!

Please join us for happy hour at Hyatt's Mosaic Grille on this same level

CSAP